PROJECT MANUAL
FOR
CITY OF LYNCHBURG

LYNCHBURG REGIONAL AIRPORT
NEW AIR TRAFFIC CONTROL TOWER

BID : 216-00018

August 2015

PROCUREMENT DIVISION
3RD FLOOR CITY HALL
900 CHURCH STREET
LYNCHBURG, VA 24504
TELEPHONE (434) 455-3970
FAX (434) 845-0711

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ADVERTISEMENT FOR BIDS

Sealed bids for the **Lynchburg Regional Airport New Air Traffic Control Tower**, will be received by the City of Lynchburg, Procurement Division, City Hall, Lynchburg, VA, until **3:00 p.m., October 1, 2015**, and then publicly opened and read in the Bidder's Room, Third Floor, City Hall.

This project includes a new 5 story air traffic control tower approximately 25' x 25', and 1 story base building approximately 15' x 20'. The project also includes new site utilities, site improvements, new security fencing, demolition of existing tower, and restoration.

The Project Manual and Drawings for this project may be viewed and downloaded from the City's website: http://www.lynchburgva.gov/current-solicitations.

An Optional pre-bid conference will be held at 11:00 a.m. on September 10, 2015, in the Second Floor Training Room, City Hall, 900 Church Street, Lynchburg, VA.

Contact Lisa Moss at (434) 455-4228; fax: (434) 845-0711; email:lisa.moss@lynchburgva.gov for further information. All requests for clarification or questions regarding this bid must be received no later than 9:00 a.m. on September 23, 2015.

BID FORM

Lisa Moss Procurement Division
City of Lynchburg
Third Floor, City Hall
900 Church Street
Lynchburg, Virginia 24504

Dear Ms. Moss:

The undersigned, as bidder, hereby declares that the only persons interested in this bid as principal, or principals, is or are named herein and that no person other than herein mentioned has any interest in this bid or in the Construction Agreement to be entered into; that this bid is made without connection with any other person, company, or parties making a bid; and that it is in all respects fair and in good faith, without collusion or fraud.

The undersigned, having visited and examined the site and having carefully studied all the Contract Documents, including without limitation, all drawings and specifications pertaining to "Lynchburg Regional Airport New Air Traffic Control Tower" for the City of Lynchburg, Virginia, hereby proposes to furnish all labor, equipment, materials, and services and to perform all operations necessary to execute and complete the Work required for the project, in strict accordance with the Contract Documents together with Addenda numbered____ through _____ issued during bidding period and hereby acknowledged, subject to the terms and conditions of the Construction Agreement for the sum as listed in the BID SCHEDULE.

LYNCHBURG REGIONAL AIRPORT - BID SCHEDULE

Airport: LYNCHBURG REGIONAL AIRPORT

Project: New Air Traffic Control Tower **RS&H Project No. 222-0264-001**

BID SHEET

Item No.	Item Description	Unit	Quantity	Individual Price	Total Price
	Schedule A - ATC Tower				
P-001-1	AIR TRAFFIC CONTROL TOWER	LS	1		
263213-1	EMERGENCY GENERATOR SYSTEM	LS	1		
024100-1	DEMO OF EXISTING ATCT	LS	1		
				TOTAL SCH. A	
	Schedule B - ATCT Equipment				
275000-1	ATCT EQUIPMENT PACKAGE	LS	1		
				TOTAL SCH. B:	
	Schedule C - Sitework and Utilities				
P-100.3-1	MOBILIZATION AND GENERAL CONDITIONS	LS	1		
P-102-10.1	SAFETY AND SECURITY	LS	1		
P-104-5.1	PROJECT SURVEY AND STAKEOUT	LS	1		
P-105-5.1	TEMPORARY CONSTRUCTION ITEMS	LS	1		
P-156-5.1a	DIVERSION DIKE	LFT	310		

P-156-5.1b	SILT FENCE	LFT	385		
P-156-5.1c	INLET / OUTLET PROTECTION	EACH	3		
024119-1	ASPHALT PAVEMENT REMOVAL	SYD	90		
033000-1	30" CURB & GUTTER (CG-6)	LF	110		
033000-1	SIDEWALK	SYD	160		
034100-1	CONCRETE WHEEL STOP	EA	2		
334100-1	12-INCH CLASS III RCP	LFT	70		
334100-2	24-INCH CLASS III RCP	LFT	120		
334100-3	8-INCH HDPE STORM PIPE	LFT	20		
334100-4	6-INCH HDPE STORM PIPE	LFT	85		
334100-5	INLET	EA	2		
334100-6	STORM MANHOLE	EA	1		
334100-7	STORM PIPE CLEAN-OUT STACK	EA	2		
334100-8	CONVERT MANHOLE TO INVERT	EA	1		
321723-1	HANDICAP PARKING SIGN	EACH	2		
321723-2	PAINTED PAVEMENT MARKING (WHITE OR BLUE)	SFT	200		
321723-3	ROADWAY DELINEATOR	EACH	1		
321723-4	24" SOLID WHITE THERMOPLASTIC	LFT	32		
329300-1	LANDSCAPE	LS	1		
331113-1	6-INCH DI CLASS 50 WATER LINE & FITTINGS	LFT	350		
331113-2	3-INCH RPZ BACKFLOW PREVENTER	EACH	1		
331113-3	6 X 6 TAPPING SLEEVE AND VALVE	EACH	1		
333000-1	4-INCH SANITARY SEWER LINE	LFT	100		
F-162-5.1	8-FOOT HIGH CHAIN LINK FENCE WITH BARBED WIRE	LFT	580		
F-162-5.2a	VEHICLE GATE	EACH	1		
F-162-5.2b	PEDESTRIAN GATE	EACH	1		
F-162-5.3	CHAIN LINK FENCE REMOVAL	LFT	210		
T-901-5.1	SEEDING	ACRE	1.2		
T-905-5.1	TOPSOILING, OBTAINED ON SITE OR REMOVED FROM STOCKPILE	CYD	540		
T-908-5.1	MULCHING	ACRE	1.2		
L-101-5.1	AIRPORT ROTATING BEACON	LS	1.0		
L-105-7.1	REMOVE AND RELOCATE BEACON	LS	1		
012100-1	AEP UTILITY ALLOWANCE	ALLOW	1	$20,000.00	$20,000.00
012100-2	VERIZON UTILITY ALLOWANCE	ALLOW	1	$15,000.00	$15,000.00
				TOTAL SCH. C:	
Section D - Airfield Lighting & Vault Modifications					
L-108-5.1	3-1/C NO. 6 AWG, L-824C CABLE, INSTALLED IN DUCT BANK OR CONDUIT	LFT	1,130		
L-108-5.2	AIRFIELD LIGHTING CONTROL CABLE, 25 PR	LFT	270		

L-110-5.1	ELECTRICAL CONDUIT 2-WAY, 2" PVC, SCHEDULE 40	LFT	180		
L-110-5.2	ELECTRICAL CONDUIT 2-WAY, 3" PVC, SCHEDULE 40	LFT	40		
L-110-5.3	ELECTRICAL CONDUIT 4-WAY, 2-3", 2-4" PVC, SCHEDULE 40	LFT	490		
L-115-5.1	ELECTRICAL HANDHOLE - VEHICLE RATED	EACH	7		
L-127-5.1	AIRFIELD LIGHTING CONTROL AND MONITORING SYSTEM MODS	LS	1		
				TOTAL SCH. D:	
Schedule E - Communication and Technology Pacakge (CTP) Allowance					
012100-3	COMMUNICATION AND TECHNOLOGY PACKAGE (CTP) ALLOWANCE	ALLOW	1	$75,000.00	$75,000.00
				TOTAL SCH E:	
				TOTAL BASE BID (SCH. A-E)	
ALTERNATE #1: (ALTERNATE IS NOT CONSIDERED AS PART OF THE BASE BID AND THERE IS NO GUARANTEE OF AWARD)					
Schedule F - Alternate #1: Split Face Thin Block Finish					
012300-1	SPLIT FACE THIN BLOCK FINISH	LS	1		
				TOTAL SCH. F	

1. Price: Includes all labor, materials, and equipment, etc. required to complete project.

2. In submitting this bid, I certify:

a. Items bid are in exact accordance with specifications, unless noted in bid.

b. Prices in this bid have been arrived at independently, without consultation or agreement with any competitor for purpose of restricting competition.

3. The bidder is expected to carefully examine the site of the proposed work, the proposal, plans, specifications, and contract forms. He shall satisfy himself as to the character, quality, and quantities of work to be performed, materials to be furnished, and as to the requirements of the proposed contract. The submission of a proposal, which includes initials on each bid form sheet, shall be prima facie evidence that the bidder has made such examination and is satisfied as to the conditions to be encountered in performing the work and as to the requirements of the proposed contract, plans, and specifications.

END OF BID SCHEDULE

It is understood and agreed that the Owner, in protecting its best interests, reserves the right to reject any or all bids or waive any defects. Any changes, erasures, modifications, deletions in the bid form, or alternate proposals not specified in the Advertisement for Bids may make the bid irregular and subject to rejection.

The listed bid items are to contain all necessary costs required for completion of the Work in accordance with the Contract Documents.

If the Construction Agreement is for unit prices and not for a lump sum price, it is understood that all quantities listed on the following pages are estimated quantities, and the Owner reserves the right to raise, lower, or eliminate any quantity or item, and in any case, the unit prices shall be used in determining partial and final payment. It is further understood that costs to cover all components of the Work as described in the Contract Documents are included in this bid, even in cases where specific line items are not identified.

We are properly equipped to execute all work of the character and extent required by the Contract Documents, and we will enter into the Construction Agreement for the execution and completion of the Work in accordance with the Contract Documents; and we further agree that, if awarded the Construction Agreement, we will commence the Work on the date stated in the "Notice to Proceed" and will maintain a work force large enough to execute the Work and all obligations no later than the completion date stated in the Contract Documents.

Enclosed herewith is the following Security, offered as assurance that the undersigned will enter into the Construction Agreement for the execution and completion of the Work in accordance with the Contract Documents:

Bidder's Certified Check issued by_____(name of bank) in the amount of:

$ _____(5% of Base Bid amount)

Bidder's Bid Bond for 5% of Base Bid Amount Issued by _____
(name of surety authorized to do business in Virginia).

The undersigned hereby agrees, if awarded the Construction Agreement, to execute and deliver to the City within ten (10) days after his receipt of the Notice of Award, a performance bond and a payment bond, in forms satisfactory to the City, from sureties authorized to do business in Virginia satisfactory to the City, in the amount of one hundred (100) percent of the Base Bid.

The undersigned further agrees that, in case of failure on his part to execute the said Construction Agreement within the ten (10) days after written notice being given on the award of the Construction Agreement or the failure to deliver the required performance and payment bonds within the ten (10) days, the monies payable by the Security accompanying this bid shall be paid to the City of Lynchburg, Virginia, as liquidated damages for such failure; otherwise the Security accompanying this Bid shall be returned to the undersigned.

Attached herewith are completed Statement of Experience and Statement of Resources forms which include the information requested.

The undersigned further certifies that this bid is not the result of, or affected by, any act of collusion with another person engaged in the same line of business, or any act punishable under the Virginia Governmental Frauds Act, or other law.

This bid remains valid and may not be withdrawn for a period of 120 days from this date.

CURRENT VIRGINIA CLASS A CONTRACTOR'S LICENSE/ REGISTRATION NO.:_____

Respectfully submitted,

_____
CONTRACTOR

_____
DATE

_____

_____
ADDRESS

BY:_____

ITS:_____
(Title)

ELECTION OF ESCROW ACCOUNT PROCEDURE FOR RETAINAGE

If determined to be the successful low bidder(s), the above signed elects to use the Escrow Account Procedure for retainage.

_____

Write “Yes” or “No” on above line

If the successful bidder elects to use the Escrow Account Procedure for Retainage, the "Escrow Agreement" form shall be executed and submitted to the City of Lynchburg Engineering Division within fifteen (15) calendar days after notification. If the "Escrow Agreement" form is not submitted within the fifteen (15) day period, the Contractor shall forfeit his rights to the use of the Escrow Account Procedure.

Company_____

Authorized Signature_____

EQUAL OPPORTUNITY REPORT STATEMENT

The Bidder shall complete the following statement by checking the appropriate blank as follows.

The Bidder has_____ has not _____ participated in a previous contract subject to the nondiscrimination clause prescribed by Executive Order 10925, dated March 6, 1961, or Executive Order 11114 dated June 22, 1963.

In conjunction with the City of Lynchburg's policy to utilize Minority and Disadvantaged Business Enterprises ("DBE") wherever possible, the Bidder has solicited quotations for labor, material and/or services from the following Minority and Disadvantaged Business Enterprises:

NAME OF FIRM	PERSON(S) CONTACTED	DATE

Of those listed above, we intend, at this time, to utilize the following in the completion of the Work required by this Construction Agreement:

_____

_____

_____

"This firm assures that it will give its best efforts to utilize Minority and Disadvantaged Business Enterprises whenever possible."

CERTIFIED BY: _____(Signature)

_____(Typed/Printed name & Title)

BIDDER'S NAME: _____

TAXPAYER IDENTIFICATION NUMBER:_____

_____This firm will perform all construction with its own employees and, therefore, is not required to solicit quotations from DBEs.

FAILURE TO DOCUMENT AND REPORT DBE CONTACTS ON THIS FORM MAY BE A BASIS FOR REJECTION OF THE BID AS NONCONFORMING.

STATEMENT OF EXPERIENCE

Proposer: _____

_____

How Long In Business:_____ At Current Address: _____

Principals: _____Title:_____

_____Title:_____

_____Title:_____

Type of Work Normally Performed:_____

_____

Projects of this type previously completed:

1._____

_____ Amount $_____

2._____

_____ Amount $_____

3._____

_____ Amount $_____

Reference (for Projects listed above):

1._____

_____ Tel.No._____

2._____

_____ Tel.No._____

3._____

_____ Tel No._____

STATEMENT OF AVAILABLE RESOURCES

Equipment:_____

_____

_____

Number of Personnel Currently Employed:_____

Number of Personnel Available for Project:_____

Other Pertinent Information:_____

_____

_____

_____

_____

_____

_____

_____

CORPORATE STATUS FORM

ALL PROSPECTIVE FIRMS MUST RESPOND TO THE FOLLOWING

If a limited liability company, limited liability partnership or a limited partnership, indicate by checking one: _____Limited liability company

_____Limited liability partnership

_____Limited partnership

Have you registered with the Virginia State Corporation Commission, to conduct business in Virginia?
☐ Yes ☐ No

Name and address of organizer: _____

_____

_____

_____

List who is authorized to execute contracts:

_____

If conducting business under an assumed (fictitious) business name, fill out the following information:

Names of persons or entities owning business using assumed business name:_____

Owners' addresses: _____

Registration date: _____ Expires: _____

If conducting business as a sole proprietorship, general partnership, or joint venture, fill out the following information:

Names of all persons liable for obligations of the business: _____

Addresses of such persons:_____

Questions to Bidders/Offerors

Bidders/Offerors are to respond to the following question: Have any of the individual(s), owner(s), and/or principal officer(s) of the firm submitting the bid/proposal ever been convicted of (1) a felony, or (2) a misdemeanor involving moral turpitude?

YES _____ NO _____

If yes, list individual or officer and title and give details.

_____

_____

_____

_____

_____

_____

_____

_____

NOTE: Answering yes to this question will not necessarily exclude your company from consideration but will be used to weigh the relationship between the offense and the contract to be performed.

Is your firm currently involved in litigation or a dispute involving arbitration?

YES _____ NO _____

If yes, for litigation list the litigation by case name, name of court, case number, and jurisdiction, and for arbitration, list the organization administering, if any, its contact information, any case number assigned, the arbitrators, and the location of the arbitration. For litigation and arbitration, briefly describe the claims and status, and give contact information for the opposing party or parties.

_____

_____

_____

_____

CONSTRUCTION AGREEMENT

This Construction Agreement (the "Contract") made and entered into on the _____ day of _____, 2015, by and between _____, party of the first part, hereinafter referred to as Contractor, and the City of Lynchburg, a municipal corporation of the Commonwealth of Virginia, party of the second part, hereinafter referred to as the Owner or City.

That the Contractor, for the consideration hereinafter fully set out, hereby agrees with the Owner as follows:

1. That the Contractor shall furnish all labor, materials, tools, and equipment and perform all Work required by the Contract Documents (as defined in the General Conditions hereto) for the **Lynchburg Regional Airport New Air Traffic Control Tower**

2. That the Contractor shall commence Work within ten (10) days after Notice to Contractor to Proceed with the Work under Contract ("Notice to Proceed"), and shall substantially complete the project within **220 calendar days**. Owner and Contractor recognize that time is of the essence of this Contract and that the Owner will suffer financial loss if the Work is not completed within the times specified in the Notice to Proceed, plus any extensions thereof. They also recognize the delays, expense and difficulties involved in providing the actual loss suffered by Owner if the Work is not completed on time. Accordingly, instead of requiring any such proof, Owner and Contractor agree that as liquidated damages for certain losses Owner is expected to suffer due to delay (but not as a penalty) Contractor shall pay One Thousand Dollars (**$1000.00)** for each day that expires after the time specified for completion of or each day that expires after the time specified for completion of the project. If the Contractor is subject to liquidated damages, the City has the right, but not the obligation, to withhold the liquidated damages from the Contractor's regular payments or retainage. Rights and obligations relating to these liquidated damages are set out more fully in the General Conditions.

3. The Owner hereby agrees to pay the Contractor for the faithful performance of this Contract in accordance with the Contract Documents, subject to additions and deductions as provided in the Contract Documents, in lawful money of the United States, as follows:

_____Dollars

($_____)

4. The Owner shall make partial payment on a monthly basis to the Contractor in accordance with the Contract Documents on the basis of a duly certified and approved estimate of work performed during the preceding calendar month by the Contractor, less five percent (5%) of the amount of such estimate which may be retained by the Owner until all Work has been performed strictly in accordance with the Contract Documents and until such Work has been accepted by the Owner.

5. Within ninety (90) days after submission by the Contractor of evidence satisfactory to the Owner that all payrolls, material bills and other costs incurred by the Contractor in connection with the construction of the Work have been paid in full, satisfaction of all the requirements of the Contract Documents, and acceptance of such Work by the Owner, final payment on account of this Contract shall be made.

6. It is further mutually agreed between the parties hereto that if, at any time after the execution of this Contract, the performance bond provided for its faithful performance and the payment bond, the Owner shall deem the surety or sureties upon such bonds or either of them to be unsatisfactory, or if for

any reason, such bonds cease to be adequate to cover the performance of the Work, the Contractor shall, at his own sole expense, within five (5) days after the receipt of Notice from the Owner so to do, furnish an additional bond or bonds in such form and amount, and with such surety or sureties as shall be satisfactory to the Owner. In such event, no further payment to the Contractor shall be deemed to be due under this Contract until such new or additional security for the faithful performance of the Work shall be furnished in manner and form satisfactory to the Owner.

7. Contractor agrees to fulfill all requirements of state, Federal, and municipal laws which may be applicable to this project.

8. This Contract is subject to the General Conditions accompanying it, and all the documents defined by the General Conditions to be the Contract Documents are a part of this Contract.

This Contact is executed in two counterparts, each of which shall, without proof or accounting for the other counterparts, be deemed an original contract.

IN WITNESS WHEREOF, _____ has caused its name to be subscribed to this Contract by _____, its _____, and its corporate seal to be hereunto affixed and attested by _____, its _____, said officers being duly authorized therefore; and the City of Lynchburg has caused its name to be hereunto subscribed by L. Kimball Payne, City Manager, and its corporate seal to be hereunto affixed and attested by Valeria Chambers, its Clerk of Council, said officers being duly authorized therefore, all as to the day and year first above written.

CONTRACTOR

BY: _____

ITS: _____

(SEAL)

_____
ATTEST:

_____

CITY OF LYNCHBURG

(SEAL)

BY: _____
City Manager

_____
ATTEST:

_____
Clerk of Council

CITY OF LYNCHBURG, VIRGINIA
STANDARD PERFORMANCE BOND

KNOW ALL MEN BY THESE PRESENTS: That_____
_____, the Contractor ("Principal"), whose principal place of business is located at _____
_____and_____
_____("Surety"), are held and firmly bound unto the City of Lynchburg, Virginia, the Owner ("Obligee"), in the amount of

_____Dollars
($_____) for the payment whereof Principal and Surety bind themselves, their heirs, executors, administrators, successors and assigns, jointly and severally, firmly by these presents.

WHEREAS,

Principal has, entered into a Construction Agreement with Obligee for certain work on a construction project known as Lynchburg Regional Airport New Air Traffic Control Tower, which contract (the "Contract") is by reference expressly made a part hereof;

NOW, THEREFORE, THE CONDITION OF THIS OBLIGATION is such that, if the Principal shall promptly and faithfully perform said Contract in strict conformity with the plans, specifications and conditions of the Contract and its Contract Documents, then this obligation shall be null and void; otherwise it shall remain in full force and effect.

Provided, that any alterations which may be made in the terms of the Contract, or in the Work to be done under it, or the giving by the Obligee of any extension of time for the performance of the Contract, or any other alterations, extensions or forbearance on the part of either or both of the Obligee or the Principal to the other shall not in any way release the Principal and the Surety, or either of them, their heirs, executors, administrators, successors or assigns, from their liability hereunder, notice to the Surety of any such alterations, extensions, or forbearance being hereby waived.

No action shall be brought on this bond unless brought within one year after: (a) completion of the Contract and all Work thereunder, including expiration of all warranties and guarantees, or (b) discovery of the defect or breach of warranty or guarantee if the action be for such.

The Surety represents to the Principal and to the Obligee that it is legally authorized to do business in the Commonwealth of Virginia.

Signed and sealed this_____day of _____, 2015.

_____(SEAL)
Contractor/Principal

By:_____

Witness:_____ Title:_____

_____(SEAL)
Surety

By:_____
Attorney -in-Fact

My Power of Attorney is recorded in the Clerks Office of the Circuit Court of_____,
Virginia in Deed Book_____, Page_____, and has not been revoked.

_____
Attorney-in-Fact

AFFIDAVIT AND ACKNOWLEDGEMENT OF ATTORNEY-IN-FACT

COMMONWEALTH OF VIRGINIA
(or, alternatively, Commonwealth or State of_____)

CITY/COUNTY OF_____to wit:

I, the undersigned notary public, do certify that_____personally appeared before me in the jurisdiction aforesaid and made oath that he is the attorney-in-fact of_____, the Surety, that he is duly authorized to execute on its behalf the aforesaid Bond(s) as its act and deed.
Given under my hand this_____day of_____2015.

_____(SEAL)
Notary Public

My Commission expires:_____

APPROVED:

_____
City Attorney/Designee Date

CITY OF LYNCHBURG
STANDARD LABOR AND MATERIAL PAYMENT BOND

KNOW ALL MEN BY THESE PRESENTS: That _____

_____, the Contractor ("Principal") whose principal

place of business is located at_____

_____and_____

_____("Surety") are held and firmly bound unto the City of Lynchburg,

Virginia, the Owner ("Obligee") in the amount of_____Dollars

($_____) for the payment whereof Principal and Surety bind themselves, their heirs,

executors, administrators, successors and assigns, jointly and severally, firmly by these presents.

WHEREAS,

Principal has by written agreement dated_____entered into a Construction Agreement

with Obligee for Lynchburg Regional Airport New Air Traffic Control Tower

which contract (the “Contract”) is by reference expressly made a part hereof;

NOW THEREFORE, THE CONDITION OF THIS OBLIGATION is such that, if the Principal shall promptly make payment to all claimants as hereinafter defined, for labor performed and material furnished in the prosecution of the Work provided for in the Contract and its Contract Documents, then this obligation shall be void~~,~~; otherwise it shall remain in full force and effect, subject, however, to the following conditions.

The Principal and Surety, jointly and severally, hereby agree with Obligee as follows:

1. A claimant is defined as one having a direct contract with the Principal or with a subcontractor of the Principal for labor, material, or both for use in the performance of the Contract. A "subcontractor" of the Principal, for the purposes of this bond only, includes not only those subcontractors having a direct contractual relationship with the Principal but also any other contractor who undertakes to participate in the Work which the Principal is to perform under the aforesaid Contract, whether there are one or more intervening subcontractors contractually positioned between it and the Principal (for example, a subcontractor). "Labor" and "material" shall include, but not be limited to, public utility services and reasonable rentals of equipment, but only for periods when the equipment rented is actually used at the Work site.

2. Subject to the provisions of paragraph 3, any claimant who has performed labor or furnished material in accordance with the Contract Documents in the prosecution of the Work provided in the Contract, who has not been paid in full therefore before the expiration of ninety (90) days after the day on which such claimant performed the last of such labor or furnished the last of such materials for which he claims payment, may bring an action on this bond to recover any amount due him for such labor or material, and may prosecute such action to final judgment and have

execution on the judgment. The Obligee need not be a party to such action and shall not be liable for the payment of any costs, fees or expenses of any such suit.

3. Any claimant who has a direct contractual relationship with any subcontractor of the Principal from whom the Principal has not required a subcontractor payment bond, but who has no contractual relationship, express or implied, with the Principal, may bring an action on this bond only if he has given written notice to the Principal within one hundred eighty (180) days from the day on which the claimant performed the last of the labor or furnished the last of the materials for which he claims payment, stating with substantial accuracy the amount claimed and the name of the person for whom the Work was performed or to whom the material was furnished. Notice to the Principal shall be served by registered or certified mail, postage prepaid, in an envelope addressed to the Principal at any place where his office is regularly maintained for the transaction of business. Claims for sums withheld as retainages with respect to labor performed or materials furnished shall not be subject to the time limitations stated in this paragraph 3.

4. No suit or action shall be commenced hereunder by any claimant.

   a. Unless brought within one year after the day on which the person bringing such action last performed labor or last furnished or supplied materials, it being understood, however, that if any limitation embodied in this bond is prohibited by any law controlling the construction hereof, the limitation embodied within this bond shall be deemed to be amended so as to be equal to the minimum period of limitation permitted by such law.

   b. Other than in a Virginia court of competent jurisdiction, with venue as provided by statute, or in the United States District Court for the district in which the project, or any part thereof is situated.

5. The amount of this bond shall be reduced by and to the extent of any payment or payments made in good faith hereunder.

6. This bond is intended to comply with the requirements and to afford all the benefits of a payment bond consistent with the requirements of Virginia Code § 2-2-4337 and § 2-2-4341. To the extent that those sections as they are in effect as of the date of issuance of this bond confer any requirements on Principal or Surety, or confer any additional benefits on any claimant (as the term "claimant" is used within either the meaning of those sections or this bond), those requirements and benefits shall be deemed to be incorporated into and be part of this bond.

Signed and sealed this_____ day of_____.

_____(SEAL)
Contractor/ Principal

By: _____

Witness: _____ Title: _____

_____(SEAL)
Surety

By: _____
Attorney-in-Fact

Typed Name: _____

My Power of Attorney is recorded in the Clerks Office of the Circuit Court of_____ Virginia in Deed Book_____, Page_____, and has not been revoked.

_____
Attorney-in-Fact

AFFIDAVIT AND ACKNOWLEDGEMENT OF ATTORNEY-IN-FACT

COMMONWEALTH OF VIRGINIA

(or, alternatively, Commonwealth or State of_____)

CITY / COUNTY OF _____

I, the undersigned notary public, do certify that_____personally appeared before me in the jurisdiction aforesaid and made oath that he is the attorney-in-fact of _____, the Surety, that he is duly authorized to execute on its behalf the foregoing bond pursuant to the Power of Attorney noted above, and on behalf of said Surety, acknowledged the aforesaid bond(s) as its act and deed.

Given under my hand this_____day of _____.

_____(SEAL)

Notary Public

_____

My Commission expires: _____

APPROVED:

_____
City Attorney/Designee Date

ESCROW AGREEMENT

THIS AGREEMENT ("Agreement"), made and entered into this ____ day of _____, 2015 by,

between and among the City of Lynchburg ("City"), _____ ("Contractor"), and

_____
(Name of Bank)

_____
(Address of Bank)

a trust company, bank, or savings and loan institution with its principal office located in the Commonwealth of Virginia (hereinafter referred to as "Bank" or "Escrow Agent"), and _____

_____ ("Surety") provides:

I.

The City and the Contractor have entered into the Construction Agreement ("Contract") with respect to City Project No. and Name: Lynchburg Regional Airport New Air Traffic Control Tower ("the Contract"). This Agreement is pursuant to, but in no way amends or modifies, the Contract. Payments made hereunder or the release of funds from escrow shall not be deemed approval or acceptance by the City of performance by the Contractor or Surety.

II.

In order to assure full and satisfactory performance by the Contractor of its obligations under the Contract, the City may, pursuant to the Contract Documents, retain certain amounts otherwise due the Contractor. The Contractor has, with the approval of the City, elected to have these retained amounts held in escrow by the Bank. This Agreement sets forth the terms of the escrow. The Bank shall not be deemed a party to, bound by, or required to inquire into the terms of, the Contract or any other instrument or agreement between the City and the Contractor.

III.

The City may from time to time pursuant to this Agreement pay to the Bank amounts retained by the City under the Contract. Except as to amounts actually withdrawn from escrow by the City, the Contractor shall look solely to the Bank for payment of funds retained under the Contract and paid by the City to the Bank.

The risk of loss by diminution of the principal of any funds invested under the terms of this Agreement shall be solely upon the Contractor.

Funds and securities held by the Bank pursuant to this Agreement shall not be subject to levy, garnishment, attachment, lien, or other process whatsoever. Contractor agrees not to assign, pledge, discount, sell or otherwise transfer or dispose of his interest in the escrow account or any part thereof, except to the Surety.

IV.

Upon receipt of checks or warrants drawn by the City's Director of Finance and made payable to it as escrow agent, the Bank shall promptly notify the Contractor, negotiate the same and deposit or invest and reinvest the proceeds in "Approved Securities" within the meaning of this Agreement in accordance with the written instruction of the Contractor. In no event shall the Bank invest the escrowed funds in any security that is not an "Approved Security."

V.

The following securities, and none other, are Approved Securities for all purposes of this Agreement:

(1) United States Treasury Bonds, United States Treasury Notes, United States Treasury Certificates of Indebtedness or United States Treasury Bills,

(2) Bonds, notes and other evidences of indebtedness unconditionally guaranteed as to the payment of principal and interest by the United States,

(3) Bonds or notes of the City,

(4) Bonds of any political subdivision of the City, if such bonds carried, at the time of purchase by the Bank or deposit by the Contractor, a Standard and Poor's or Moody's Investors Service rating of at least "A", and

(5) Certificates of deposit issued by commercial Banks located within the Commonwealth, including, but not limited to, those insured by the Bank and its affiliates,

(6) Any bonds, notes, or other evidences of indebtedness listed in Section (1) through (3) may be purchased pursuant to a repurchase agreement with a Bank, within or without the City ,having a combined capital, surplus and undivided profit of not less than $25,000,000 provided the obligation of the Bank to repurchase is within the time limitations established for investments as set forth herein. The repurchase agreement shall be considered a purchase of such securities even if title, and/or possession of such securities is not transferred to the Escrow Agent, so long as the repurchase obligation of the Bank is collaterized by the securities themselves, and the securities have on the date of the repurchase agreement a fair market value equal to at least 100 percent of the amount of the repurchase obligation of the Bank, and the securities are held by a third party, and segregated from other securities owned by the Bank.

No security is an Approved Security hereunder if it matures more than five years after the date of its purchase by the Bank or deposit by the Contractor.

VI.

The Contractor may from time to time withdraw the whole or any portion of the escrowed funds by depositing with the Bank Approved Securities in an amount equal to, or in excess of, the amount so withdrawn. Any securities so deposited or withdrawn shall be valued at such time of deposit or withdrawal at the lower of par or market value, the latter as determined by the Bank. Any securities so deposited shall thereupon become a part of the escrowed fund.

Upon receipt of a direction signed by the City's Director of Public Works or the City Engineer, the Director of Finance or the City Accountant shall authorize the Bank to pay the principal of the fund, or any specified amount thereof, to the account of the City of Lynchburg. Such payment shall be made in cash as soon as is practicable after receipt of the direction.

Upon receipt of a direction signed by the City's Director of Public Works or the City Engineer, the Director of Finance or the City Accountant shall authorize the Bank to pay and deliver the principal of the fund, or any specified amount thereof, to the Contractor, in cash or in kind, as may be specified by the Contractor. Such payment and delivery shall be made as soon as is practicable after receipt of the direction.

VII.

For its services, hereunder the Bank shall be entitled to a reasonable fee in accordance with its published schedule of fees or as may be agreed upon by the Bank and the Contractor. Such fee and any other costs of administration of this Agreement shall be paid from the income earned upon the escrowed fund, and, if such income is not sufficient to pay the same, by the Contractor.

VIII.

The net income earned and received upon the principal of the escrowed fund shall first be paid or applied to pay the Bank's fee and any other costs of administration and such income shall be deemed a part of the principal of the fund. After all of the Bank's fees and other costs of administration have been paid from such income, the net income earned thereafter may then be paid over to Contractor in installments.

IX.

The Surety undertakes no obligation hereby but joins in this Agreement for the sole purpose of acknowledging that its obligations as surety for the Contractor's performance of the Contract are not affected hereby.

WITNESS the following signatures, all as of the day and year first above written.

CITY OF LYNCHBURG

BY: _____
City Manager

CONTRACTOR: _____

BY: _____
Officer, Partner, or Owner (Seal)

SURETY:

By: _____

Its: President (Seal)

ATTEST:

_____
Secretary

By: _____
Attorney-in-Fact

AFFIDAVIT AND ACKNOWLEDGEMENT OF ATTORNEY-IN-FACT

COMMONWEALTH OF VIRGINIA
(or, alternatively, Commonwealth or State of _____)
CITY / COUNTY OF _____

I, the undersigned notary public, do certify that _____personally appeared before me in the jurisdiction aforesaid and made oath that he is the attorney-in-fact of _____, the Surety, that he is duly authorized to execute on its behalf the foregoing bond pursuant to the Power of Attorney noted above, and on behalf of said Surety, acknowledged the aforesaid bond(s) as its act and deed.
Given under my hand this_____day of _____.

_____(SEAL)
Notary Public

My Commission expires: _____

APPROVED:

_____
City Attorney/Designee Date

INSTRUCTIONS TO BIDDERS

DESCRIPTION OF WORK:
The Work included under this Contract shall consist of all labor, materials, equipment, and the performance of all work necessary to complete the project known as "Lynchburg Regional Airport New Air Traffic Control Tower" as described in the Contract Documents. This Work shall be performed in accordance with the Contract Documents.

ACCEPTANCE AND GUARANTEE:
At the completion of the project, a final inspection will be made by the Owner's Project Manager. The Contractor will be notified of the remaining work to be performed. When the work is satisfactorily completed, notification will be given that the project has been accepted. The guarantee period will be one (1) year from date of acceptance.

PROTECTION OF PROPERTY AND PERSONNEL:
The Contractor shall erect traffic control devices, barricades, warning signs, overhead protection, etc. , as required by local codes and laws. Contractor shall observe OSHA regulations and Owner's safety policies.

1. General: Subject to Owner's right to waive informalities, to be valid for consideration, bids must be completed and submitted in accordance with these instructions to bidders. All individual bid unit price items must be filled in, regardless of the quantity shown.

2. Plans and Specifications: Bidding documents will be provided as indicated in the Advertisement for Bids.

3. Qualification of Bidders: Each bidder must be prepared to submit within five calendar days of the Owner's request written evidence of his qualifications for the project, including, without limitation, financial data, previous experience, resources, personnel and evidence of authority to conduct business in the jurisdiction where the project is located.

4. Examination of Bid Documents and Site:

   4.1 Before submitting bids, each bidder must examine bid documents, including, without limitation, all the Contract Documents, thoroughly; familiarize himself with Federal, state and local laws, ordinances, rules, codes, and regulations affecting the Work; and correlate his observations with requirements of the bid documents.

   4.2 Bidders are requested and expected to visit the site of the project to alert themselves to local and special conditions which may be encountered during construction of the project such as: labor and transportation, handling and storage of materials, the availability of materials, and site access. Failure to make such investigations shall not relieve the successful bidder from performing and completing the Work in accordance with the Contract Documents.

      a. A pre-bid conference will be held at the time and place stated in the Advertisement for Bids.

5. Clarification:

   5.1 No oral clarification of the bid documents will be made to any bidder. To be given consideration, requests for clarification must be received in time to allow preparation of a written response at least seven (7) days prior to date fixed for opening of bids. Clarifications will be issued in the form of written addenda to the bid documents and posted to the Procurement Website within five (5) days of the bid opening. Only clarifications by formal written addenda will be binding.

   (1) All communications in regard to clarifications and any other matters related to this project shall be addressed to: Lisa Moss, Procurement Division, 900 Church Street, Lynchburg, VA 24504, Fax: 434-845-0711, email: lisa.moss@lynchburgva.gov.

6. Substitutions:

6.1 Substitutions of material or equipment or both may be offered by the Contractor with his bid, provided that, if approved:

a. No major changes in the construction or design intent of the project would be required. Changes required to accommodate substituted items shall be made by the Contractor at no additional cost or time delay.

b. Features of quality, capacity, construction, performance, appearance, size, arrangement, and general utility, including economy of operation of substitutes offered, either parallel or exceed those of specified products.

c. The provisions of the General Conditions are met, and the provisions of the General Conditions any other guarantees, if required by the specification sections, shall apply in full force and effect to the performance of such substitute products~~,~~ approved for incorporation into the Work.

6.2 Technical data covering the proposed substitution shall be furnished with the bid when possible, and not later than 10 days after bid submission.

7. Bid Submission:

7.1 Submit bids using forms furnished in the Project Manual and fill in all blank spaces on the form. Repeat notation "Contractor's Current Virginia License No._____" on outside of inner envelope containing bid and bid security, and place this envelope within another envelope addressed to:

City of Lynchburg
Procurement Division
900 Church Street
Third Floor, City Hall
Lynchburg, VA 24504

Bidders shall include the following with their bid submission:

- Bid Form
- Statement of Experience
- Statement of Available Resources
- Equal Opportunity Report Statement
- Corporate Status Form
- Questions to Offeror Form
- Bid Bond or Cashiers Check Equivalent

7.2 Both the inner and outer envelopes shall have noted thereon:

a. "Sealed Bid #2016-00018 Lynchburg Regional Airport New Air Traffic Control Tower
b. The bidder's name and address; and
c. Repeat notation "Current Registered Virginia Contractor No. ____" on the outside envelope.

7.3 Each bid must be accompanied by a cashier's check payable to the City drawn on a bank satisfactory to the City, or a Bid Bond, in the amount of five percent (5%) of the amount of the total base bid, with the City as obligee, as assurance that the successful bidder will enter into the Contract within ten (10) days after Notice of Award.

If the successful bidder defaults by failure to enter into the Contract and to provide required performance and payment bonds, the certified check or Bid Bond accompanying the successful bid shall be collected by the City, not as a penalty but as liquidated damages for delays and such additional expenses as may be incurred by the City for reasons of such default.

7.4 Contractors will indicate a lump sum bid for on the bid form. The lump sum bid shall contain all necessary costs required for completion of the Work. Any changes, erasures, modifications, or deletions in the bid form, or alternate proposals not specified in the bid proposal may make the proposal irregular and subject to rejection.

7.5 Receipt deadline for bids will be as stated in the Advertisement for Bids.

7.6 Bids will be opened publicly in accordance with the Advertisement for Bids.

7.7 Withdrawal of bid after bid opening: To withdraw a bid after bid opening, a bidder must satisfy the substantive requirements of Va. Code §2.2-4330. In addition, the following procedures shall apply:

a. The bidder shall give notice in writing of his claim of right to withdraw his bid within two business days after the conclusion of the bid opening procedure and shall submit original work papers with such notice.

b. The mistake may be proved only from the original work papers, documents and materials used in preparation of the bid and delivered as required herein.

8. Bonds and Damages:

8.1 Bonds shall be with a surety company acceptable to the Owner~~.~~ that is legally authorized to do business in Virginia and in a form acceptable to Owner.

8.2 A performance bond and a labor and material payment bond will be required in the amount of 100 percent of the bid.

8.3 Liquidated damages shall be as indicated in the Contract Documents.

9. Award of Contract:

9.1 The award of the Contract will be the responsible bidder submitting the lowest responsive base bid.

Selection of the apparently successful bidder's responsibility will include a serious evaluation of whether the bidder has conscientiously attempted to meet Minority and Disadvantaged Business Enterprise goals. A requirement of the Contract bidder will be that a genuine concerted effort will be utilized to meet the Contract goal.

9.2 Before the Contract is awarded, the bidder submitting the lowest responsive bid must satisfy the City that it has the requisite organization, capital, equipment, ability, resources, personnel, management, business integrity, and at least five years experience in the type municipal work for which it has submitted a bid. Each bidder shall, with his bid, submit a list of at least five projects of similar size and dollar value completed within the last five years, giving location, dollar value, year completed, and the name(s) of the owner(s) and architect/engineers(s). The bidder shall verify to the City that it has the sufficient and qualified personnel to provide for the Contact Work. Failure by the lowest responsive bidder to sufficiently satisfy the City of its ability to meet any of the above requirements may serve as grounds for rejection of the bid.

9.3 The Owner reserves the right to cancel the Advertisement for Bids, reject any and all bids, waive any and all informalities, and disregard all conforming, nonconforming, conditional bids or counterproposals.

9.4 Unless canceled or rejected, a responsive bid from the lowest responsible bidder shall be accepted as submitted, except that if the responsive bid from the lowest responsible bidder exceeds

available funds, pursuant to Section 18.1-9 of the Lynchburg Public Procurement Code, the Owner may negotiate with the apparent low bidder to obtain a contract price within available funds.

a. Procedures for Negotiations: If the Owner wishes to negotiate with the apparent low bidder to obtain a contract price within available funds, negotiations shall be conducted in accordance with the following procedures:

1. If the using agency wishes to conduct negotiations pursuant to this section, it shall provide the procurement administrator with a written determination that the bid from lowest responsive, responsible bidder exceeds available funds. This determination shall be confirmed in writing by the director of finance or his designee. The using agency shall also provide the procurement administrator with suggested measures to bring the proposed purchase within budget through negotiations with the lowest responsive, responsible bidder, including reductions in scope, changes in quality, value engineering, changes in terms and conditions, or changes in schedule.

2. The procurement administrator shall advise the lowest responsive, responsible bidder, in writing, that the proposed purchase exceeds available funds. He shall further invite proposed measures, such as a reduction in scope, change in quality, value engineering, changes in terms or conditions, or changes in schedule for the proposed purchase, and invite the lowest responsive, responsible bidder to amend its bid based upon the proposed measures to bring the purchase within available funds.

3. Informal discussions between the City and the lowest responsive, responsible bidder, either in person, by e-mail, by telephone, or by other means, may be used to attempt to obtain a contract within available funds.

4. Following any successful negotiations, the lowest responsive, responsible bidder shall submit a proposed addendum to its bid, which addendum shall include the specific changes in the proposed purchase, the reduction in price, and the new contract value. The addendum shall be reviewed by the purchasing agency, the City Manager, and City Attorney for acceptability.

5. If an addendum is acceptable to the City, the City may award a contract within funds available to the lowest responsive, responsible bidder based upon the amended bid proposal.

6. If the City and the lowest responsive, responsible bidder cannot negotiate a contract within available funds, all bids shall be rejected.

9.5 Protests of Award or Decisions to Award of Contract

a. The following are the exclusive procedures for a bidder or offeror to protest the City's award or decision to award a contract.

1. Any protest to award a contract shall be in writing and shall be delivered so that it is received by the City Manager not later than five (5) business days after announcement of the award or decision to award, whichever comes first. Otherwise any such protest shall be deemed to be waived.

2. Except for a protest of an emergency or sole source procurement, a protest of a City award or decision to award a contract may only be made by a person who submitted a bid or proposal for the procurement at issue and who was reasonably likely to have its bid or proposal accepted but for the City's decision. In the case of an emergency or sole source procurement, a protest may only be made by a person who can show that he was reasonably likely to have submitted a successful bid or proposal if the procurement had been other than emergency or sole source.

3. Protests shall only be granted if (1) the protester has complied fully with Sec. 18.1-6 of the Lynchburg Public Procurement Code and there has been a violation of law, the Lynchburg Public Procurement Code, or mandatory terms of the solicitation that clearly prejudiced the protestor in a material way, or (2) a statute requires voiding of the decision.

4. The City Manager shall issue a written decision on a protest within ten (10) days of its receipt by the City Manager.

5. If the protest is denied, the protestor may only appeal the denial or otherwise contest or challenge the procurement by then filing suit in the Lynchburg Circuit Court, Lynchburg, Virginia, and serving the city with such suit within ten (10) days of such denial. Otherwise, the City Manager's decision shall be final and conclusive, and the protester's right to appeal the denial or to otherwise contest or challenge the procurement shall be deemed to be waived.

6. Strictly following these procedures shall be a mandatory prerequisite for protest of the City's award or decision to award a contract. Failure by a bidder to follow these procedures strictly shall preclude that bidder's protest and be deemed to constitute a waiver of any protest.

b. A protest may not be based upon the alleged non-responsibility of a person to whom the City awards or makes a decision to award a contract.

10. Bidders are referred to the General Conditions for the meanings of capitalized terms.

End of Instructions to Bidders

GENERAL CONDITIONS

ARTICLE 1	CONTRACT DOCUMENTS AND DEFINITIONS
ARTICLE 2	ARCHITECT/ENGINEER
ARTICLE 3	OWNER
ARTICLE 4	CONTRACTOR
ARTICLE 5	SUBCONTRACTORS
ARTICLE 6	WORK BY OWNER OR BY SEPARATE CONTRACTORS
ARTICLE 7	MISCELLANEOUS PROVISIONS
ARTICLE 8	CONTRACT TIME
ARTICLE 9	PAYMENTS AND COMPLETION
ARTICLE 10	PROTECTION OF PERSONS AND PROPERTY
ARTICLE 11	INSURANCE FOR CONTRACTS
ARTICLE 12	CHANGES AND MODIFICATIONS IN THE WORK
ARTICLE 13	CLAIMS AND DISPUTE PROCEDURE
ARTICLE 14	UNCOVERING AND CORRECTION OF WORK
ARTICLE 15	TERMINATION OF THE CONTRACT

GENERAL CONDITIONS

ARTICLE 1 CONTRACT DOCUMENTS AND DEFINITIONS

1.1 DEFINITIONS

1.1.1 CONTRACT AND CONTRACT DOCUMENTS:
The Contract Documents include: (1) the Construction Agreement (the "Contract"), its General Conditions, its Special Conditions (if any) and its attachments (if any); (2) the City's Invitation for Bid No. 2016-00018 dated August 2015, and any addenda; (3) the Contractor's bid; (4) the Contract plans, drawings, and specifications and any addenda; and (5) any Modifications and any Field Orders

1.1.2 MODIFICATION:
A Modification is (1) a written amendment to the Contract signed by both parties (Project Manager for City of Lynchburg and authorized agent for the Contractor), (2) a written Change Order signed by the Project Manager or Owner's authorized representative and an authorized agent for the Contractor, or (3) a written Change Directive signed by the Owner's authorized representative. Modifications may be made to the Contract and Contract Documents without notice to any surety for the performance or payment bonds for the Work. Any Modification that increases the Contract Sum by more than $50,000 or that causes total expenditures for the Contract to exceed the amount budgeted for the Contract may only be made with the specific approval of the City Manager.

1.1.3 WORK:
"Work" means the construction and services required by the Contract Documents and includes all services, plant, labor, materials, supplies, equipment and other things necessary for Contractor to carry out and complete the requirements of the Contract Documents. "Work" includes material suitably stored and protected. "Work" also includes any portion of the Work, whether completed or not.

1.1.4 PROJECT:
The Project is the total construction of which the Work performed by Contractor under the Contract Documents may be the whole or a part.

1.1.5 FURNISH, INSTALL & PROVIDE:
The terms "Furnish" or "Install" or "Provide", unless specifically limited in context, mean furnishing and incorporating a specified item, product or material into the Work, including all necessary labor, materials, equipment to make the item and the Work ready for use.

1.1.6 EXTRA WORK:
The term "Extra Work" as used herein, refers to and includes work required by the Owner, which, in the judgment of the Owner involves changes in or additions to the Work required by the Contract Documents in their then-existing form.

1.1.7 NOTICE OF AWARD:
"Notice of Award" is the written notice of the Owner's acceptance of the Contractor's bid given by the Owner to Contractor as the successful bidder.

1.1.8 NOTICE:
"Notice" means written notice made in the manner specified in this paragraph.

1.1.8.1 "Notice" shall be deemed to have been given to the Owner if sent to the following persons by the means indicated in 1.1.8.3 and either such Notice actually was received by such persons or adequate proof of receipt is made:

Department of Public Works Buildings and Grounds	Procurement Division	City Attorney
800 Orchard Street Lynchburg, Virginia 24501	3rd Floor, City Hall 900 Church Street Lynchburg, Virginia 24504	3rd Floor, City Hall 900 Church Street Lynchburg, Virginia 24504

1.1.8.2 "Notice" shall be deemed to have been given to the Contractor if sent to the following person by the means indicated in 1.1.8.3 and either such Notice was received by such person or the Contractor or adequate proof of receipt by such person or the Contractor is made:

(Insert Successful bidder authorized representatives name and address)

_____

1.1.8.3 "Notice" shall be sent by special courier, recognized overnight delivery service, or United States mail. With the exception of original bid documents, facsimile copies and e-mail shall be acceptable if the original is then sent by special courier, recognized overnight delivery service, or United States mail within three business days.

1.1.9 CHANGE DIRECTIVES:
If the parties cannot agree to a written amendment to the Contract or to a Change Order, Owner may, by issuance of a written "Change Directive," direct Contractor to perform Work that Owner acknowledges, or that Contractor contends, to be a change to the Work required by the Contract Documents. A change order signed by the Owner that Contractor fails or refuses to sign shall be considered a "Change Directive."

1.1.10 MISCELLANEOUS WORDS OR TERMS:
1.1.10.1 Whenever they refer to the Work or its performance, "directed", "required", "permitted", "ordered", "designated", "prescribed", and words of like import shall imply the direction, requirements, permission, order, designation or prescription of the Owner, and "approved", "acceptable", "satisfactory", "in the judgment of" and words of like import shall mean approved by or acceptable to or satisfactory to or in the judgment of the Owner.

1.1.10.2 The Contract Documents generally refer to the Owner, Contractor, Architect/Engineers, entities, and persons as if masculine in gender and singular in number. Such references are intended to include the feminine or neutral in gender and/or the plural in number when appropriate.

1.2 EXECUTION, CORRELATION AND INTENT OF CONTRACT DOCUMENTS

1.2.1 Two originals of the Contract shall be executed.

1.2.2 The intent of the Contract Documents is to include all items necessary for the proper execution and completion of the Work, including without limitation, all items reasonably inferable from the Contract Documents. The Contract Documents are complementary, and what is required by any one shall be as binding as if required by all. Words and abbreviations which have well-known technical or trade meanings are used in the Contract Documents in accordance with such recognized meanings.

1.2.3 Anything shown on the drawings and not mentioned in the specifications or mentioned in the specifications and not shown on the drawings shall have the same effect as if shown or mentioned respectively in both. Technical specifications take priority over general specifications, and detail drawings take precedence over general drawings. Contractor shall promptly notify the A/E and Owner of any conflict or inconsistency in the Contract Documents, upon its discovery, and promptly submit an explanation in writing of the conflict or inconsistency to the A/E, with a copy to the Owner. The A/E's decision thereon shall be final. In case of conflict or inconsistency between the drawings and the specifications, the specifications shall govern.

1.2.4 Should any labor, material, or equipment be required which is not denoted in the drawings and specifications, but which is, nevertheless, reasonably necessary for the proper carrying out of the intent of the Work, it is agreed that the labor, material, or equipment is implied, and the Contractor shall provide such labor and furnish such materials and equipment as fully as if they were completely delineated and prescribed, without additional cost to the Owner.

1.2.5 The Contractor may be furnished additional instructions and detail drawings to carry out the Work included in the Contract Documents. The additional drawings and instructions thus supplied to the Contractor will coordinate with the Contract Documents and will be so prepared that they can be reasonably interpreted as a part thereof. The Contractor shall carry out the Work in accordance with the additional detail drawings and instructions.

1.2.6 The drawings and specifications are divided into sections for convenience and clarity only. The Contractor shall not construe this division as a division of the Work into various subcontractor units. The Contractor may subcontract the Work in such divisions as he sees fit, but he is ultimately responsible for furnishing all Work required by the Contract Documents.

1.2.7 The provisions of this Contract cannot be amended, modified, varied or waived in any respect that causes a change to the Contract Sum or Contract Time except by a Modification. **The Contractor is hereby given notice that no person has authority to orally waive~~,~~ or to release the Contractor from any of the Contractor's duties or obligations under or arising out of the Contract Documents.** Any waiver, approval or consent granted by Modification or Field Order to the Contractor shall be limited to those matters specifically and expressly stated thereby to be waived, approved or consented to and shall not relieve the Contractor of the obligation to obtain any future waiver, approval or consent.

1.3 OWNERSHIP AND USE OF DOCUMENTS

1.3.1 All plans, drawings, specifications, and documents relating to the Work are the property of the Owner and are to be used only for the Project.

ARTICLE 2 ARCHITECT/ENGINEER

2.1 DEFINITIONS

2.1.1 The term Architect/Engineer, hereinafter "A/E" or "Architect" or "Engineer", shall mean the consulting firm or City Department/Division, or their duly authorized representatives, lawfully licensed to practice in Virginia, that is responsible for the activities specified herein.

2.1.2 Although the A/E is referred to throughout the Contract Documents as if singular in number and masculine in gender, A/E includes plural in number and feminine or neuter in gender, as appropriate.

2.2. ARCHITECT/ENGINEER SERVICES

2.2.1 The A/E will provide services as described in these General Conditions.

2.2.2 The A/E will advise and consult with the Owner. The Owner's instructions to the Contractor may be forwarded through the A/E. The A/E has authority to act on behalf of the Owner only to the extent provided in the Contract Documents, and the A/E does not have authority to approve a change to the Contract Sum or the Contract Time.

2.2.3 The A/E may visit the site at intervals appropriate to the stage of construction to familiarize himself generally with the progress and quality of the Work and to determine in general if the Work is proceeding

in accordance with the Contract Documents. Any visits or inspections by the A/E, any Owner's representative, or any consultant retained by the Owner are solely for the Owner's benefit and shall not confer any rights on Contractor or excuse Contractor from any obligation under the Contract Documents.

2.2.4 The A/E will immediately inform the Owner and Contractor whenever, in the reasonable opinion of the A/E, any of the Work is proceeding contrary to the requirements of the Contract Documents and will be unacceptable. Such notification by the A/E is solely for the benefit of the Owner and will not be a cause for the Contractor to claim either delay of the Work or any increase in the Contract Sum or Contract Time.

2.2.5 The A/E, the Owner and other governmental representatives shall at all times have access to the Project site and the Work regardless of its stage of progress. The Contractor shall provide facilities for such access so that the A/E, the Owner and other governmental representatives may perform their functions under the Contract Documents.

2.2.6 Where applicable, based on the A/E's observations and an evaluation of the Contractor's Applications for Payment, the A/E will recommend the amounts owing to the Contractor and will issue Certificates for Payment in such amounts, as provided in Article ~~9~~9, Payments and Completion.

2.2.7 The A/E will be an interpreter of the requirements of the Contract Documents. The A/E will render interpretations necessary for the proper execution and progress of the Work, with reasonable promptness and in accordance with any time limit agreed upon. Either party to the Contract may make written request to the A/E for such interpretations. All interpretations of the A/E shall be consistent with the intent of, and reasonably inferable from, the Contract Documents and will be in writing and/or in the form of drawings.

2.2.8 The A/E will recommend to the Owner the rejection of Work that does not conform to the Contract Documents. Whenever, in his opinion, he considers it necessary or advisable for the implementation of the intent of the Contract Documents, he will have authority to require special inspection or testing of the Work in accordance with Subparagraph 7.6.2 whether or not such Work be then fabricated, installed or completed.

2.2.9 The A/E will review and approve or take other appropriate action upon Contractor's submittals such as Shop Drawings, Product Data, Samples and Manuals, but only for conformance with the design concept of the Work and with the information given in the plans, drawings, and specifications. Contractor shall ensure that all submittals are complete and have had included with them all correlated items that the A/E requires for his review. In the A/E’s and Owner’s sole discretion, the A/E may decline to review partial submittals or submittals for which correlated items have not been included. Contractor shall clearly note, both in a cover letter with any submittal and on the submittal itself, any deviation or inconsistency of anything submitted with the requirements of the Contract Documents. The A/E's approval of a specific item shall not indicate approval of an assembly of which the item is a component. The A/E's review and approval is for the sole benefit of the Owner and is not for the benefit of the Contractor. The A/E's review and approval shall in no way excuse Contractor from fully complying with the Contract Documents.

2.2.10 The A/E's acceptance of materials or products on behalf of the Owner shall not bar future rejection of such items (a) if they are subsequently found to be defective or inferior in quality or uniformity to the materials or products specified by the Contract Documents, (b) if such materials or products are not as represented by the Contractor, or (c) if such materials or products do not conform to the requirements of the Contract Documents.

2.2.11 As required, the A/E will conduct inspections to assist the Owner in determining the dates of Substantial Completion and Final Completion, will receive and forward to the Owner for the Owner's review written

warranties and related documents required by the Contract Documents and assembled and submitted by the Contractor, and will recommend a final Certificate for Payment upon Contractor's full compliance with the requirements of Article 9, Payment and Completion.

2.2.12 All claims, disputes, or other matters or questions between the Contractor and Owner arising out of or relating to the A/E's interpretation of the Contract Documents or arising out of any other decisions, communications, or actions of the A/E relating to the performance of the Work shall be resolved as set forth in Article 12, Changes and Modifications in the Work, and Article 13, Claims.

2.2.13 In case of the termination of the employment of the A/E, the Owner shall appoint a new A/E, who shall have the same status under the Contract Documents as the former A/E.

ARTICLE 3 OWNER

3.1 DEFINITION

3.1.1 The Owner is the City of Lynchburg, Virginia ("City"). The term Owner means the Owner or its authorized representative. The Departmental Director, or his designee, is the authorized Owner's representative for this Contract. Notwithstanding the foregoing, the authority of the Owner's representative is subject to the limitations in the Lynchburg Public Procurement Code.

3.1.2 The Departmental Director, will designate a single Owner's representative, with the title of Project Manager (PM), who will have the power to act, within the scope of his delegated authority, for and on behalf of the Owner, in accordance with the terms of the Contract Documents.

3.1.3 For purposes of any change in the Work, the term "Owner" or "Owner's representative" specifically excludes any and all inspectors having building code or City ordinance responsibilities or jurisdiction under the requirements of the building permit for the Project.

3.2 INFORMATION POSSESSED BY OWNER

3.2.1 The Owner, as a courtesy, may make available for the Contractor's reasonable review, at the Owner's offices or together with the Contract Documents, certain boring logs, geotechnical, soils and other reports, surveys and analyses pertaining to the Project site. Any such information provided to the Contractor is intended to be for the Contractor's convenience only, and its accuracy and completeness are not guaranteed or warranted by the Owner or the A/E, it being the Contractor's sole responsibility to verify the accuracy and completeness of such information. Such information is not incorporated by reference into or made a part of the Contract Documents.

3.2.1.1 Notwithstanding any information provided by Owner or anyone acting on the behalf of Owner, the Contractor assumes full responsibility for inspection of the site and for the means and methods of construction that he employs when performing the Work. The Owner shall not be liable for any additional work or costs arising as a result of any conclusions reached or assumptions derived by the Contractor from or based upon any such information that the Owner makes available for the Contractor's convenience.

3.3 OWNER-PAID PERMITS AND FEES

3.3.1 The Owner will, where applicable, pay for:

.1 Sewer availability fees;

.2 Water availability/meter connection fee;

.3 Electrical, natural gas, telephone, and cable TV permanent installation charges;

.4 Any easements required;

.5 Railroad flagging services; and

.6 Permits for work in Virginia Department of Transportation (VDOT) right-of-way. The Contractor is required to comply with the general requirement for work in the VDOT right-of-way as outlined in the The Manual of Specifications and Standard Details, 2005 for the City of Lynchburg, and the VDOT Manual for this work. Upon completion of all work in the VDOT right-of-way, the VDOT Personnel will conduct an inspection and issue a punch list. The Contractor shall be responsible for completion of those items on the punch list and for obtaining the written release of the permit.

3.3.2. The Contractor's attention is directed to Article 4.7, Contractor-Paid Taxes, Permits, Fees, and Notices, describing other permits to be obtained and fees to be paid by the Contractor.

3.4 OWNER'S RIGHT TO STOP WORK

3.4.1 If the Contractor fails to correct defective Work as required herein or persistently fails to carry out the Work in accordance with the Contract Documents, the Owner, by a written order, may order the Contractor to stop the Work, or any portion thereof, until the cause for such order has been eliminated; however, this right of the Owner to stop the Work shall not give rise to any duty on the part of the Owner to exercise this right for the benefit of the Contractor or any other person or entity.

3.5 OWNER'S RIGHT TO CARRY OUT THE WORK

3.5.1 If the Contractor defaults or neglects to carry out the Work in accordance with the Contract Documents and fails within seven (7) days after receipt of Notice from the Owner to commence and continue correction of such default or neglect with diligence and promptness, the Owner may, without prejudice to any other remedy he may have, rectify such deficiencies, including without limitation, by performing the Work or having the Work performed by other contractors, as outlined in Section 6.1, Owner’s Right to Perform Work and to Award Separate Contracts. In such case, an appropriate Change Order or Change Directive shall be issued by Owner deducting from the payments then or thereafter due the Contractor the cost of correcting such deficiencies, including compensation for the A/E's additional services made necessary by such default, neglect or failure. If the payments then or thereafter due the Contractor are not sufficient to cover such amount, the Contractor shall pay the difference to the Owner.

3.5.2 Neither the Owner nor the A/E nor their officers, agents, assigns or employees are in any way liable or accountable to the Contractor or his surety for the method by which Work performed by the Owner or performed by other contractors pursuant to this Article 3.5, or any portion thereof, is accomplished or for the price paid therefore. Notwithstanding the Owner's exercise of its rights under this Article 3.5, the Contractor and its surety shall have sole responsibility to maintain and protect the Work, including without limitation, that portion of the Work performed by or on behalf of Owner pursuant to this Article 3.5.

3.6 SUSPENSION OF WORK

3.6.1 The Owner shall have the authority to suspend the Work, in whole or in part, for such periods and such reasons as the Owner may deem necessary or desirable, in its sole discretion, including without limitation:

.1 Unsuitable weather;

.2 Other conditions considered unfavorable for the suitable prosecution of the Work; and/or

.3. Other conditions considered adverse to the best interests of the Owner.

3.6.2 Any such suspension shall be made by Owner by written order to the Contractor. The Contractor shall obey immediately such order of the Owner and shall not resume the Work until so ordered in writing by the Owner. The Contractor shall be entitled to an extension of the Contract Time, subject to the provisions of Article 8, Contract Time, herein.

3.6.3 No such suspension of the Work shall be the basis of a claim by the Contractor for any increase in the Contract Sum or for any other damages, losses, costs or expenses if the suspension is for a reasonable time under the circumstances then existing and the cause thereof is beyond the control and is without the fault or negligence of the Owner or those acting on Owner's behalf.

3.6.4 In the event of suspension of Work, the Contractor will, and will cause his Subcontractors and others providing any of the Work through Contractor to, protect carefully his and their materials and Work against damage or injury from the weather and maintain completed and uncompleted portions of the Work as required by the Contract Documents. If, in the opinion of the Owner, any Work is damaged or injured by reason of failure on the part of the Contractor or any of his subcontractors to so protect same, such Work shall be removed and replaced at the expense of the Contractor.

3.7 USE AND OCCUPANCY PRIOR TO FINAL ACCEPTANCE BY OWNER

3.7.1 The Owner has the right to take possession of and use any completed or partially completed portions of the Work, notwithstanding that the time for completing the entire Work or any portions thereof may, or may not, have expired. The taking of possession and use by the Owner shall be in accordance with the provisions in Article 9.8, Substantial Completion and Guarantee Bond. If such prior use delays the Work, the Contractor may submit a request for a time extension in accordance with the requirements of Article 8, Contract Time.

3.8 RIGHT TO AUDIT AND PRESERVATION OF RECORDS

3.8.1 The Contractor shall maintain books, records and accounts that completely and accurately account for all of his costs and receipts relating to the Project in accordance with generally accepted accounting principles and practices. The Owner or its authorized representatives shall have the right to review, inspect, audit and/or copy the books, records, accounts and related documents, including without limitation, supporting documents, of the Contractor under any of the following conditions:

.1 If the Contract is terminated for any reason in accordance with the provisions of these Contract Documents, in order to arrive at equitable termination costs;

.2 If the Contractor and the Owner dispute the amount due the Contractor under the terms of this Contract;

.3 To check or substantiate any amounts invoiced or paid that are required to reflect the costs of the Contractor, or the Contractor's efficiency or effectiveness under this Contract or in connection with any extras, changes, claims, additions, backcharges, or other, as may be provided for in this Contract; and/or

.4 If it becomes necessary to determine the Owner's rights and the Contractor's obligations under the Contract or to ascertain facts relative to any Claim.

3.8.2 These provisions for review, inspection, audit and copying shall give the Owner unlimited access during normal working hours to the Contractor's books, records, accounts and supporting documents under the conditions stated above.

3.8.3 The Contractor shall make all his books, records, accounts, and all other documents relating to his costs and receipts under this Contract, including without limitation any supporting documents, available to the Owner and its representatives for review, audit, inspection and copying at any time during the period from entry into this Contract through three years after Final Payment or termination of this Contract, whichever occurs later.

3.8.4 Any payments made under this Contract shall not constitute a waiver of the Owner's rights to review, inspect, copy and audit. Payments shall not constitute a waiver or agreement by the Owner that it accepts as correct the billings, invoices or other charges upon which the payments are based. If the Owner's review and audit produces a claim against the Contractor, the Owner may pursue all its legal remedies, even though Owner has made all or part of the payments required by this Contract.

3.8.5 If any review or audit by the Owner or the Owner's representatives discloses an underpayment by the Owner, the Owner shall pay any amounts found by the audit to be owed to the Contractor. If such audit discloses an overpayment, the Contractor reimburse the Owner for the amount of the overpayment.

3.8.6 The Owner's right to review, inspect, audit and copy, and the Contractor's duty as to preservation of records shall terminate at the end of three (3) years after Final Payment or termination of this Contract, whichever occurs later. The Contractor shall include this "Right to Audit and Preservation of Records" clause in all his subcontracts, and he shall require the same to be inserted by all Subcontractors and lower-tier subcontractors in their subcontracts~~,~~ for any portion of the Work. Should Contractor fail to cause this clause to be included in any such subcontract or lower tier subcontract or otherwise fail to ensure the Owner's rights under this Article 3.8, Contractor shall be liable to Owner for all costs, expenses and attorney's fees that Owner may incur in order to obtain the information that would have otherwise been available to Owner under this Article 3.8, and the absence of such information shall create a presumption in the Owner's favor, which Contractor must overcome with clear and convincing evidence, that the missing information does not support the payment to Contractor or Contractor claim at issue.

3.8.7 Review, inspection, audit and copying pursuant to this Article 3.8 may be conducted by the Owner or its authorized representatives.

3.8.8 Documents subject to this Article 3.8 shall be made available to Owner and its representatives in whatever formats Owner requests, including without limitation, any electronic formats and/or in paper formats.

3.9 RIGHT TO REVIEW OTHER DOCUMENTS AND MATERIALS

3.9.1 In addition to the rights granted to the Owner under Article 3.8, Right to Audit and Preservation of Records or Documents, the Owner shall have the right to inspect, review and copy any and all of the Contractor's records or documents pertaining to or relating in any way to the Work, including, but not limited to, correspondence, memoranda, minutes, reports, intra- and inter-office communications, work papers, estimating sheets, progress reports, forecasts, audio or video recordings, computer disks, e-mails, films, or any other materials, regardless of physical form or characteristics, which were prepared by or in the possession of, or obtainable by, the Contractor. The Contractor shall make all such documents and records available to the Owner upon ten (10) days Notice to the Contractor of the Owner's intent to inspect and review such documents. The Contractor shall include this "Right to Review Documents and Other Materials" clause in all its subcontracts, and Contractor shall cause the same to be inserted by all Subcontractors and lower-tier subcontractors in their subcontracts for any portion of the Work. The Contractor hereby waives any right he may have to additional compensation or time extensions in the

event he fails or refuses to preserve and produce records pertaining to any such claim as requested by the Owner pursuant to this paragraph. In addition, the Owner may withhold all or any portion of any progress payments, which may be otherwise due, in the event Contractor refuses to comply with its obligations under this Article 3.9. The review, inspection and copying of documents and other records under this Article 3.9 may be conducted by the Owner or its authorized representatives.

3.9.2 Records and documents subject to this Article 3.9 shall be made available to Owner and its representatives in whatever formats Owner requests, including without limitation, any electronic formats and/or in paper formats.

ARTICLE 4 CONTRACTOR

4.1 DEFINITION

4.1.1 The Contractor is the person or entity identified in the Contract as such, and is generally referred to throughout the Contract Documents as if singular in number and masculine in gender but includes the feminine and neuter in gender, as appropriate. The term Contractor means the Contractor or his authorized representative.

4.1.2 This entire Contract is not one of agency by the Contractor for Owner but one in which the Contractor is engaged independently in the business of providing the services and performing the Work herein described as an independent contractor.

4.2 REVIEW OF CONTRACT DOCUMENTS

4.2.1 The Contractor shall not perform any portion of the Work at any time without having obtained and carefully reviewed the Contract Documents or, where required, approved Shop Drawings, Product. Data, Samples or Manuals for such portion of the Work.

4.2.2 The Contractor shall keep at the Project site at least two (2) copies of the drawings and specifications and shall at all times give the A/E, inspectors, and representatives of the Owner access thereto. Further, said drawings and specifications shall be the approved sets issued to the Contractor by the appropriate City permit agencies

4.3 CONTRACTOR'S REPRESENTATIONS

By entering into this Contract with the Owner, the Contractor represents and warrants the following, together with all other representations and warranties in the Contract Documents

4.3.1 That he is experienced in and competent to perform the type of work required and to furnish the plant, materials, supplies or equipment to be so performed or furnished by him;

4.3.2 That he is financially solvent, able to pay his debts as they mature, and possessed of sufficient working capital to initiate and complete the Work required by the Contract Documents;

4.3.3 That he is familiar with all federal, state, and local government laws, ordinances, permits, regulations and resolutions that may in any way affect the Work or those employed therein;

4.3.4 That such temporary and permanent Work required by the Contract Documents which is to be done by him will be satisfactorily constructed and fit for use for its intended purpose and that such construction will not injure any person, or damage any property;

4.3.5 That he has carefully examined the Contract Documents and the site of the Project and the Work and that from his own investigations, he has satisfied himself and made himself familiar with: (1) the nature and

location of the Work, (2) the character, quality and quantity of materials likely to be encountered, including, but not limited to, all structures and obstructions on or at the project site, both natural and man-made; (3) the character of equipment and other facilities needed for the performance of the Work, (4) the general and local conditions, including without limitation its climatic conditions, the availability and cost of labor and the availability and cost of materials, tools and equipment; (5) the quality and quantity of all materials, supplies, tools, equipment, labor and professional services necessary to complete the Work in the manner required by the Contract Documents; and (6) all other matters or things which could in any manner affect the performance of the Work;

4.3.6 That he will fully comply with all requirements of the Contract Documents;

4.3.7 That he will perform the Work consistent with good workmanship, sound business practice, and in the most expeditious and economical manner consistent with the best interests of the Owner;

4.3.8 That he will furnish efficient business administration, an experienced superintendent, and an adequate supply of workmen, equipment, tools and materials at all times;

4.3.9 That he will complete the Work within the Contract Time;

4.3.10 That his Contract Sum is based upon the labor, materials, systems and equipment required by the Contract Documents, without exception; and

4.3.11 That he has satisfied himself as to the feasibility and correctness of the Contract Documents for the construction of the Work.

4.4 SUPERVISION AND CONSTRUCTION PROCEDURES

4.4.1 The Contractor shall supervise and direct the Work, using his best skill and attention. He shall be solely responsible for all construction means, methods, techniques, sequences and procedures and for coordinating all portions of the Work under the Contract; subject, however, to the Owner's right to reject means and methods proposed by the Contractor which are unsafe or otherwise not in compliance with the Contract Documents.

4.4.2 The Contractor shall be responsible to the Owner for the acts and omissions of Contractor's employees, Subcontractors and sub-subcontractors, suppliers, their agents and their employees, and of any other persons providing any of the Work through Contractor, and for their compliance with each and every requirement of the Contract Documents, in the same manner as if they were directly employed by the Contractor.

4.4.3 The Contractor understands and agrees that he shall not be relieved of his obligations to perform the Work in accordance with the Contract Documents either by the activities or duties of the Owner or the A/E in their administration of the Contract or by inspections, tests, or approvals required or performed under Article 7 by persons other than the Contractor.

4.4.4 Before starting a section of the Work, the Contractor shall carefully examine all preparatory work that has been executed by others to receive his Work to see that it has been completed. He shall check carefully, by whatever means are required, to ensure that his Work and adjacent, related work will finish to proper quality, contours, planes, and levels.

4.4.5 The Contractor understands and agrees that the Owner and A/E will not have any liability for or any responsibility to exercise any control over construction means, methods, techniques, sequences or procedures, or for safety precautions and programs in connection with the Work, and they will not be responsible for the Contractor's failure to carry out the Work in accordance with the Contract Documents.

The Owner and the A/E will not have any liability for or any responsibility to exercise any control over the acts or omissions of the Contractor, Subcontractors, sub-subcontrators or any of their agents or employees, or any other persons performing any of the Work.

4.4.6 The Contractor shall use no plant, equipment, materials, or persons for this Work to which the Owner objects.

4.4.7 The Contractor shall not remove any portion of the Work or stored materials from the site of the Project without the Owner's prior, written approval.

4.5 LABOR, MATERIALS AND EQUIPMENT

4.5.1 The Contractor shall furnish all plant, labor, materials, supplies, equipment and other facilities and things necessary or proper for, or incidental to, the Work, and will perform all other obligations imposed on him by the Contract Documents. Final payment will not be made until the Work is so completed.

4.5.2 Unless otherwise provided in the Contract Documents, the Contractor shall provide and pay for all labor, materials, equipment, tools, construction equipment and machinery, water, heat, utilities, transportation, and other facilities and services necessary for the proper execution and completion of the Work, whether temporary or permanent and whether or not incorporated or to be incorporated in the Work.

4.5.3 Work, materials, and equipment which are necessary in the construction but which are not specifically referred to in the specifications or shown in the drawings but implied by the Contract Documents shall be furnished by the Contractor at his own cost and expense. Such work and materials shall correspond with the general character of the Work as may be determined by the A/E subject to review as provided in Article 2.2.11.

4.5.4 The Contractor shall perform at least that percentage of the Work specified in the Contract to be Contractor self performed with forces that are in the direct employment of the Contractor. The Contractor shall submit to the Owner within thirty (30) days after award of the Contract a designation of the Work to be performed by the Contractor with his own forces. The percentage of the Work to be performed under subcontract shall be calculated by adding the amounts of all subcontracts and dividing this sum by the total Contract Sum.

4.5.5 The Contractor shall at all times enforce strict discipline, safety and good order among all persons providing any of the Work through him and shall not cause or allow to be used for the Work any unfit person or anyone not skilled in the task assigned to him. If any person providing any of the Work through the Contractor shall appear to the Owner to be incompetent or to act in a disorderly or improper manner, such person shall be removed immediately, at the request of the Owner, and shall not provide any of the Work except on written consent of the Owner.

4.5.6 No materials or supplies for the Work shall be purchased by the Contractor or by any Subcontractor subject to any chattel mortgage, or under a conditional sale or other agreement by which an interest is retained by the seller. The Contractor warrants that he has good title to all materials and supplies used by him in the Work.

4.5.7 The Contractor shall provide approved and adequate sanitary accommodations. All wastes shall be covered, disinfected, incinerated or otherwise disposed of legally.

4.5.8 All equipment, apparatus and/or devices of any kind to be incorporated into the Work that are shown or indicated on the drawings or called for in the specifications or required for the completion of the Work shall be entirely satisfactory to the Owner as regards operation, capacity and/or performance. No approval, either written or verbal, of any drawings, descriptive data or samples of such equipment,

apparatus, and/or device shall relieve the Contractor of his responsibility to turn over the same in good working order for its intended purpose at the completion of the Work in complete accordance with the Contract Documents. Any equipment, apparatus and/or device not fulfilling these requirements shall be removed and replaced by Contractor with proper and acceptable equipment, apparatus, and/or device, or put in good working order satisfactory to the Owner by Contractor without additional cost to the Owner.

4.6 WARRANTY

4.6.1 The Contractor warrants to the Owner that all materials and equipment furnished under this Contract will be new unless otherwise specified, and that all workmanship will be of first class quality, free from faults and defects and in conformance with the Contract Documents and all other warranties and guaranties specified therein. Where no standard is specified for such workmanship or materials, they shall be the best of their respective kinds. All Work not conforming to these requirements, including substitutions not properly approved and authorized, may be considered defective. If required by the Owner, the Contractor shall furnish satisfactory evidence as to the kind and quality of materials and equipment. This warranty is not limited by the provisions of Article 13, Uncovering and Correction of Work.

4.6.2 The Work included in this Contract is specified in the Contract Documents. The Contractor shall be required to complete the Work specified and to provide all items needed for construction of the Work, complete and in good order.

4.7 CONTRACTOR-PAID TAXES, PERMITS, FEES AND NOTICES

4.7.1 The Contractor shall pay all sales, consumer, use and other similar taxes for the Work or portions thereof provided by the Contractor which are legally enacted at the time bids are received, whether or not yet effective. Taxes to be paid by the Contractor shall include, but shall not be limited to, the Lynchburg City Business, Professional and Occupational License Tax (a gross receipts tax).

4.7.2 Except as provided in Article 3.3, Owner-Paid Permits and Fees, the Contractor will be responsible for obtaining and paying for all other fees, permits and licenses necessary for the proper execution of the Work, including but not limited to:

.1 Building Permit and inspections (City fees waived);

.2 Plumbing, Electrical, Mechanical Permits and inspections (City fees waived);

.3 Temporary water meter, temporary electrical and telephone installations and temporary utility usage;

.4 Temporary security lighting;

.5 All other permits necessary in order to perform the Work shall also be secured by the Contractor, and fees necessary in order to perform the Work shall be paid by him as part of this Contract at no additional cost to the Owner.

4.7.3 The Contractor shall give all notices and comply with all laws, ordinances, rules, regulations, codes, permits, resolutions and lawful orders of any public authority bearing on the performance of the Work; including but not limited to OSHA, Title 40.1 Labor and Employment Chapter 3 of the Code of Virginia, and Title VII of the Civil Rights Act of 1964, as amended. All safety violations shall be corrected immediately upon receipt of notice of violation.

4.8 COMPLIANCE

4.8.1 All demolition and excavation shall comply with all laws, ordinances, rules and regulations, and lawful orders of public authority, including without limitation, those for the prevention of accidents as issued by the Department of Labor and Industry of the Commonwealth of Virginia.

4.8.2 To the extent of the Work indicated in the Contract Documents, the Contractor shall comply and the construction shall conform with all applicable and current editions or revisions of the following codes, specifications and standards. In case of conflict, the order of precedence shall be as hereinafter listed:

.1 Lynchburg Public Procurement Code;

.2 Contract Documents;

.3 The Virginia Uniform Statewide Building Code (“USBC”), as amended including, without limitation, The International Building Code ("IBC") and other codes incorporated by the USBC and IBC); and

.4 The Virginia Department of Transportation Road and Bridge Specifications and the Road Designs and Standards.

4.8.3 If the Contractor (or any person in a contract with the Contractor relating to the Work) finds an error, inconsistency, omission, ambiguity, discrepancy, conflict or variance in the Contract Documents, or between the Contract Documents and any provisions of law, ordinance, rule, or regulations or any of the codes, specifications and standards set forth in 4.8.2 herein, the Contractor has the obligation to promptly seek in writing a clarification thereof from the A/E, with a copy to the Owner, prior to the time of beginning any of the Work that is affected by such error, inconsistency, omission, ambiguity, discrepancy, conflict or variance. The Owner will welcome such a clarification request, and, if deemed necessary by the Owner, the Owner will issue a written instruction clarifying the matter in question. If the Contractor feels that the written clarification requires additional work, the Contractor shall follow the change process in Article 12, Changes and Modifications in the Work.

Should the Contractor fail to seek such a clarification thereof immediately upon the discovery of the need therefor, prior to the time the said Work is performed, the Contractor thereby assumes all risk of loss related to such error, inconsistency, ambiguity, discrepancy, conflict or variance which the Contractor (and any person in contract with Contractor relating to the Work) knew or should have known, using a normal, professional standard of care, existed prior to the time the Work was performed.

4.8.4 Any material or operation specified by reference to publications~~,~~ or published specifications of a manufacturer, a society, an association, a code, or other published standard, shall comply with the requirements of the referenced document which is current on the date of receipt of bids. If the Contractor observes that any of the Contract Documents are at variance with any such referenced publications, codes, published specifications, or published standards in any respect, he shall promptly notify the A/E in writing, with a copy to the Owner. The A/E will make such judgments as are necessary and notify the Contractor prior to the performance of the Work.

4.8.5 If the Contractor performs any Work contrary to any law, code, ordinance, regulation, publication, standard, permit, rule, regulation or resolution, he shall assume full responsibility therefore and shall bear all costs attributable thereto.

4.8.6 The Contractor is responsible for locating all underground structures such as water, oil and gas mains, water and gas services, storm and sanitary sewers and telephone and electric conduits that may be encountered during construction. The Contractor shall have Miss Utility locate all utilities on the site within the area of the Work and shall dig test holes, to determine the position of the underground

structures. The Contractor shall pay the cost of digging test holes and likewise he shall pay the cost of the services of the representatives of the owners of such utilities for locating the said utilities. The cost of determining the location of any and all utilities is to be included in the bid price. The Owner shall pay the owners of such utilities for fees or charges for relocation of gas, electric, telephone, cable or other lines and/or services indicated to be relocated by others.

4.8.7 If utilities are marked which are not shown on the plans, the Contractor shall immediately give Notice to the Owner and the A/E of such finding. The Owner and A/E shall provide a direction to the Contractor within a reasonable period of time if additional work is required as a result of the finding. If the Contractor believes that it requires additional work, the Contractor shall follow the change process in Article 12, Changes and Modifications in the Work.

4.9 ALLOWANCES

4.9.1 The Special Conditions, if any, will contain provisions for allowances, if applicable to this Contract.

4.10 SUPERINTENDENT

4.10.1 The Contractor shall employ and have present at the Project site a competent Superintendent and any necessary assistants to ensure adequate supervision of the Work. The Superintendent shall have full authority to represent the Contractor, and all communications given to the Superintendent shall be as binding as if given to the Contractor.

4.10.2 Such Superintendent shall be acceptable to the Owner and shall be one who will be continued in that capacity for duration of this Project, unless he ceases to be on the Contractor's payroll. The Superintendent shall not be employed on any other project during the performance of this Contract.

4.11 CONSTRUCTION SCHEDULE

4.11.1 The Contractor shall, within twenty (20) days after issuance of the Notice of Award, prepare and submit to the A/E and Owner for review, a reasonably practicable and feasible Construction Schedule, showing the method by which the Contractor will comply with Completion Date requirements as set forth in the Contract. Unless otherwise agreed in writing by Owner or indicated in the specifications, the Construction Schedule shall use the Critical Path Method ("CPM") and an industry-standard computer software program, such as Primvera, acceptable to Owner and A/E, and shall be provided in electronic and paper format. The Construction Schedule shall show in detail how the Contractor plans to execute and coordinate the Work. The Contractor shall use this schedule in the planning, scheduling, direction, coordination and execution of the Work. The Construction Schedule shall encompass all of the work of all trades necessary for construction of the Project and shall be sufficiently complete and comprehensive to enable progress to be monitored on a day-to-day basis. The Owner and A/E shall each be provided with a copy of all schedules, updates, reports and other documentation required herein, which shall be suitable for reproduction by the Owner, and, unless otherwise agreed by Owner, shall be in electronic and paper format. When required to assist the A/E with Project staffing requirements for the following week, the Contractor shall provide the A/E, on each Friday, with a detailed work schedule for the following week. The Contractor shall provide the A/E with at least a seventy-two (72) hour notice for the following items: (1) All traffic lane changes, (2) Work ready for inspection or testing, (3) _____. The Contractor may be charged for additional costs of inspection when material and workmanship are found to not be ready for inspection or testing at the time the Contractor calls for inspection or testing.

4.11.2 It is the sole responsibility of the Contractor to prepare, maintain, update, revise and utilize the Construction Schedule as outlined in this Article 4.11, Construction Schedule. The Construction Schedule shall be the sole overall schedule utilized by the Contractor in managing this Project; provided, however, that Contractor may, at its option, employ and utilize other schedules based upon and consistent

with the Construction Schedule. In general, it is the intent of this paragraph 4.11.2 to allow the Contractor to choose its own means, methods and construction procedures consistent with good practice and the Contract Documents.

4.11.3 If the Contractor should express an intention to complete the Work earlier than any required Milestone or Completion Date, including without limitation, in any schedule, the Owner shall not be liable to the Contractor for any delay or associated extra costs based upon the Contractor being unable to complete the Work before such earlier date. The duties, obligations and warranties of the Owner to the Contractor apply only to the completion of the Work on the Milestone and Completion Dates required by the Contract Documents and do not apply to early completion.

4.11.4 Submission to the Owner of the Construction Schedule is advisory only, does not satisfy any requirement for any notice required by the Contract Documents or the Lynchburg Public Procurement Code, and such submission shall not relieve the Contractor of the responsibility for accomplishing the Work within each and every required Milestone and Completion Date. Omissions and errors in the approved Construction Schedule shall not excuse performance that is not in compliance with the Contract Documents. Submission to the Owner and/or A/E in no way makes the Owner and/or A/E an insurer of the Construction Schedule's success or makes Owner and/or the A/E liable for time or cost overruns flowing from the Construction Schedule’s shortcomings. The Owner hereby disclaims any obligation or liability by reason of Owner and/or A/E approval or failure to object to the Construction Schedule, and any such approval or failure to object shall not be considered an admission by the Owner that the Construction Schedule was reasonably practicable or feasible.

4.11.5 Contractor shall consult with and obtain information from principal Subcontractors necessary in preparation of the Construction Schedule, and for updates and revisions required therein. Contractor shall provide each principal Subcontractor with copies of the Construction Schedule and any revisions or updates affecting that Subcontractor's work. Contractor shall hold appropriate progress meetings with Subcontractors and shall direct and coordinate the work of Subcontractors consistent with and as required herein. Owner shall have the right to attend Subcontractor progress meetings but shall not be required to participate in such meetings or provide information to Subcontractors, except through the Contractor. Contractor shall keep up-to-date minutes of subcontractor progress meetings and shall provide same to Owner. The Contractor shall ensure that each Subcontractor, sub-subcontractor or supplier acknowledges and accepts the requirements of the Construction Schedule relating to their part of the Work.

4.11.6 If Contractor's Construction Schedule indicates that Owner, the A/E, or a separate contractor is to perform an activity by a specific date, or within a certain duration, Owner, the A/E, or any separate contractor shall not be bound to said date or duration unless Owner expressly and specifically agrees in writing to the same. The Owner's and/or A/E’s overall review and acceptance or approval of the schedule does not constitute an agreement to specific dates or durations for activities of the Owner, A/E, or any separate contractor.

4.11.7 The Contractor's Superintendent shall maintain at the Project site a current, updated Construction Schedule, indicating actual monthly progress for those portions of the Project on which Work has been or is being performed.

4.11.8 If an extension or contraction of any Milestone or Completion Date is authorized by any Change Order, the Contractor shall revise his Construction Schedule, Milestone and Completion Dates accordingly.

4.11.9 If, in the opinion of the Owner, the Construction Schedule does not accurately reflect the actual progress and sequence of the Contractor's performance of the Work, the Contractor shall revise the Construction Schedule, upon the Owner's request, and submit a revised Construction Schedule that accurately represents the progress and sequence of the Contractor's performance of the Work.

4.11.10 Contractor shall submit to the Owner the name of any scheduling consultant that Contractor may select or retain, prior to using such consultant. Contractor shall not utilize any particular scheduling consultant over the reasonable objection of the Owner to that consultant.

4.11.11 Contractor covenants, warrants, and guarantees that Contractor will not:

.1 Misrepresent to Owner its planning and scheduling of the Work;

.2 Utilize schedules materially different from those made available to the Owner or any subcontractors for the direction, execution and coordination of the Work, or which are not feasible or realistic;

.3 Prepare schedules, updates, revisions or reports that do not accurately reflect Contractor's actual intent or Contractor's reasonable and actual expectations as to:

(a) The sequences of activities,

(b) The duration of activities,

(c) The responsibility for activities,

(d) Resource availability,

(e) Labor availability or efficiency,

(f) Expected weather conditions,

(g) The value associated with the activity,

(h) The percentage complete of any activity,

(i) Completion of any item of work or activity,

(j) Project completion,

(k) Delays, slippages, or problems encountered or expected,

(l) Subcontractor requests for time extension, or delay claims of subcontractors, and

(m) If applicable, the float time available.

4.11.12 Contractor's failure to substantially comply with the foregoing covenants, warranties and guarantees of paragraph 4.11.11 shall be a substantial and material breach of contract which will permit Owner to terminate Contractor for default~~,~~ or withhold payments under the Contract Documents~~,~~ and shall entitle Owner to the damages afforded by these Contract Documents or applicable law.

4.11.13 Should Contractor fail to substantially comply with the provisions of the Contract Documents relating to scheduling and execution of the Work by the overall Construction Schedule, Owner shall have the right, at its option, to retain the services of scheduling consultants or experts (including attorneys if necessary in the opinion of the Owner) to prepare schedules, reports, updates and revisions of the schedule in accordance with the Contract Documents and to review and analyze same, in order to allow Owner and the A/E to evaluate the progress of the Work by Contractor, to determine whether Contractor is substantially complying with the Contract Documents, and to direct such action by the

Contractor, as permitted by the Contract Documents, as required to ensure, under the Owner's schedule prepared hereunder, that Contractor will complete the Work within the Contract Time. All costs and expenses and fees incurred by Owner in exercising its rights hereunder shall be charged to Contractor's account. If Contractor fails to substantially comply with the scheduling and execution of the Work requirements of the Contract Documents, Contractor hereby agrees, in such instance, to comply with such Owner-prepared schedules, if any, or directions, activity sequences and durations as Owner may reasonably require, without additional cost to the Owner (subject only to cost adjustments for such changes in the Work as Owner may direct), to ensure completion within the Contract Time.

4.11.14 The Construction Schedule shall be utilized by Owner, A/E and Contractor for submission, review and approval of monthly Payment Requests. The schedule must be updated by Contractor monthly with each progress payment application and submitted to the Owner and A/E for review with the progress payment application. Owner shall not be required to process and review Contractor's Application for Payment if Contractor has failed or refused to provide the scheduling update information required herein.

4.11.15 The type of schedule to be utilized on this Project, along with its particular elements, shall be as specified in the Contract Documents.

4.12 RESPONSIBILITY FOR COMPLETION

4.12.1 The Contractor shall furnish such manpower, materials, facilities and equipment and shall work such hours, including night shifts, overtime operations and Sundays and holidays, as may be necessary to ensure the performance of the Work within the Milestone and Completion dates specified in the Contract. If the Owner notifies the Contractor that it has become apparent that the Work will not be completed within required Milestone or Completion Dates and such is not due solely to circumstances for which Contractor has established entitlement to an extension to the Contract Time, the Contractor agrees that it will assume full responsibility to take some or all of the following actions, at no additional cost to the Owner (except for circumstances beyond the Contractors' control), in order to ensure, in the opinion of the Owner, that the Contractor will comply with all Milestone and Completion Date requirements:

.1 Increase manpower, materials, crafts, equipment and facilities;

.2 Increase the number of working hours per shift, shifts per working day, working days per week, or any combination of the foregoing; and

.3 Reschedule activities to achieve maximum practical concurrency of accomplishment of activities.

Failure of the Owner to notify the Contractor of the apparent delay shall not relieve Contractor of the obligation to finish the Work within the required Milestone or Completion date.

4.12.2 If the actions taken by the Contractor to remedy delays not due solely to circumstances for which Contractor has established entitlement to a time extension are not satisfactory, the Owner may direct the Contractor to take any and all actions necessary to ensure completion within the required Milestone and Completion Dates, without additional cost to the Owner. In such event, the Contractor shall continue to assume responsibility for his performance and for completion within the required dates.

4.12.3 If, in the opinion of the Owner, the actions taken by the Contractor pursuant to this Article or the progress or sequence of Work are not accurately reflected on the Construction Schedule, the Contractor shall revise such schedule to accurately reflect the actual progress and sequence of Work.

4.12.4 Failure of the Contractor to substantially comply with the requirements of this Article is grounds for a determination by the Owner, pursuant to Article 15, Termination Of The Contract, that the Contractor is failing to prosecute the Work with such diligence as will ensure its completion within the time specified.

4.12.5 The Owner may, at its sole discretion and for any reason, including when it is apparent to the A/E or Owner that the Work will not be completed within the required Milestone or Completion Dates, require the Contractor to accelerate the Construction Schedule by providing overtime, Saturday, Sunday and/or holiday work and/or by having all or any subcontractors designated by the Owner provide overtime, Saturday, Sunday, and/or holiday work. If the Owner requires overtime, Saturday, Sunday or holiday work by the Contractor's or his Subcontractor's own forces, and such requirement is not related in any way to the Contractor's apparent inability to comply with Milestone and Completion Date requirements, the Owner shall reimburse the Contractor for the direct cost to the Contractor of the premium time for all labor utilized by the Contractor in such overtime, Saturday, Sunday or holiday work (but not for the straight time costs of such labor), together with any Social Security and State or Federal unemployment insurance taxes in connection with such premium time. However, no overhead supervision costs, commissions, profit or other costs and expenses shall be payable in connection therewith.

4.12.6 This provision does not eliminate the Contractor's responsibility to comply with the City's noise ordinances, all VDOT permit requirements, and all other applicable laws, regulations, rules, ordinances, resolutions, and permit requirements.

4.13 DOCUMENTS AND SAMPLES AT THE SITE

4.13.1 The Contractor shall, at the Owner's direction, maintain at the site for the Owner one record copy of all drawings, specifications, addenda, Change Orders and other Modifications, and Field Orders in good order and marked currently to record all changes made during construction, and approved Shop Drawings, Product Data, Samples and Manuals. These shall be available to the A/E. These shall be delivered to the Owner upon completion of the Work.

4.14 SHOP DRAWINGS, PRODUCT DATA, SAMPLES AND MANUALS

4.14.1 SHOP DRAWINGS are drawings, diagrams, schedules and other data specially prepared for the Work by the Contractor or any Subcontractor, manufacturer, supplier or distributor to illustrate some portion of the Work.

4.14.2 PRODUCT DATA are illustrations, standard schedules, performance charts, instructions, brochures, diagrams and other information furnished by the Contractor to illustrate a material, product or system for some portion of the Work.

4.14.3 SAMPLES are physical examples that illustrate materials, equipment or workmanship and establish standards by which the Work will be judged.

4.14.4 MANUALS are manufacturer's installation, start-up, operating, maintenance and repair instructions, together with parts lists, pictures, sketches and diagrams that set forth the manufacturer's requirements, for the benefit of the Contractor and the Owner.

4.14.5 The Contractor shall review, approve and submit, with reasonable promptness and in such sequence as to cause no delay in the Work or in the work of the Owner or any separate contractor, all Shop Drawings, Product Data, Samples and Manuals required by the Contract Documents.

4.14.6 By approving and submitting Shop Drawings, Product Data, Samples and Manuals, the Contractor represents that he has determined and verified all materials, field measurements, and field construction

criteria related thereto, and that he has checked and coordinated the information contained within such submittals with the requirements of the Work and of the Contract Documents.

Parts and details not fully indicated on the contract drawings shall be detailed by the Contractor in accordance with standard engineering practice. Dimensions on the drawings, as well as detailed drawings themselves, are subject in every case to measurements of existing, adjacent, incorporated and completed Work, which shall be taken by the Contractor before undertaking any Work dependent on such data.

4.14.7 The Contractor shall not be relieved of responsibility for any deviation from the requirements of the Contract Documents by the Owner or A/E's approval of Shop Drawings, Product Data, Samples or Manuals under Article 2, Architect/Engineer unless the Contractor has specifically informed the Owner and A/E in writing of such deviation at the time of submission and the Owner has given specific written approval to the specific deviation. The Contractor shall not be relieved from responsibility for errors or omissions in the Shop Drawings, Product Data, Samples or Manuals by the A/E's approval thereof.

4.14.8 The Contractor shall direct specific attention, in writing or on resubmitted Shop Drawings, Product Data or Samples, to revisions other than those requested by the Owner or A/E on previous submittals.

No portion of the Work requiring submission of Shop Drawings, Product Data, or Samples shall commence until the submittal has been approved by the Owner and A/E as provided in Article 2, Architect/Engineer. All such portions of the Work shall be in accordance with approved submittals.

4.14.9 For substances that are proposed for use in the Project that may be hazardous to human health, the Contractor shall submit to the A/E, for information only, information on precautions for safely using these substances, including Material Safety Data Sheets and certification of registration by the Contractor with authorities under the respective Virginia and Federal Toxic Substances Control Acts.

4.14.10 Unless otherwise modified by the Owner in writing, the Contractor shall label or stamp and number all Shop Drawings, Product Data, Samples or Manuals as prescribed by the Project Manager.

4.14.11 The Contractor shall submit a copy of each submittal, including the transmittal sheet (for shop drawings, product data, samples or manuals) to the Owner simultaneously with the Contractor's submission of said drawings, data, samples or manual packages to the A/E.

4.15 EQUAL PRODUCTS:

4.15.1 The term "Product" as used in the Contract Documents refers to materials, equipment, supplies, articles, fixtures, devices, types of construction, or products, as appropriate.

4.15.2 All products furnished shall, whenever specified and otherwise wherever practicable, be the standard products of recognized, reputable manufacturers. If the manufacturer cannot make scheduled delivery of an approved item, the Contractor may request approval of the A/E to use another brand, make, manufacturer, article, device, product, material, fixture, form or type of construction which the Contractor judges to be equal to that specified. An item need not be considered by the A/E for approval as equal to the item so named or described unless it (1) it is at least equal in quality, durability, appearance, strength, and design; (2) it will perform at least equally the specific function imposed by the general design for the work being contracted for or the material being purchased; and (3) it conforms substantially, even with deviations, to the detailed requirements for the item in the specifications. Approval shall be at the sole discretion of the A/E and will be based upon considerations of quality, workmanship, economy of operation, suitability for the purpose intended, and acceptability for use on the project. Any such approval must be in writing to be effective, and the decision of the A/E shall be final.

4.15.4 To obtain such approval of equal products other than those specified in Contract Documents, and not previously approved during the bidding, the Contractor's request for approval of any equal product shall include the following:

.1 Complete data substantiating compliance of the proposed equal product with the Contract Documents;

.2 Accurate cost data on proposed equal product in comparison with product or method specified;

.3 Product identification including manufacturer's name, address, and phone number;

.4 Manufacturer's literature showing complete product description, performance and test data, and all reference standards;

.5 Samples and colors in the case of articles or products;

.6 Name and address of similar projects on which the product was used and date of installation;

.7 All directions, specifications, and recommendations by manufacturers for installation, handling, storing, adjustment, and operation.

4.15.5 The Contractor shall also submit with his request for approval a statement which shall include all of the following representations by the Contractor, namely that:

.1 He has investigated the proposed equal product and determined that it is equal or better in all respects to that specified and that it fully complies with all requirements of the Contract Documents;

.2 He will meet all contract obligations with regard to this substitution;

.3 He will coordinate installation of accepted equal products into the work, making all such changes and any required schedule adjustments, at no additional cost to the Owner, as may be required for the Work to be complete in all respects;

.4 He waives all claims for additional costs and additional time related to equal products. He also agrees to hold the Owner harmless from claims for extra costs and time incurred by subcontractors and suppliers, or additional services which may have to be performed by the A/E, for changes or extra work that may, at some later date, be determined to be necessary in order for the Work to function in the manner intended in the Contract Documents;

.5 He will provide the same warranty and guarantee, and perform any work required in accordance therewith, for the equal product that is applicable to the specified item for which the equal product is requested;

.6 Material will be installed, handled, stored, adjusted, tested, and operated in accordance with the manufacturers' recommendation and as specified in the Contract Documents;

.7 In all cases, new materials will be used unless this provision is waived in writing by, the Owner or unless otherwise specified in the Contract Documents;

.8 All material and workmanship will be in every respect, in accordance with that which in the opinion of the Owner, is in conformity with approved modern practice; and

.9 He has provided accurate cost data on the proposed equal product in comparison with the product or method specified, if applicable.

4.15.6 The Owner may require tests of all products proposed as equal products so submitted to establish quality standards, at the Contractor's expense. After approval of an equal product, if it is determined that the Contractor submitted defective information or data regarding the equal product upon which Owner's approval was based, and that unexpected or uncontemplated redesign or rework of the Project will be required in order to accommodate the equal product, or that the item will not perform or function as well as the specified item for which equal product was requested, the Contractor will be required to furnish the original specified item or request approval to use another equal product. The Contractor shall pay all costs, expenses or damages associated with or related to the unacceptability of such an equal product and the resultant utilization of another item, and no time extension shall be granted for any delays associated with or related to such an equal product.

4.15.7 Equal products will not be considered for approval by the Owner if:

.1 The proposed equal product is indicated or implied on the Contractor's shop drawing or product data submittals and has not been formally submitted for approval by the Contractor in accordance with the above-stated requirements; or

.2 Acceptance of the proposed equal product will require substantial design revisions to the Contract Documents or is otherwise not acceptable to the Owner.

4.15.8 Except as otherwise provided for by the provisions of any applicable laws, the Contractor shall not have any right of appeal from the decision of the Owner disapproving any products submitted if the Contractor fails to obtain the approval for an equal product under this Article.

4.15.8 If the Contractor proposes a product which the Owner determines is not equal to the product named in Contract Documents but which the Owner nevertheless is willing to accept, Contractor shall provide, upon request by the Owner, an itemized comparison of the proposed substitution with the product specified and the cost differential which shall be credited to the Owner in a Change Order issued in accordance with Article 12, Changes and Modifications in the Work.

4.16 USE OF SITE

4.16.1 The Contractor shall confine his operations at the site to areas permitted by law, ordinances, permits, easements, right-of-way agreements and the Contract Documents. The Contractor shall not unreasonably encumber the site, in the opinion of the Owner, with any materials, equipment or trailers, nor shall Contractor block the entrances or otherwise prevent reasonable access to the site, other working and parking areas, completed portions of the Work and/or properties, storage areas, areas of other facilities that are adjacent to the worksite. If the Contractor fails or refuses to move said material, equipment or trailers within 24 hours of Notice by the Owner to so do, the Owner shall have the right, without further Notice, to remove, at the Contractor's expense, any material, equipment and/or trailers which the Owner deems are in violation of this paragraph.

4.17 CUTTING AND PATCHING OF WORK

4.17.1 The Contractor shall be responsible for all cutting, fitting or patching that may be required to complete the Work and to make its several parts fit properly and in accordance with the Contract Documents.

4.17.2 The Contractor shall not damage or endanger any portion of the Work or the work of the Owner or any separate contractors by cutting, patching or otherwise altering any work~~,~~ or by excavation. The

Contractor shall not cut or otherwise alter the work of the Owner or any separate contractor except with the written consent of the Owner and of such separate contractor. The Contractor shall not unreasonably withhold from the Owner or any separate contractor Contractor's consent to cutting or otherwise altering the Work. The Owner shall not be required to accept Work with a cut, splice, or patch when such cut, splice or patch is not generally accepted practice for the particular work involved or is otherwise unworkmanlike in the opinion of the Owner.

4.18 SITE CLEAN UP

4.18.1 The Contractor at all times shall keep the Project site and adjacent areas free from accumulation of waste materials or rubbish caused by his operations. Before final payment is made, the Contractor shall remove all of his waste materials, rubbish, scrap materials, debris, tools, construction equipment, machinery, surplus materials, falsework, temporary structures, including foundations thereof and plant of any description, from the Project site and put the site in a neat, orderly condition.

4.18.2 If the Contractor fails to clean up as required herein at any time during the performance of the Work or at the completion of the Work, the Owner may, upon 24 hours notification, clean up the site at the Contractor's expense.

4.19 PATENTS, ROYALTIES, ETC.

4.19.1 The Contractor guarantees to save harmless the Owner, its officers, agents, servants and employees from liability of any kind or nature, including without limitation, cost, expense and attorney's fees, on account of suits and claims of any kind for violation or infringement of any patents or patent rights by the Contractor, or by anyone directly or indirectly employed by him, or by reason of the use of any art, process, method, machine, manufacture, or composition of matter patented or unpatented in the performance of this Contract in violation or infringement of any letter or rights. The Contractor agrees to pay all royalties, fees, licenses, etc. required in respect of the Work or any part thereof as part of his obligations hereunder without any additional compensation.

4.20 INDEMNIFICATION

4.20.1 It is hereby mutually covenanted and agreed that the relation of the Contractor to the Work to be performed by him under this Contract shall be that of an independent contractor and that as such he will be responsible for all damages, loss or injury, including death, to persons or property that may arise or be incurred in or during the conduct and progress of said work as the result of any action, omission or operation under the Contract or in connection with the Work, whether such action, omission or operation is attributable to the Contractor, subcontractor, any material supplier, or anyone directly or indirectly employed by any of them. The Contractor shall make good any damages that may occur in consequence of the Work or any part of it. The Contractor shall assume all liability, loss and responsibility of whatsoever nature by reason of his neglect or violation of any federal, state, county or local laws, regulations , codes or ordinances.

4.20.2 The Contractor shall indemnify, hold harmless and defend the Owner, its employees, agents, servants and representatives from and against any and all claims, suits, demands, actions (regardless of the merits thereof) and damages of whatever nature arising out of or resulting from the performance of the Work or the failure to perform the Work, including without limitation, jurisdictional labor disputes or other labor troubles that may occur during the performance of the Work.

4.20.3 The indemnification obligations under this Article shall not be affected in any way by any limitation on the amount or type of damages, compensation or benefits payable by or for the Contractor or any Subcontractor under worker's or workman's compensation acts, disability benefit acts or other employee benefit acts.

4.20.4 The obligations of the Contractor under this Article 4.20 shall not extend to the actions or omissions of the A/E, his agents or employees, arising out of the preparation or approval of maps, drawings, opinions, reports, surveys, change orders, designs or specifications.

4.20.5 The obligations of the Contractor under this Article 4.20 shall not extend to the proportion of damages, loss or injury, including death, to persons or property that may arise or be incurred as the result of any action, omission or operation of the Owner, or Owner's separate contractor(s), and their employees, agents, servants, and/or representatives.

4.21 NON-DISCRIMINATION IN EMPLOYMENT

4.21.1 During the performance of this Contract, the Contractor agrees as follows:

.1 The Contractor will not discriminate against any employee or applicant for employment because of race, religion, color, sex, national origin, age, disability, or any other basis prohibited by state law relating to discrimination in employment, except where there is bona fide occupational qualification reasonably necessary to the normal operation of the Contractor. The Contractor agrees to post in conspicuous places, available to employees and applicants for employment, notices setting forth the provisions of this nondiscrimination clause.

.2 The Contractor, in all solicitations or advertisements for employees placed by or on behalf of the Contractor, will state that such Contractor is an equal opportunity employer.

.3 Notices, advertisements and solicitations placed in accordance with federal law, Rule or regulation shall be deemed sufficient for the purpose of meeting the requirements of this section.

.4 The Contractor will include the provisions of the foregoing paragraphs 1, 2, and 3 in every subcontract or purchase order of over $10,000, so that the provisions will be binding upon each subcontractor or vendor.

4.21.2 DRUG-FREE WORKPLACE REQUIRED:

As required by section 2.2-4312 of the Code of Virginia during the performance of the Contract, Contractor agrees to (i) provide a drug-free workplace for the contractor's employees; (ii) post in conspicuous places, available to employees and applicants for employment, a statement notifying employees that the unlawful manufacture, sale, distribution, dispensation, possession, or use of a controlled substance or marijuana is prohibited in the Contractor's workplace and specifying the actions that will be taken against employees for violations of such prohibition; (iii) state in all solicitations or advertisements for employees placed by or on behalf of the Contractor that the Contractor maintains a drug-free workplace; and (iv) include the provisions of the foregoing clauses in every subcontract or purchase order of over $10,000, so that the provisions will be binding upon each subcontractor or vendor.

For the purposes of this Article 4.21, "drug-free workplace" means a site for the performance of Work done in connection with this Contract where Contractor's employees are prohibited from engaging in the unlawful manufacture, sale, distribution, dispensation, possession or use of any controlled substance or marijuana during the performance of the Contract.

4.22 CONTRACT SECURITY

4.22.1 The Contractor shall deliver to the Owner, within ten (10) working days from Notice of Award, two (2) originals of a Performance Bond and a separate Labor and Material Payment Bond, in a form acceptable to the Owner, and each in an amount required by the Contract Documents and the Virginia Public

Procurement Act, as security for the faithful performance of the Contract, and the payment of all persons performing labor and furnishing materials in connection with this Contract. The City will not issue Notice to Proceed until the bonds are received. The amount of the Performance and Payment Bonds shall be increased to the same extent the Contract Sum is increased due to Modifications. The form of bonds shall be acceptable to the Owner, and the surety shall be such surety company or companies as are acceptable to the Owner and as are authorized to transact business in the Commonwealth of Virginia. The cost of such bonds shall be included in the Contractor's bid amount.

4.22.2 The bonds shall irrevocably obligate the Contractor and surety to the full amount of the bonds unless and until all of Contractor's obligations under the Contract Documents have fully been fulfilled.

4.22.3 If, at any time, any surety or sureties for any bond relating to the Work becomes insolvent or is determined by the Owner to be unable to adequately secure the interest of the Owner, the Contractor shall, within (30) days after Notice from the Owner to do so, substitute an acceptable bond(s) in such form and sum and with such other sureties as obligors as may be satisfactory to the Owner. The premiums on such bond(s) shall be paid by the Contractor.

ARTICLE 5 SUBCONTRACTORS

5.1 DEFINITIONS

5.1.1 A Subcontractor is a person or entity who has a direct contract with the Contractor to perform or supply any of the Work at the site. Subcontractor means a Subcontractor or his authorized representative. The term Subcontractor does not include any separate contractor performing work pursuant to Article 6 or his subcontractors.

5.1.2 A Sub-subcontractor is a person or entity who has a direct or indirect contract with a Subcontractor to perform or supply any of the Work at the site. The term Sub-subcontractor includes a Sub-subcontractor or an authorized representative thereof.

5.1.3 The A/E will not deal directly with any Subcontractor or Sub-subcontractor or materials supplier. Subcontractor, Sub-subcontractors or material suppliers shall route requests for information or clarification through the Contractor to the A/E, with a copy to the Owner.

5.2 AWARD OF SUBCONTRACT AND OTHER CONTRACTS FOR PORTIONS OF THE WORK

5.2.1 The Contractor shall submit to the Owner with a copy to the A/E prior to the award of any subcontract for Work under this Contract and thirty (30) calendar days after the award of this Contract, the names of the suppliers of principal items, systems, materials, and equipment proposed for the Work; the names and addresses, business and emergency phones of the Subcontractors which he proposes to employ under this Contract, as well as such other information as may be requested by the Owner. The Owner will review each Subcontractor and supplier based upon his apparent financial soundness and responsibility, his known or reported performance on previous similar work, and his available plant, equipment and personnel to perform the Work. The Contractor shall not employ a Subcontractor or supplier to whom the Owner reasonably objects. The Owner's objection to a proposed Subcontractor or supplier shall not affect the Contract Sum.

5.2.2 The Contractor shall make no substitutions for any Subcontractor, person or entity previously selected unless first submitted to the Owner for review and approval.

5.3 SUBCONTRACTUAL RELATIONS

5.3.1 By an appropriate written agreement, the Contractor shall require each Subcontractor, to the extent of the Work to be performed by the Subcontractor, to be bound to the Contractor by the terms of the Contract Documents, and to assume toward the Contractor all the obligations and responsibilities which the Contractor, by these Contract Documents, assumes toward the Owner and the A/E. Said agreement shall preserve and protect the rights of the Owner and the A/E under the Contract Documents with respect to the Work to be performed by the Subcontractor so that the subcontracting thereof will not prejudice such rights, and shall allow to the Subcontractor, unless specifically provided otherwise in the Contractor-Subcontractor agreement, the benefit of all rights, remedies and redress against the Contractor that the Contractor, by these Contracts Documents, has against the Owner. Where appropriate, the Contractor shall require each Subcontractor to enter into similar agreements with his Sub-subcontractors. The Contractor shall make available to each proposed Subcontractor, prior to the execution of the subcontract, copies of all of the Contract Documents, and identify to the Subcontractor any terms and conditions of the proposed subcontract which may be at variance with the Contract Documents. Each Subcontractor shall similarly make copies of such Contract Documents available to his Sub-subcontractor's. Each subcontract agreement shall insure that all appropriate provisions of the Contract Documents are complied with by the Subcontractor.

5.3.2 The provisions herein regarding the City's reasonable objection to any Subcontractor shall in no way affect the liability of the Contractor to Owner regarding performance of all obligations by or payment of Subcontractors. The City's failure to object to any given Subcontractor shall not relieve the Contractor of his obligation to perform or have performed to the full satisfaction of the Owner all of the work required by this Contract.

5.3.3 Neither this article nor any other provision of the Contract Documents shall be deemed to make the Owner a joint venture or partner with the Contractor or to place the Subcontractor and materialmen in privity of contract with the Owner.

5.4 QUALIFICATION SUBMITTALS

5.4.1 Specific qualification submittals may be required of the Contractor, Subcontractors, installers and suppliers for certain critical items of the Work. Required qualification submittals are set forth in detail in the Instruction to Bidders and shall be provided, collected and submitted by the Contractor to the A/E with copies to the Owner. All information required of a single Subcontractor, installer or supplier shall be contained in a single, complete submittal. The Contractor shall submit the required qualification information within ten (10) days after receipt of the Owner's request.

5.4.2 The Owner may reject any proposed Subcontractor, installer or supplier, or any qualification submittals related thereto, for the following reasons:

.1 The Contractor's failure to submit requested information within the specified time; or

.2 The Contractor's failure to provide all of the requested information; or

.3 The Contractor's submission of a Subcontractor, installer or supplier, or qualifications thereof, which are unacceptable in the judgment of the Owner.

5.4.3 Should the Owner have reasonable objection to any proposed Subcontractor, installer or supplier, the Contractor shall submit another firm for approval by the Owner at no additional cost to the Owner.

ARTICLE 6 WORK BY OWNER OR BY SEPARATE CONTRACTORS

6.1 OWNER'S RIGHT TO PERFORM WORK AND TO AWARD SEPARATE CONTRACTS

6.1.1 The Owner reserves the right to perform work related to the Project with his own forces, and to award separate contracts in connection with other portions of the Project or other work on the site.

6.1.2 When separate contracts are awarded for different portions of the Project or other work on the site, the term "contractor" in the contract documents in each case shall mean the contractor who executes each separate construction agreement.

6.2 MUTUAL RESPONSIBILITY

6.2.1 The Contractor shall afford other contractors and the Owner reasonable opportunity for the introduction and storage of their materials and equipment and the execution of their work and shall properly connect and coordinate the Work with such other work. The Contractor shall coordinate his Work with the Owner and other contractors and store his apparatus, materials, supplies and equipment in such orderly fashion at the site of the Work as will not unduly interfere with the progress of the Work or the work of any other contractors.

6.2.1.1 If the execution or result of any part of the Work depends upon any work of the Owner or of any separate contractor, the Contractor shall, prior to proceeding with the Work, inspect and promptly report to the Owner in writing any apparent discrepancies or defects in such work of the Owner or of any separate contractor that render it unsuitable for the proper execution or result of any part of the Work.

6.2.1.2 Failure of the Contractor to so inspect and report shall constitute an acceptance of the Owner's or separate contractor's work as fit and proper to receive the Work, except as to defects which may develop in the Owner's or separate contractor's work after completion of the Work and which the Contractor could not have discovered by its inspection prior to completion of the Work.

6.2.2 Should the Contractor cause damage to the work or property of the Owner or of any separate contractor on the Project, or to other work on the site, or delay or interfere with the Owner's work on ongoing operations or facilities or adjacent facilities or said separate contractor's work, the Contractor shall be liable for the same; and, in the case of another contractor, the Contractor shall attempt to settle said claim with such other contractor prior to such other contractor's institution of litigation or other proceedings against the Contractor.

If such separate contractor sues the Owner on account of any damage, delay or interference caused or alleged to have been so caused by the Contractor, the Owner shall notify the Contractor, who shall defend the Owner in such proceedings at the Contractor's expense. If any judgment or award is entered against the Owner, the Contractor shall satisfy the same and shall reimburse the Owner for all damages, expenses, and other costs that the Owner incurs as a result thereof.

6.2.3 Should Contractor have a dispute with a separate contractor with whom the Owner has contracted regarding damage to the Work or the property of Contractor or to the Work or property of said separate contractor or with regard to any delays or interferences which either Contractor or said separate contractor has caused to the performance of the other's Work, Contractor agrees to attempt to settle such dispute directly with said separate contractor. Contractor agrees that it will not seek to recover from the Owner any damages, costs, expenses (including, but not limited to, attorney's fees) or losses of profit incurred by the Contractor as a result of any damage to the Work or property of the Contractor or for any delay or interference caused or allegedly caused by any separate contractor.

6.3 OWNER'S RIGHT TO CLEAN UP

6.3.1 If a dispute arises between the Contractor and separate contractors as to their responsibility for cleaning up as required by Article 4, Contractor, the Owner may clean up and charge the cost thereof to the contractor responsible as the Owner shall determine to be just.

ARTICLE 7 MISCELLANEOUS PROVISIONS

7.1 GOVERNING LAW

The provisions of this Contract shall be interpreted in accordance with the laws of the Commonwealth of Virginia.

7.2 PROVISIONS REQUIRED BY LAW DEEMED INSERTED

Each and every provision of law and clause required by law to be inserted in this Contract shall be deemed to be inserted herein, and the Contract shall be read and enforced as though it were included herein and if through mistake or otherwise, any such provision is not inserted or is not correctly inserted, then upon the application of either party, the Contract shall forthwith be physically amended to make such insertion.

7.3 SUCCESSORS AND ASSIGNS

The Owner and the Contractor each binds himself, his partners, successors, assigns and legal representatives to the other party hereto and to the partners, successors, assigns and legal representatives of such other party in respect to all covenants, agreements and obligations contained in the Contract Documents. Neither party to the Contract shall assign the Contract or sublet it without the written consent of the other, nor shall the Contractor assign any monies due or to become due to him hereunder, without the previous written consent of the Owner and the Contractor's surety.

In the event the Contractor desires to make an assignment of all or part of the Contract or any monies due or to become due hereunder, the Contractor shall file a copy of consent of surety, together with a copy of the assignment to the Owner and A/E. In the event the Contractor assigns all or any part of the monies due or to become due under this Contract, the instrument of assignment shall state that the right of assignees in and to any monies due to or to become due to Contractor shall be subject to prior liens and claims of all persons, firms and corporations that provided labor services or furnished material and equipment during the performance of the Work. The rights of assignees shall further be subject to the payment of any liens, claims, or amounts due to Federal, state, or local governments.

7.4 RIGHTS AND REMEDIES

7.4.1 The duties and obligations imposed by the Contract Documents and the rights and remedies available thereunder shall be in addition to, and not a limitation of, any duties, obligations, rights and remedies otherwise imposed or available by law, not inconsistent with the Contract Documents. No time limitations described in this Contract shall be construed to alter the applicable statutory period of limitations with regard to the enforcement of the obligations of the parties.

7.4.2 No action or failure to act by the Owner, A/E or Contractor shall constitute a waiver of any right or duty afforded any of them under the Contract, nor shall any such action or failure to act constitute an approval of or acquiescence in any breach thereunder, except as may be specifically agreed in writing.

7.4.3 Contractor agrees that he can be adequately compensated by money damages for any breach of this Contract which may be committed by the Owner and hereby agrees that, no default, act, or omission of the Owner or the A/E, except for failure to make payments as required by the Contract Documents, shall constitute a material breach of the Contract entitling Contractor to cancel or rescind the provisions of this Contract or (unless the Owner shall so consent or direct in writing) to suspend or abandon performance of all or any part of the Work. Contractor hereby waives any and all rights and remedies to which he might otherwise be or become entitled, saving only its right to money damages.

7.5 SEVERABILITY

In the event that any provision of this Contract shall be adjudged or decreed to be invalid, such ruling shall not invalidate the entire agreement but shall pertain only to the provision in question and the remaining provisions shall continue to be valid, binding, and in full force and effect.

7.6 TESTS

7.6.1 If the Contract Documents, laws, ordinances, rules, regulations, codes, permits, resolutions or orders of any public authority having jurisdiction require any portion of the Work to be inspected, tested or approved, the Contractor shall give the Owner at least 24 hours notice of its readiness so that the Owner or the A/E or other representatives of the Owner may observe such inspection, testing or approval. The Contractor shall bear all costs of such inspections, tests or approvals conducted by public authorities. Site inspections, tests conducted on site or tests of materials gathered on site, which the Contract requires to be performed by independent testing entities, shall be contracted and paid for by the Contractor. Examples include, but are not limited to, the testing of cast-in-place concrete, foundation materials, soil compaction, pile installations, caisson bearings, and steel framing connections.

7.6.2 All materials and workmanship (if not otherwise designated by the specifications) shall be subject to inspection, examination or test by the Owner, A/E, and other representatives of the Owner, at any and all times during the manufacture and/or construction and at any and all places where such manufacture and/or construction are carried on. Special, full-sized and performance tests shall be as described in the specifications. Without additional charge, the Contractor shall furnish promptly all reasonable facilities, labor and materials necessary to make tests safe and convenient.

7.6.3 The selection of bureaus, laboratories and/or agencies for the inspection and tests of supplies, materials or equipment shall be subject to the approval of the Owner. Satisfactory documentary evidence, including but not limited to certificates of inspection and certified test reports that the material has passed the required inspection and tests must be furnished to the Owner, with a copy to the A/E, by the Contractor prior to the incorporation of the supplies, materials or equipment into the Work or at such times as to allow for appropriate action by the Owner.

7.6.4 Inspection or testing performed exclusively for the Contractor's convenience shall be the sole responsibility of the Contractor. Tests required by Contractor's or Subcontractor's error, omission or non-compliance with the Contract Documents, shall be paid for by the Contractor.

7.6.5 It is specifically understood and agreed that an inspection and approval of the materials by the Owner shall not in any way subject the Owner to pay for the said materials or any portion thereof, even though incorporated in the Work, if said materials shall in fact turn out to be unfit to be used in the Work, nor shall such inspection be considered as any waiver of objection to the Work on account of the unsoundness or imperfection of the material used.

ARTICLE 8 CONTRACT TIME

8.1 DEFINITION

8.1.1 Unless otherwise provided, the Contract Time is the period of time specified in the Contract Documents for Substantial Completion of the Work as defined herein, including authorized adjustments thereto. The Contractor shall complete his Work within the Contract Time.

8.1.2 The date of commencement of the Work is the date established in the Notice to Proceed

The Contractor shall not commence Work or store materials or equipment on site until written Notice to Proceed is issued or until the Contractor otherwise receives the Owner's written consent. The Contractor shall commence work no later than ten (10) days after the date established in the Notice to Proceed.

8.1.3 The date of Substantial Completion of the Work or designated portion thereof is the date determined by Owner when: (1) construction is sufficiently complete, in accordance with the Contract Documents, so the Owner can occupy or utilize the Work or designated portion thereof for the use for which it is intended; and (2) the Contractor has satisfied all other requirements for Substantial Completion which may be set forth in the Contract Documents.

8.1.4 The date of Final Completion of the Work is the date determined by the Owner when the Work is totally complete, to include punch list work, in accordance with the Contract Documents and the Owner may fully occupy and utilize the Work for the use for which it is intended.

8.1.5 The term “day” as used in the Contract Documents shall mean calendar days unless otherwise specifically designated.

8.2 PROGRESS AND COMPLETION

8.2.1 All time limits stated in the Contract Documents, including without limitation the date of Substantial Completion of the Work, are of the essence of the Contract.

8.2.2 The Contractor shall begin the Work on the date of commencement as defined herein. He shall carry the Work forward expeditiously with adequate forces and shall achieve Substantial and Final Completion as required by the Contract Documents.

8.3 CLAIMS FOR TIME EXTENSIONS

8.3.1 The time during which the Contractor is delayed in the performance of the Work by the acts or omissions of the Owner, the A/E or their employees or agents, acts of God, unusually severe and abnormal climatic conditions, s, floods, epidemics, quarantine restrictions, strikes, riots, civil commotion or freight embargoes, or other conditions beyond the Contractor's control and which the Contractor could not reasonably have foreseen and provided against, shall be added to the time for completion of the Work (i.e., the Contract Time) stated in the Agreement; however, no claim by the Contractor for an extension of time for delays will be considered unless made in compliance with the requirements of this Article and other provisions of the Contract Documents.

8.3.2 The Owner shall not be obligated or liable to the Contractor for, and the Contractor hereby expressly waives any claims against the Owner on account of, any indirect or direct damages, costs or expenses of any nature which the Contractor, its Subcontractors, or Sub-subcontractor's or any other person may incur as a result of (1) any delays, reasonable or unreasonable, foreseeable or unforeseeable, which are either not caused by the acts or omissions of the Owner, its agents or employees or which arise from or out of (or due to) causes not within the control of the Owner, its agents or employees, or (2) any reasonable delay regardless of its cause, it being understood and agreed that the Contractor's sole and exclusive remedy in any such events shall be an extension of the Contract Time, but only as determined in accordance with the provisions of the Contract Documents.

8.3.3 The burden of proof to substantiate a claim for an extension of the Contract Time shall rest with the Contractor, including evidence that the cause was beyond his control. It shall be deemed that the Contractor has control over the supply of labor, materials, equipment, methods and techniques of

construction and over the Subcontractors, Sub-contractors, and suppliers, unless otherwise specified in the Contract Documents.

8.3.4 In the event of changes in the Work, the Contractor must identify any additional time required in the Proposed Change Order. The Owner need not consider any time extensions for changes in the Work not included in the Proposed Change Order.

8.3.5 No time extensions will be granted as a result of the Contractor's improper or unreasonable scheduling or for the Contractor's failure to have Shop Drawings, Product Data, Samples or Manuals submitted in ample time for review under a reasonable and agreed upon schedule.

8.3.6 Delays by Subcontractors, Sub-subcontractors or suppliers will not be considered justification for a time extension, except for the same valid reasons and conditions enumerated herein.

8.3.7 The Contractor acknowledges and agrees that actual delays due to changes, suspension of work or excusable delays~~,~~ in activities which, according to the Construction Schedule, do not affect the Contract Time will not be considered to have any effect upon the Contract Time and therefore will not be the basis for a time extension.

8.3.8 The Contractor acknowledges and agrees that time extensions will be granted only to the extent that: (1) excusable delays exceed the available flexibility in the Contractor's schedule; and (2) Contractor can demonstrate that such excusable delay actually caused, or will cause, delay to the Contractor's schedule that will extend the Contract Time.

8.3.9 With respect to Suspensions of Work under Paragraph 3.6, Suspension of Work, herein, the Contractor shall be entitled to an extension of the Contract Time not to exceed the length of time that the Work was suspended (unless as determined under this Article and the other requirements of the Contract Documents that a further extension is justified and warranted) if the claim is submitted in accordance with the requirements of this Article, and if the suspension is not due to any act or omission of the Contractor, any Subcontractor or Sub-subcontractor or any other person or organization for whose acts or omission the Contractor may be liable. The Contractor's claim will be evaluated in accordance with the terms of this Article.

8.3.10 The Contractor shall not be entitled to any extension of time for delays resulting from any conditions or other causes unless it shall have given written Notice to the Owner, within seven (7) calendar days following the commencement of each such condition or cause, describing the occurrence, the activities impacted and the probable duration of the delay. The Contractor's complete claim submittal for a time extension shall be submitted no later than twenty (20) calendar days after cessation of the delay or within such other longer period as the Owner may agree in writing to allow.

8.3.11 No such extension of time shall be deemed a waiver by the Owner of his right to terminate the Contract for abandonment or delay by the Contractor as herein provided or to relieve the Contractor from full responsibility for performance of his obligations hereunder.

8.4 CHANGE ORDER WORK

8.4.1 The Contractor shall make every reasonable effort to perform Change Order work within the Contract Time and in such manner as to have minimum delaying effects on all remaining Work to be performed under the Contract. If, however, the Change Order work results in an unavoidable increase in the time required to complete the Work, an extension of the Contract Time may be granted to the Contractor for the Change Order work. The Contractor's request shall be determined in accordance with the provisions of Article 8.3, Claims for Time Extensions, herein and as follows:

.1 If the time required for performance of the Change Order work has an unavoidable, direct, delaying effect on the primary sequence of Work activities remaining after rescheduling (e.g., the critical path in CPM type scheduling), the overall Contract Time may be extended by the minimum number of days required for the Change Order work as mutually agreed upon by the Owner and the Contractor;

.2 If the time required for performance of the Change Order work does not have an unavoidable direct delaying effect on the primary sequence of Work activities but is ordered by the Owner at a time such that insufficient Contract Time remains for completion of the Change Order work (and any limited number of contingent work activities), the Contract Time may be extended by the minimum number of days required for the Change Order work as mutually agreed upon by the Owner and the Contractor but only for the Change Order work and contingent activities, All other unaffected Work shall be performed within the Contract Time;

.3 Failure of the Owner and the Contractor to agree on a Contract Time extension as specified in .1 and .2 above shall not relieve the Contractor from proceeding with and performing the Change Order work promptly, as well as in such manner as to have minimal delaying effects on all remaining Work to be performed under the Contract. Such disagreement shall be resolved as soon as practical by negotiation.

8.5 LIQUIDATED DAMAGES FOR DELAY

8.5.1 The damages incurred by the Owner due to the Contractor's failure to complete the Work within required Milestone Dates and the Contract Time, including any extensions thereof, shall be in the amount set forth in the Construction Agreement, for each consecutive day beyond the Milestone Dates or the Contract Time (Sundays and all holidays included) for which the Contractor shall fail to complete the Work.

8.5.2 The parties hereby agree that the amount of liquidated damages provided in this Contract is neither a penalty nor a forfeiture and is intended to compensate the Owner solely for the Owner's inability to use the Work for its fully intended purpose, and is not intended to, nor does said amount include: (1) any damages, additional or extended costs~~,~~ incurred by the Owner for extended administration of this Contract, or by the Owner's agents, consultants or independent contractors for extended administration of this Contract, or (2) any additional services, relating to or arising as a result of the delay in the completion of the Work. Owner shall be entitled to claim against Contractor for its actual damages for any damages not specifically included within the liquidated damages as set forth herein. Such damages shall be computed separately, and, together with liquidated damages, either deducted from the Contract Sum or billed to the Contractor, at the option of the Owner.

Contractor agrees that it will not challenge the per diem amounts of liquidated damages imposed pursuant to this Article 8.5 except as to whether Contractor is responsible for the delays, themselves, that have resulted in the assessment of liquidated damages. The Contractor waives any challenge as to the validity of any liquidated damages specified on the grounds that such liquidated damages allegedly are void as penalties or allegedly are not reasonably related to Owner’s actual damages.

Owner may, in its sole discretion, deduct from any payments otherwise due Contractor amounts of liquidated damages assessable under this Article 8.5. Owner’s failure to deduct liquidated damages assessable under this Article 8.5 from payments to Contractor shall not be deemed a waiver by Owner of any entitlement to such liquidated damages.

8.6 TIME EXTENSIONS FOR WEATHER

8.6.1 The Contract Time will not be extended due to inclement weather conditions that are normal to the general locality of Work site. The time for performance of this Contract includes an allowance for

workdays (based on a 5-day workweek) which, according to historical data, may not be suitable for construction work.

.1 The following is the schedule of monthly anticipated normal inclement weather workdays for the Project location and will constitute the base line for monthly weather time extension evaluations.

ANTICIPATED NORMAL INCLEMENT WEATHER WORK-DAYS INCLUDED IN THE CONTRACT TIME OF PERFORMANCE											
JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
7	7	7	7	9	7	7	7	6	6	6	7

8.6.2 The Contractor, in his planning and scheduling of the Work as required by the Contract Documents, shall allow for the normal inclement weather for the locality of the Work site. If the Contractor believes that the progress of the Work has been adversely affected and that it will directly result in a failure to meet Substantial Completion within the Contract Time, by weather conditions above and beyond the amount normally expected, he shall submit a written request to the Owner, with a copy to the A/E, for an extension of time, pursuant to Paragraph 8.3, Claims for Time Extensions.

8.6.3 Such request shall be evaluated by the Owner in accordance with the provisions of the Contract Documents and shall include a comparison of actual weather statistics compiled by City of Lynchburg's Department of Public Works, for the time of year, locality of the particular Work site with the days claimed by the Contractor and the anticipated normal inclement weather as stated in subparagraph 8.6.1. The normal inclement weather expected has been included in the designated Contract Time for completion. The decision of the Owner shall be final.

8.6.4 The Contractor shall not be entitled to any money damages whatsoever for any delays resulting from inclement weather, whether normal or abnormal, foreseeable or unforeseeable. The Contractor and Owner stipulate and agree that, for delays due to weather as determined in 8.6.3, the Contractor's sole relief is a time extension granted in accordance with this Article 8.6, Time Extensions for Weather.

ARTICLE 9 PAYMENTS AND COMPLETION

9.1 CONTRACT SUM

9.1.1 The Contract Sum is stated in the Construction Agreement and, including authorized adjustments thereto, is the total amount payable by the Owner to the Contractor for the performance of the Work under the Contract Documents. The Contract Sum includes, but is not limited to, the Contractor's profit and general overhead and all costs and expenses of any nature whatsoever (including without limitation taxes, labor, equipment and materials), foreseen or unforeseen, and any increases in said costs and expenses, foreseen or unforeseen, incurred by the Contractor in connection with the performance of the Work, all of which costs and expenses shall be borne solely by the Contractor. The Contractor agrees to assume all increases in costs of any nature whatsoever that may develop during the performance of the Work.

9.2 SCHEDULE OF VALUES

9.2.1 For Lump Sum Price contracts, before the pre-construction meeting, the Contractor shall submit to the Owner and A/E a schedule of values allocated to the various portions of the Work, prepared on payment forms provided by the Owner and supported by such data to substantiate its accuracy as the Owner may require. This schedule of values, unless rejected by the Owner, shall be used as a basis for the Contractor's Applications for Payment.

9.2.2 For Unit Price contracts, the Contractor shall utilize the payment request form provided by the Owner, wherein the schedule of values shall correspond with the individual unit price bid items. When so requested by the Owner, the Contractor shall provide a more detailed cost breakdown of the unit price items.

9.2.3 Contractor may include in his schedule of values a line item for "mobilization" which shall include a reasonable amount for mobilization for the Contractor and his Subcontractors. The Contractor shall not front-end load his schedule of values.

9.3 APPLICATION FOR PAYMENT

9.3.1 The Contractor shall submit to the A/E three (3) originally executed, itemized Applications for Payment (and one (1) copy to the Owner) by the tenth of each month, along with any authorized change orders for that billing cycle. The Applications for Payment shall be notarized, indicate in complete detail all labor and material incorporated in the Work during the month prior to submission, and supported by such data substantiating the Contractor's payment request as the Owner may require. The Applications for Payment shall also contain Contractor’s certification that due and payable amounts and bills have been paid by the Contractor for Work for which previous Certificates of Payment were issued and payments received from the Owner.

9.3.2 Payment may be made for the value of materials, which are to be incorporated into the finished Work, and which are delivered to and suitably stored and protected on the Work site. The Contractor shall provide releases or paid invoices from the seller of such materials to establish, to the Owner's satisfaction, that the Owner has title to said material. Stored materials shall be in addition to the Work completed and shall be subject to the same retainage provisions as the completed Work. Material once paid for by the Owner becomes the property of the Owner and may not be removed from the Work site without the Owner's written permission.

9.3.3 The requirements for payment for materials stored off-site shall include, but are not limited to, those specified in Paragraph 9.3.2 and the additional requirements hereinafter specified. Material stored off-site under this provision shall be included in the definition of Work, Article 1, Contract Documents.

9.3.3.1 The requirements of Paragraph 10.2, Safety of Persons and Property, are fully applicable to materials stored off-site.

9.3.3.2 For purposes of administering this provision, the following definitions are provided.

a. Material stored NEAR the Work site: A storage location shall be considered near the Work site if it is not more than fifty (50) miles (approximately a one-hours drive) from the Work site.

b. Material stored DISTANT from the Work site: Locations beyond the limit of fifty (50) miles shall be considered distant.

9.3.3.3 All proposed off-site locations, regardless of whether they are near or distant, shall be approved by the Owner prior to any payment under this Article. The approval process will include an inspection of the proposed storage site, which may or may not coincide with any inspection of materials stored.

9.3.3.4 Prior to payment for any material stored off-site, said material shall be inspected to verify that it is properly stored; i.e., segregated, inventoried, identified as the property of the Owner and Contractor, and duly protected as required in Article 10.2, Safety of Persons and Property. This material shall be clearly identified and physically segregated from any other material or stock, in such a manner that it is clear, from casual observation that said material is not a part of any other stock or stored material.

9.3.3.5 For materials stored distant to the Work site, the Contractor shall reimburse the Owner for all reasonable costs incurred by the Owner, to include but not limited to salary, transportation, lodging and per diem, for the Owner's or the A/E's employees to travel to and from the storage locations for the purpose of verifying that the material is properly stored. It is anticipated that such trips would occur whenever additional material is claimed for payment and/or at least every six (6) months until the material is delivered to the Work site.

9.3.3.6 Except for unusual circumstances, the Contractor will not be required to reimburse the Owner's costs for visits to storage locations near the Work site.

9.3.3.7 The Contractor shall hold the Owner harmless from any and all losses, additional costs, direct or indirect damages and/or delays, whatsoever, which may occur as a result of a failure of the Contractor to deliver (or have delivered), in a timely manner, materials (for which payment has been made) to the Work site for installation and incorporation into the Work.

9.3.3.8 The Contractor shall provide to the Owner a release of lien or other suitable certification by the seller of the materials, in addition to paid invoices, verifying that the Contractor has valid title to all materials for which payment is requested. The seller, however, shall not be required to waive his rights for recovery against Contractor or any surety if his contract is breached.

9.3.4 The Contractor warrants that title to all Work, materials and equipment covered by an Application for Payment will pass to the Owner, either by incorporation in the construction or upon the receipt of payment by the Contractor, whichever occurs first, free and clear of all liens, claims, security interests or encumbrances, hereinafter referred to as "liens". The Contractor further warrants that no Work, materials or equipment covered by an Application for Payment will have been acquired by the Contractor or by any other person performing Work at the site or furnishing materials and equipment for the Work that is subject to an agreement under which an interest therein or an encumbrance thereon is retained by the seller or otherwise imposed by the Contractor or such other person.

9.3.5 The Contractor's Application for Payment shall provide that the payment request attests that all Work for which the request is made has been completed in full according to all the requirements of the Contract Documents. By submitting his Application for Payment, the Contractor also represents that he has no knowledge that any Subcontractors or suppliers have not been fully and timely paid and that, insofar as he knows, the only outstanding items for payment with respect to the Contract are those to be paid from the funds for which application is being made.

9.4 CERTIFICATES FOR PAYMENT

9.4.1 The A/E will, within seven (7) calendar days after the receipt of the Contractor's Application for Payment, recommend a Certificate for Payment to the Owner, for such amount as the A/E determines is properly due, with his reasons for any withholding or adjusting a Certificate as provided in Paragraph 9.6, Payments Withheld.

9.4.2 After the Certificate for Payment is recommended by the A/E, the Owner will review it and make any changes deemed necessary by the Owner's representative. The recommendation of the Certificate for Payment by the A/E does not waive or limit the Owner's right to reduce the amount of the payment due to the Contractor as determined to be appropriate by the Owner.

9.4.3 The recommendation of a Certificate for Payment will constitute a representation by the A/E to the Owner, based on his observations at the site as provided in Article 2, Architect/Engineer, and the data comprising the Application for Payment, that the Work has progressed to the point indicated; that, to the best of his knowledge, information and belief: (1) the quality of the Work is in accordance with the

Contract Documents (subject to an evaluation of the Work for conformance with the Contract Documents upon Substantial or Final Completion, to the results of any subsequent tests required by or performed under the Contract Documents, to minor deviations from the Contract Documents correctable prior to completion, and to any specific qualifications stated in his Certificate); and that (2) the Contractor is entitled to payment in the amount certified. However, by recommending a Certificate for Payment, the A/E shall not thereby be deemed to represent that he has made exhaustive or continuous on-site inspections to check the quality or quantity of the Work or that he has reviewed the construction means, methods, techniques, sequences or procedures, or that he has made any examination to ascertain how or for what purpose the Contractor has used the moneys previously paid on account of the Contract Sum.

9.4.3.1.1 The Application for Payment shall be on a form approved by the City. Payment for stored material delivered but not incorporated in the work will be the invoiced amount only. Stored materials drawdown shall be approved by the Owner. Submit applicable invoices with Application for Payment. Monthly partial payment request shall be submitted in **TRIPLICATE** to Owner's representative for approval by the 25th of the month so that the Owner can approve payment request by the first working day of the next month. Partial payments shall be made on a monthly basis on or before the end of the next month for which the Work was performed, in accordance with the Contract Documents.

9.4.3.1.2 The Owner shall pay to the Contractor 95 percent of the total amount due and the Owner shall retain five (5) percent of the amount due until all work has been performed strictly in accordance with the Contract Documents and until such work has been accepted by the Owner.

9.5.1 The Owner shall make payment in the manner and within thirty (30) calendar days after receipt of the Certificate of Payment from the A/E based upon the Owner's approval or adjustment of said Certificate. The Contractor shall be paid the amount approved or adjusted by the Owner, less 5% retainage which is being held to assure faithful performance; provided however, that said retainage is not applicable to Time and Material Change Orders.

9.5.1.1 In relation to punch list or other uncompleted Work and in lieu of a portion of the above-specified five-percent 5% retainage, the Owner may, at its sole discretion, elect to retain fixed amounts directly relating to the various items of uncompleted Work. All amounts withheld shall be included in the Final Payment.

9.5.2 The Contractor shall, within seven (7) days after receiving payment from the Owner, do one of the following:

9.5.2.1 Pay all Subcontractors for the proportionate share of the total payment received from the Owner for Work performed by each Subcontractor under the Contract; or

9.5.2.2 Notify the Owner and Subcontractor(s), in writing, of his intention to withhold all or part of the Subcontractor's payment with the reason for nonpayment.

9.5.3 The Contractor shall make payment to Subcontractors as heretofore specified. Each payment shall reflect the percentage actually retained, if any, from payments to the Contractor on account of such Subcontractor's Work.

9.5.4 The Contractor shall provide the Owner with his social security number, if an individual, or his federal identification number, if a corporation, partnership, or other entity.

9.5.5 The Contractor shall pay unpaid Subcontractors interest on payments that are not made in accordance with this Article 9.5, Progress Payments. The rate of interest shall be in compliance with the Prompt

Payment section of the Virginia Public Procurement Act of the Code of Virginia. The Contractor shall, by an appropriate agreement with each Subcontractor, require each Subcontractor to make payments to his Sub-subcontractors according to all the same requirements as provided in this Article 9.5 Progress Payments.

9.5.6 The Owner may, upon written request, furnish to any Subcontractor, if practicable, information regarding the percentages of completion or the amounts applied for by the Contractor and the action taken thereon by the Owner on account of Work done by such Subcontractor.

9.5.7 Neither the Owner nor the A/E shall have any obligation to pay or to see to the payment of any monies to any Subcontractor except as may otherwise be required by law.

9.5.8 No Certificate for Payment, nor any payment, nor any partial or entire use or occupancy of the Project by the Owner, shall constitute an acceptance of any Work not in accordance with the Contract Documents, nor shall it waive any right or claim by Owner based upon the Work, or any portion of the Work, including Work for which payment has been made, not conforming to the requirements of the Contract Documents.

9.6 PAYMENTS WITHHELD

9.6.1 The Owner may withhold the payment in whole or in part, if necessary to reasonably protect the Owner. If the A/E is unable to make representations as provided in subparagraph 9.4.3 and to recommend payment in the amount of the application, he will notify the Owner as provided in subparagraph 9.4.1. If the Contractor and the Owner cannot agree on a revised amount, the Owner will promptly issue a Certificate for Payment for the amount for which he is able to make representations with respect to payment, due for Work performed. The Owner may also decline to certify or make payment because of subsequently discovered evidence or subsequent observations, and the Owner may nullify the whole or any part of any Certificate for Payment previously issued.

9.6.2 The Owner may withhold from the Contractor so much of any payment approved by the A/E, as may in the judgment of the Owner be necessary:

.1 To protect the Owner from loss due to defective work not remedied;

.2 To protect the Owner upon receipt of notice of the filing in court or in an arbitration proceeding as may be required in any third party contract, of verified claims of any persons supplying labor or materials for the Work, or other verified third party claims;

.3 To protect the Owner upon reasonable evidence that the Work will not be completed for the unpaid balance of the Contract Sum;

.4 To protect the Owner upon reasonable evidence that the Work will not be completed within the Contract Time established by this Contract; or

.5 To protect the Owner upon the Contractor's failure to properly schedule and coordinate the Work in accordance with or as required by the Contract Documents, or failure to provide progress charts, revisions, updates or other scheduling data as required by the Contract Documents, or upon the Contractor's failure to provide as-built drawings as required herein, or upon Contractor's failure to otherwise substantially or materially comply with the Contract Documents.

9.6.3 If required by the Contract Documents, the Contractor shall, concurrent with his submission of the Construction Schedule, submit a practicable and realistic payment schedule showing the dates on which the Contractor will submit each and every Application for Payment and the amount he expects to receive

for each and every monthly progress payment. If during the performance of the Work, the Contractor expects to receive an amount for a monthly progress payment larger than that indicated on the payment schedule, the Contractor shall notify the Owner at least thirty (30) days in advance of that payment so that the necessary allocation of funds can be processed. If Contractor fails to submit a practicable and realistic payment schedule, the Contractor's Application for Payment shall be honored only to the extent that the Work is actually performed and that the proportion of payments made to the Contract Sum does not exceed the proportion of the Contract Time expired as of the time of the request.

9.7 FAILURE OF PAYMENT

If the Owner does not make payment to the Contractor within the thirty (30) calendar days after receipt of the Contractor's Application for Payment by the A/E through no fault of Contractor, and the Owner otherwise not being entitled under the Contract Documents or applicable law to withhold payment, then the Contractor may, upon fifteen (15) additional days' written Notice to the Owner and the A/E, stop the Work until payment of the amount owing has been received. In such event, the Contract Sum shall be increased by the amount of the Contractor's reasonable costs of shutdown, delay and start-up, which shall be effected by appropriate Change Order as provided herein.

9.8 SUBSTANTIAL COMPLETION AND GUARANTEE BOND

9.8.1 Unless otherwise specified in Article 9.9, Final Completion and Final Payment, when the Contractor considers that the Work, or a designated portion thereof which is acceptable to the Owner, is substantially complete as defined in Article 8, Contract Time, the Contractor shall request in writing that the A/E and the Owner perform a Substantial Completion inspection. Prior to such inspection the Contractor shall:

.1 If applicable, secure a Certificate of Occupancy for the Project or a designated portion thereof; and

.2 Submit five (5) copies each of the Operations and Maintenance Manuals to the A/E as specified and one (1) copy to the Owner.

9.8.2 The Owner shall determine whether the Work is substantially complete and shall compile a punch list of items to be completed or corrected. The failure to include any items on such list does not alter the responsibility of the Contractor to complete all Work in accordance with the Contract Documents.

9.8.3 When the Owner on the basis of his inspection determines that the Work or a designated portion thereof is substantially complete, the A/E will then prepare a Certificate of Substantial Completion which shall establish the Date of Substantial Completion and shall state the responsibilities of the Owner and the Contractor for security, maintenance, heat, utilities, damage to the Work and insurance. The Certificate of Substantial Completion shall be submitted to the Owner and the Contractor for their written acceptance of the responsibilities assigned to them in such Certificate.

9.8.4 The Contractor shall have thirty (30) days from the Date of Substantial Completion to complete all items on the punch list to the satisfaction of the Owner. If the Contractor fails to complete all punch list items within the designated time, the Owner shall have the option to correct or conclude any remaining items by utilizing its own forces or by hiring others. The cost of such correction of remaining punch list items by the Owner or others shall be deducted from the final payment to the Contractor, and if the Owner has not retained sufficient funds to cover the cost, Contractor or its surety shall pay the difference within 30 days of a written demand by the Owner to do so.

9.8.5 Guarantees and warranties required by the Contract Documents shall commence on the Date of Final Completion of the Work, unless otherwise provided in the Certificate of Substantial or Final Completion, or the Contract Documents. Provided, however, that if Contractor does not complete certain punch list

items within the time period~~,~~ specified in 9.8.4, all warranties and guarantees for such incomplete Punch List items shall become effective upon issuance of final payment for the Work.

9.8.5.1 The Contractor shall guarantee for a term of one (1) year from the date of Final Completion or Final Payment, whichever comes later, (unless otherwise provided for in the Certificate(s) of Substantial or Final Completion or the Contract Documents): (1) the quality and stability of all materials equipment and Work; (2) all the Work against defects in materials, equipment or workmanship; and (3) all shrinkage, settlement or other faults of any kind which are attributable to defective materials or workmanship. The Contractor shall remedy at his own expense, when so notified in writing to do so by the Owner, and to the satisfaction of the Owner, the Work or any part thereof that does not conform to any of the warranties and guaranties described in the Contract Documents~~.~~ or that otherwise does not conform to the requirements of the Contract Documents

9.8.5.2 In order to make good the guarantee as herein required, the Contractor shall deposit with the Owner, after Substantial Completion but before Final Payment, a Guarantee Bond(s) issued by a surety licensed to do business in Virginia and otherwise acceptable to the Owner, for the faithful performance of the guarantee. Said Bond(s) shall be for a period of one (1) year from the date the guaranties and warranties commence and in the amount of five percent (5%) of the final gross value of the Contract.

9.8.5.3 The Contractor shall complete repairs during the guarantee period~~,~~ within five (5) working days after the receipt of Notice from the Owner, and if the Contractor shall fail to complete such repairs within the said five (5) working days, the Owner may employ such other person or persons as it may deem proper to make such repairs and pay the expenses thereof out of any sum retained by it, provided nothing herein contained shall limit the liability of the Contractor or his surety to the Owner for non-performance of the Contractor's obligations at any time.

9.8.6 The issuance of the Certificate of Substantial Completion does not indicate final acceptance of the Work by the Owner, and the Contractor is not relieved of any responsibility for the Work except as specifically stated in the Certificate of Substantial Completion.

9.8.7 Upon Substantial Completion of the Work, or designated portion thereof, and upon application by the Contractor and certification by the A/E, the Owner shall make payment, adjusted for retainage and payments withheld, if any, for such Work or portion thereof, as provided in the Contract Documents.

9.8.8 Should the Owner determine that the Work or a designated portion thereof is not substantially complete, he shall provide the Contractor a written Notice stating why the Work or designated portion is not substantially complete. The Contractor shall expeditiously complete the Work and shall re-request in writing that the Owner perform a Substantial Completion inspection.

9.9 FINAL COMPLETION AND FINAL PAYMENT

9.9.1 A Certificate of Final Completion shall be issued by the A/E prior to final payment. At the Owner's sole option, this Final Completion Certificate may be issued without a Certificate of Substantial Completion. The Contractor, prior to application for Final Payment and within the time specified for completion of the Work, shall complete all Work, to include punch list items and provide operation and maintenance manuals and as-built data, for the Work, as completed and in place. Said Certificate of Final Completion shall be issued, even if a Certificate of Substantial Completion has been issued previously and temporary authority to operate the Work has been granted.

9.9.1.1 The Certificate of Final Completion shall certify that all Work has been completed in accordance with Contract Documents and is ready for use by the Owner.

9.9.2 For all projects where Substantial Completion Certificates have been issued for various portions of the Work, at differing times, the Contractor shall request and the Owner shall, prior to final payment, issue a Certificate of Final Completion which certifies that all required Work, including punch list items, has been completed in accordance with the Contract Documents.

9.9.3 Neither the final payment nor any remaining retainage shall become due until the Contractor submits to the A/E the following:

.1 An Application for Payment for all remaining monies due under the -Contract.

.2 Consent of surety to final payment;

.3 If required by the Owner, other data establishing payment or satisfaction of all such obligations, such as receipts, releases and waivers of claims arising out of the Contract, to the extent and in such form as may be designated by the Owner. If any Subcontractor refuses to furnish waiver of claims satisfactory to the Owner, the Contractor may furnish a bond satisfactory to the Owner to indemnify Owner against any such claim. If any such claim remains unsatisfied after all payments are made, the Contractor shall refund to the Owner all monies that the latter may be compelled to pay in discharging such claim, including all costs and reasonable attorneys' fees;

.4 As-built drawings, operation and maintenance manuals and other project closeout submittals, as required by the Contract Documents;

.5 Construction releases as required by the Contract Documents from each property owner on whose property an easement for construction of the Work has been obtained by the Owner, such release to be in the forms to be provided by the Owner. This release is for the purpose of releasing the Owner and the Contractor from liability, claims, and damages arising from construction operations on or adjacent to the easement and includes proper restoration of the property after construction. It shall be the Contractor's sole responsibility to obtain all such releases and furnish them to the Owner; and

.6 A written certification that:

.1 The Contractor has reviewed the requirements of the Contract Documents,

.2 The Work has been inspected by the Contractor for compliance with all requirements of the Contract Documents,

.3 Pursuant to this inspection, the Contractor certifies and represents that the Work complies in all respects with the requirements of the Contract Documents,

.4 The Contractor further certifies and represents that all equipment and systems have been installed in accordance with the Contract Documents and have been tested in accordance with specification requirements and are operational, and

.5 The Contractor hereby certifies and represents that the Work is complete in all respects and ready for final inspection.

9.9.4 Upon receipt of the documents required in subparagraph 9.9.3 and upon receipt of a final Application for Payment, the A/E and Owner will promptly make a final inspection. When the A/E finds the Work

acceptable under the Contract Documents and the Contract fully performed, he will issue within seven (7) days a final Certificate for Payment and a Final Certificate of Completion.

The Certificate of Completion will state that to the best of his knowledge, information and belief, and on the basis of his observations and inspections, the Work has been completed in accordance with the terms and conditions of the Contract Documents and that the entire balance designated in the final Certificate for Payment is due and payable. The final Certificate for Payment will constitute a further representation that the conditions precedent to the Contractor's being entitled to final payment as set forth in Subparagraph 9.9.3 have been fulfilled. The Owner shall review the Certificate of Payment and shall accept it and issue final acceptance, or reject it and notify the Contractor, within ten (10) days. Final payment to the Contractor shall be made within thirty (30) days after final acceptance. All prior estimates and payments, including those relating to Change Order work, shall be subject to correction by this final payment.

9.9.5 The making of Final Payment shall constitute a waiver of all claims by the Owner, except those arising from:

.1 Unsettled claims;

.2 Faulty, defective, or non-conforming Work discovered or appearing after Substantial or Final Completion;

.3 Failure of the Work to comply with the requirements of the Contract Documents;

.4 Terms of any warranties or guarantees required by the Contract Documents; or

.5 Fraud or bad faith committed by the Contractor or any subcontractor or supplier during performance of Work but discovered by Owner after Final Payment.

9.9.6 The acceptance of Final Payment shall constitute a waiver of all claims by the Contractor, except those previously made in writing and so identified by the Contractor~~,~~ as unsettled at the time of the final Application for Payment. No payment, however, final or otherwise, shall operate to release the Contractor or his sureties from any obligations under this Contract or the Performance, Payment, or Guarantee Bonds.

ARTICLE l0 PROTECTION OF PERSONS AND PROPERTY

10.1 SAFETY PRECAUTIONS AND PROGRAMS

10.1.1 The Contractor shall be responsible for initiating, maintaining and supervising all safety precautions and programs in connection with the Work. The requirement applies continuously throughout the Contract performance, until Final Payment is made, and is not limited to regular working hours.

10.2 SAFETY OF PERSONS AND PROPERTY

10.2.1 The Contractor shall take all reasonable precautions for the safety of, and shall provide all reasonable protection to prevent damage, injury or loss to:

.1 All persons performing any of the Work and all other persons who may be affected thereby;

.2 All the Work and all materials and equipment to be incorporated therein, whether in storage on or off the site, under the care, custody or control of the Contractor or any of his Subcontractors or Sub-subcontractor's. Machinery, equipment and all hazards shall be guarded or eliminated in

accordance with the safety provisions of the Manual of Accident Prevention in Construction published by the Associated General Contractors of America, to the extent that such provisions are not in contravention of applicable law; and

.3 Other property at the site or adjacent thereto, including trees, shrubs, lawns, walks, pavements, roadways, structures and utilities not designated for removal, relocation or replacement in the course of construction.

10.2.2 The Contractor shall give all notices and comply with all applicable laws, ordinances, codes, rules, regulations, permits, resolutions and lawful orders of any public authority bearing on the safety of persons or property or their protection from damage, injury or loss.

The Contractor shall at all times safely guard the Owner's property from injury or losses in connection with the Contract. Contractor shall at all times safely guard and protect his Work and adjacent property as provided by law and the Contract Documents, from damage. All passageways, guard fences, lights and other facilities required for protection by local authorities or local conditions must be provided and maintained without additional cost to the Owner.

10.2.3 The Contractor shall erect and maintain, as required by existing conditions and progress of the Work, all reasonable safeguards for safety and protection, including posting danger signs and other warnings against hazards, promulgating safety regulations and notifying owners and users of adjacent utilities.

10.2.4 When the use or storage of explosives or other hazardous materials or equipment is necessary for the execution of the Work, the Contractor shall exercise the utmost care and shall carry on such activities under the supervision of properly qualified personnel.

10.2.5 The Contractor is responsible for the proper packing, shipping, handling and storage (including but not limited to shipment or storage at the proper temperature and humidity) of materials and equipment to be incorporated in the Work, so as to insure the preservation of the quality and fitness of the materials and equipment for proper installation and incorporation in the Work, as required by the Contract Documents.

For example, but not by way of limitation, Contractor shall, when necessary, place material and equipment on wooden platforms or other hard and clean surfaces and not on the ground and/or place such material and equipment under cover or in any appropriate shelter or facility. Stored materials or equipment shall be located so as to facilitate proper inspection. Material and equipment that is delivered crated shall remain crated until ready for installation. Lawns, grass plots or other private property shall not be used for storage purposes without the written permission of the owner or lessee unless otherwise within the terms of the easements obtained by the Owner.

10.2.6 In the event of any indirect or direct damage to public or private property referred to in Paragraphs 10.2.1.2 and 10.2.1.3, caused in whole or in part by an act, omission or negligence on the part of the Contractor, any Subcontractor, any Sub-subcontractor, or anyone directly or indirectly employed by any of them or by anyone for whose acts any of them may be liable, the Contractor shall at his own expense and cost promptly remedy and restore such property to a condition equal to or better than existing before such damage was done. The Contractor shall perform such restoration by underpinning, replacing, repairing, rebuilding, replanting, or otherwise restoring as may be required or directed by the Owner, or shall make good such damage in a satisfactory and acceptable manner. In case of failure on the part of the Contractor to promptly restore such property or make good such damage, the Owner may, upon two (2) calendar days written Notice, proceed to repair, replace, rebuild or otherwise restore such property as may be necessary and the cost thereof, or a sum sufficient in the judgment of the Owner to reimburse the owners of property so damaged, will be deducted from any monies due or to become due the Contractor under the Contract. If insufficient monies remain due or will become due to pay such sum, Contractor or

its surety shall, within 30 days of receipt of a written demand from Owner to do so, pay Owner such sum.

10.2.7 The Contractor shall designate a responsible member of his organization at the site whose duty shall be the prevention of accidents and the protection of material, equipment and other property. This person shall be the Contractor's superintendent unless otherwise designated by the Contractor in writing to the Owner.

10.2.8 The Contractor shall not load or permit any part of the Work to be loaded so as to endanger the safety of any portion of the Work.

10.2.9 The Contractor shall give notice in writing at least forty-eight (48) hours before breaking ground, to all persons, Public Utility Companies, owners of property having structures or improvements in proximity to site of the Work, superintendents, inspectors, or those otherwise in charge of property, streets, water pipes, gas pipes, sewer pipes, telephone cables, electric cables, railroads or otherwise, who may be affected by the Contractor's operation, in order that they may remove any obstruction for which they are responsible and have representative(s) on site to see that their property is properly protected. Such notice does not relieve the Contractor of responsibility for any damages and claims. Nor does such notice relieve the Contractor from his responsibility to defend and indemnify the Owner from actions resulting from the Contractor’s performance of such work in connection with or arising out of the Contract.

10.2.10 The Contractor shall protect all utilities encountered while performing its work, whether indicated on the Contract Drawings or not. The Contractor shall maintain utilities in service until moved or abandoned. The Contractor shall exercise due care when excavating around utilities and shall restore any damaged utilities to the same condition or better as existed prior to starting the Work, at no cost to the Owner. The Contractor shall maintain operating utilities or other services, even if they are shown to be abandoned on the drawings, in service until new facilities are provided, tested and ready for use.

10.2.11 The Contractor shall return all improvements on or about the site and adjacent property which are not shown to be altered, removed or otherwise changed to conditions which existed prior to starting the Work.

10.2.12 The Contractor shall protect the Work, including but not limited to, the site, stored materials and equipment, excavations, and excavated or stockpiled soil or other material, intended for use in the Work, and shall take all necessary precautions to prevent or minimize damage to same and to prevent detrimental effect upon his performance or that of his Subcontractors, caused by or due to rain, snow, ice, run-off, floods, temperature, wind, dust, sand and flying debris. For example, but not by way of limitation, Contractor shall, when necessary, utilize temporary dikes, channels or pumping to carry-off, divert or drain water, and shall as necessary tie-down or otherwise secure the Work and employ appropriate covers and screens.

10.3 OBLIGATION OF CONTRACTOR TO ACT IN AN EMERGENCY

10.3.1 In case of an emergency that threatens immediate loss or damage to property and/or safety of life, the Contractor shall act to prevent threatened loss, damage, injury or death. The Contractor shall notify the Owner of the situation and all actions taken immediately thereafter. If the Contractor fails to act and any loss, damage, injury or death occurs that could have been prevented by the Contractor's prompt and immediate action, the Contractor shall be fully liable to the Owner or any other party for all costs, damages, claims, actions, suits, costs of defense, and all other expenses arising therefrom or relating thereto.

10.3.2 Prior to commencing the Work and at all times during the performance of the Work, the Contractor shall provide the Owner two, twenty-four hour (24) emergency phone numbers where his representatives can be contacted at any time.

ARTICLE 11 INSURANCE FOR CONTRACTS

11.1 CONTRACTOR'S INSURANCE

11.1.1 During the term of this Contract, the Contractor shall procure and maintain insurance coverages with insurance companies rated by A. M. Best Company as A – VIII or better. The company(is) shall be authorized to do business under the laws of the Commonwealth of Virginia and be acceptable to the City of Lynchburg and shall provide the following minimum types of insurance:

a. **Commercial General Liability Insurance** – This will cover claims for Bodily Injury, Property Damage, Personal and Advertising Injury, Products and Completed Operations, which may arise from operations under the Contract, whether such operations be performed by the Contractor or by any Subcontractor or Independent Contractor, or by anyone directly or indirectly employed by any of them. Such insurance shall include coverages "X", "C" and "U" for explosion, collapse of other structures and underground utilities, as well as Contractual Liability Insurance covering the requirements outlined in the General Conditions. This insurance shall name the City, the City Council and its employees as additional insureds ***by endorsement*** to the Commercial General Liability policy. Such policy shall not have a restriction on the limits of coverage provided to the City of Lynchburg as an additional insured. The City of Lynchburg shall be entitled to protection up to the full limits of the Contractor's policy regardless of the minimum requirements specified in this Contract. If endorsements to the Commercial General Liability insurance policies cannot be made, then separate policies providing such protection shall be purchased by the Contractor.

1. The Policy shall have the following ***minimum*** limits:

$1,000,000 Each Occurrence Limit
$1,000,000 General Aggregate Limit
$1,000,000 Personal and Advertising Injury Limit
$1,000,000 Products and Completed Operations Aggregate Limit
$5,000 Medical Expense Limit

This insurance shall include the following provisions and /or endorsements:

1) The General Aggregate limit shall apply on a "per project" and on a "per location" basis;
2) Coverage shall apply to all liability arising from all premises and operations conducted by the Contractor, Subcontractors and independent contractors;
3) The Contractor agrees that liability arising from Products and Completed Operations will be covered. Such liability coverage will be maintained for two years after completion of the Work.
4) The Contractor shall require each of his Subcontractors to procure and maintain Commercial General Liability Insurance of the type specified in these Contract Documents in the minimum amounts required by the Owner and the Contractor (which shall be the amounts required by this paragraph 11.1.1. of Contractor unless otherwise agreed in writing by Owner), during the term of their subcontracts.

b. **Worker's Compensation and Employer's Liability Insurance** for the Contractor's employees engaged in the Work under this Contract, in accordance with statutory requirements of the Commonwealth of Virginia. The Contractor shall require each of his

Subcontractors to provide Worker's Compensation and Employer's Liability Insurance for all of the Subcontractor's employees engaged on such subcontracts. If any class of employees engaged on Work under the Contract is not protected under the Worker's Compensation statute, the Contractor shall provide similar protection for these employees in amounts not less than the legal requirements. The amount of Employer's Liability Insurance for the Contractor and each of his Subcontractors shall be not less than:

$100,000 per employee for Bodily Injury.
$100,000 per employee for disease
$500,000 per policy for disease

The Worker's Compensation and Employer's Liability Insurance policy shall include an "all states" or "other states" endorsement.

c. **Commercial Automobile Liability Insurance**, including coverage for owned, hired, non owned and borrowed vehicles used in the work with ***minimum*** limits of $1,000,000 Combined Single Limit per occurrence. This insurance shall name the City, the City Council and its employees as additional insureds ***by endorsement*** to the Commercial Automobile Liability policy. Such policy shall not have a restriction on the limits of coverage provided to the City of Lynchburg as an additional insured. The City of Lynchburg shall be entitled to protection up to the full limits of the Contractor's policy regardless of the minimum requirements specified in this Contract.

d. **Umbrella Liability or Excess Liability** Insurance with the following minimum limits of:

$5,000,000 Each Occurrence
$5,000,000 Annual Aggregate

The following policies shall be scheduled as underlying policies:

Commercial General Liability
Commercial Automobile Liability
Employers Liability

This insurance shall name the City, the City Council and its employees as additional insureds ***by endorsement*** to the Umbrella or Excess Liability policy. Such policy shall not have a restriction on the limits of coverage provided to the City of Lynchburg as an additional insured. The City of Lynchburg shall be entitled to protection up to the full limits of the Contractor's policy regardless of the minimum requirements specified in this Contract.

11.1.2 Proof of insurance for each type of coverage listed herein shall be provided within 10 days after issuance of the award letter for the Contract, and no Work shall proceed unless all such insurance is in effect. The Contractor shall not allow any Subcontractor to commence work on his subcontract until all such insurance of the Subcontractor has been so obtained and approved by the Contractor and found to be in accordance with the requirements set forth herein. The Contractor certifies by commencement of the Work that his insurance and that of Subcontractors is in effect and meets the requirements set forth herein.

11.1.3 The Contractor shall purchase and maintain required liability and all other insurance as is appropriate for the Work being performed and furnished. The insurance shall provide protection from claims which may arise out of or result from Contractor's performance and furnishing of the Work and Contractor's other obligations under the Contract Documents, whether it is to be performed or furnished by Contractor, any Subcontractor or Supplier, or by anyone directly or indirectly employed by any of them to perform or furnish any of the Work, or by anyone for whose acts any of them may be liable:

a. claims under Worker's Compensation, Employers Liability, disability benefits, and other similar employee benefit acts;

b. claims for damages because of bodily injury, occupational sickness or disease, or death of Contractor's employees;

c. claims for damages because of bodily injury, sickness or disease, or death of any person other than Contractor's employees;

d. claims for damages insured by personal injury liability coverage which are sustained: (1) by any person as a result of an offense directly or indirectly related to the employment of such person by Contractor; or (2) by any other person for any other reason;

e. claims for damages, other than to the Work itself, because of injury to or destruction of tangible property wherever located, including loss of use resulting therefrom; and

f. claims for damages because of bodily injury or death of any person or property damage arising out of the ownership, maintenance, or use of any motor vehicle.

11.1.4 The insurance required to be purchased and maintained by the Contractor shall:

a. include completed operations insurance;

b. with respect to any other insurance coverage written on a claims-made basis, remain in effect for at least 2 years after final payment (and Contractor shall furnish the City and A/E evidence satisfactory to the City of continuation of such insurance at final payment and 1 year thereafter);

c. contain a cross liability or severability of interest clause or endorsement. Insurance covering the specified additional insureds shall be primary insurance, and all other insurance carried by the additional insureds shall be excess insurance.

11.1.5 All of the aforesaid insurance policies must be endorsed to provide that the insurance company ***shall give 30 days written notice to the City*** if the policies are to be terminated or if any changes are made during the Contract period which will affect in any way the insurance provided pursuant to such policy. Before starting the Work, the Contractor shall provide the City with a copy of each policy that he and each of his Subcontractors is required to carry in accordance with this Article 11, together with receipted bills evidencing proof of premium payment. These policies shall contain endorsements to the policies naming the City of Lynchburg as an additional insured as required.

11.1.6 Nothing contained herein shall effect, or shall be deemed to affect, a waiver of the City's sovereign immunity under law.

ARTICLE 12 CHANGES AND MODIFICATIONS IN THE WORK

12.1 CHANGES IN THE WORK

12.1.1 The Owner, without invalidating the Contract and without notice to the surety, may order a change to the Work consisting of additions, deletions or other revisions to the general scope of the Contract, or changes in the sequence of the performance of the Work. The Contract Sum and the Contract Time shall be adjusted accordingly. All such changes in the Work shall be authorized by Change Order,

Modification, or Change Directive, and all Work involved in a change shall be performed in accordance with the terms and conditions of the Contract Documents. If the Contractor should proceed with a change in the Work upon an oral order, by whomsoever given, it shall constitute a waiver by the Contractor of any claim for an increase in the Contract Sum and/or Contract Time, on account thereof.

12.2 FIELD ORDER

12.2.1 A Field Order is a written order to the Contractor signed by the Owner's designated representative, interpreting or clarifying the Contract Documents or directing the Contractor to perform minor changes in the Work. Any work relating to the issuance of a Field Order shall be performed promptly and expeditiously and without additional cost to the Owner and within the Contract Time, unless the Contractor submits a Proposed Change Order, defined below, which is approved by the Owner. Field Orders shall be numbered consecutively by date of issuance by the Owner.

12.3 OWNER CHANGE REQUEST

12.3.1 An Owner Change Request is a written request from the Owner to the Contractor that describes a proposed change in the Work. The Contractor is required to submit a complete proposal for the total cost and additional time, if any, necessary to perform the proposed change in the Work. Owner Change Requests shall be numbered consecutively by date of issuance by the Owner.

12.4 CONTRACTOR'S PROPOSED CHANGE ORDER

12.4.1 A Contractor's Proposed Change Order is a written request from the Contractor to the Owner requesting a change in the Contract Sum and/or Contract Time. A Contractor's Proposed Change Order is submitted as a proposal in response to a Owner Change Request or as a claim for an increase in the Contract Sum or Contract Time pursuant to the issuance of a Field Order, or as a result of unforeseen circumstances, such as an unknown site conditions.

Change Orders for unforeseen site conditions will only be entertained if the Contractor has not accepted responsibility for the unforeseen site conditions pursuant to other provisions in the Contract Documents. A Contractor's Proposed Change Order must be submitted within twenty (20) calendar days of the issuance of a Owner Change Request or a Field Order or the discovery of an unforeseen circumstance. The Contractor shall not be entitled to any adjustment to the Contract Time or Contract Sum if Contractor fails to comply strictly with the requirements of the preceding sentence. Contractor's Proposed Change Orders shall be numbered consecutively by date of issuance by the Contractor. The Contractor shall also indicate on the Proposed Change Order the number of the Owner Change Request or the Field Order to which it responds. The Contractor understands and agrees to the City's provisions and policy regarding Change Orders as outlined in Article 1, section 1.1.2 of these General Conditions.

12.4.2 In the case of unit price items, it is understood and agreed by the Contractor that the estimates of the quantities in unit price items are approximate only and are presented solely for the purpose of comparing bids and may not represent the actual amount of work to be performed. The Contractor, therefore, understands and agrees that the Owner reserves the right to increase, decrease or eliminate entirely the quantity of work to be done under any item. If called upon to do more work under any unit price item named in the Bid Documents, he will perform all such additional work and accept as payment the unit price named in the proposal, subject to the 20% deviation limitations specified in subparagraph 12.4.2.2.

12.4.2.1 The Contractor's Proposed Change Order shall be determined by applicable unit prices, if any, as set forth in the Contract.

12.4.2.2 However, if changes in quantities are of an item increase the actual work to more than twenty percent (20%) of the original bid quantity for that item, or decrease quantities of that item more than 20% of the original bid quantity for that item, then the Owner or the Contractor shall have the right to request a decrease or an increase in the unit price for the item for quantities greater than 120% or less than 80% of the original bid quantity for that item.

12.4.2.3 It shall be understood that such unit prices shall constitute full payment for the extra work performed, including, but not limited to, “general conditions” costs, plant, materials, labor, equipment, overhead, profit, and safety requirements.

12.4.3 If no such unit prices are set forth, the Contractor's proposal shall be on a lump sum basis and shall be itemized and segregated by labor, equipment, and materials for the various components of the change in the Work (no aggregate labor total will be acceptable) and shall be accompanied by signed proposals of any Subcontractors who will perform any portion of the change in the Work and of any persons who will furnish materials or equipment for incorporation therein.

12.4.3.1 The portion of the proposal relating to labor, whether by the Contractor's forces or the forces of any of its Subcontractors, may include reasonably anticipated gross wages of job site labor, including foremen, who will be directly involved in the change in the Work (for such time as they will be so involved), plus separately identified payroll costs (including premium costs of overtime labor, if overtime is authorized, Social Security, Federal or State unemployment insurance taxes and fringe benefits required by collective bargaining agreements entered into by the Contractor or any such Subcontractor in connection with such labor).

12.4.3.2 The portion of the proposal relating to materials may include the reasonably anticipated direct costs to the Contractor or to any of its Subcontractors of materials to be purchased for incorporation in the change in the Work, plus transportation and applicable sales or use taxes.

12.4.3.3 The proposal may further include the Contractor's and any of his Subcontractor's reasonably anticipated equipment rental costs, except small hand tools, in connection with the change in the Work.

12.4.4 Base Cost is defined as the total of labor, material and equipment rentals as described in subparagraphs 12.4.3.1, 12.4.3.2 and 12.4.3.3. The actual net cost in money to the Owner for the change in the Work shall be computed as follows:

.1 If the Contractor performs the change in the Work without use of Subcontractors or sub-subcontractors, his compensation will be the Base Costs as described above, plus a maximum mark-up of 15% for overhead and profit.

.2 If the work is performed by a bona fide Subcontractor, the Subcontractor's compensation will be the Base Costs as described above plus a maximum mark-up of 15% for overhead and profit. The Contractor's compensation will be a maximum mark-up of five percent (5%) of the Subcontractors Base Costs for his overhead and profit.

.3 If the Work is performed by a bona fide Sub-subcontractor, the Subcontractor's compensation will be the Base Costs as herein described, plus a maximum mark-up of 15% for overhead profits. The mark-up of any Sub-subcontractor’s work by the Contractor and all intervening tiers of Subcontractors shall not exceed a total of 10%.

12.4.5 The mark-up on the cost of labor, materials, and equipment described in Paragraphs 12.4.4.1, 12.4.4.2, and 12.4.4.3 shall be all the compensation to which the Contractor, Subcontractors and Sub-subcontractor are entitled for all indirect costs associated with or relating to the change in the Work including, but not limited to, labor and/or equipment inefficiency, changes in sequence, delays, interferences, impact on unchanged work, gross receipts tax, superintendent, small tools, reproduction, administration, insurance, unrelated safety requirements, temporary structures and offices, all other general and administrative, home office and field office expenses.

12.4.6 The Proposed Change Order may also include the cost of increases in premiums for the Payment Bond and the Performance Bond, provided coverage for the cost of the change in Work results in such increased costs. At the Owner's request, the Contractor shall provide proof of his notification to the surety of the change in the Work and of the surety's agreement to include such change in its coverage. The cost of the increase in premiums shall not be marked up.

12.4.7 In the event that it is necessary to increase the Contract Time in order to perform the change in the Work, the Contractor shall provide an estimate of the increase in the Contract Time as part of the Proposed Change Order. The Contractor's request for a time extension shall be evaluated in accordance with the criteria described in Article 8.3, Claims for Time Extensions.

12.4.8 If the Contractor's Proposed Change Order is rejected by the Owner as being within the scope of the Work required by the Contract Documents, the Owner may, at its sole option and discretion, direct the Contractor to perform the Work which is the subject of the said Proposed Change Order, with claimed compensation to be accounted for pursuant to 12.6 and to be subject to the procedures of Article 13. The Contractor shall then promptly proceed with said Work. Nothing herein shall excuse the timely performance by the Contractor of the Work because any Proposed Change Order is pending.

12.5 CHANGE ORDER

12.5.1 A Change Order is a written order to the Contractor signed by the Owner, issued after execution of the Contract, authorizing a change in the Work or an adjustment in the Contract Sum and/or the Contract Time. The Contract Sum and the Contract Time may be changed only by Change Order. A Change Order signed by the Contractor indicates his agreement therewith, including the adjustment in the Contract Sum and/or the Contract Time. Change Orders shall be numbered consecutively by date of issuance by the Owner and shall, if applicable, indicate the number of the Field Order(s), Request for Proposal(s) and/or Proposed Change Order(s) to which they relate.

12.5.1.1 If the Owner determines that the Contractor's Proposed Change Order, submitted pursuant to Article 12.4 for a change in the Contract Sum or Contract Time, is acceptable, the Owner shall prepare and issue a Change Order which will authorize the Contractor to proceed with the change in the Work with the adjustment to Contract Sum and Contract Time stated in the Proposed Change Order, or as otherwise may be agreed upon by the parties. The amounts stated in the Change Order for the adjustment to Contract Sum and Contract Time for the change in the Work shall be binding on the parties.

12.5.2 After issuance of the Change Order, the Contractor shall ensure that the amount of the Performance and Payment Bond coverage has been revised to reflect the increase in the Contract Sum due to the Change Order. Notwithstanding the foregoing, Contractor's failure to do so shall not release any surety from its obligations under any bonds.

12.6 CHANGE DIRECTIVE

12.6.1 If Owner and Contractor cannot agree as to whether something constitutes a change to the Work originally contemplated by the Contract Documents, or if they cannot agree as to the adjustment to the Contract Sum or Contract Time required for what Owner acknowledges to be a change to the Work constituting Extra Work, Owner may, in his sole discretion, issue a written Change Directive directing Contractor to perform such work. Contractor shall then promptly proceed with the work at issue. Owner may elect, in its sole discretion, to have the compensation or claimed compensation for such work accounted for on either a time and material basis or lump sum basis as described in 12.6.2 and 12.6.3.

12.6.2 If Owner elects to have the compensation and/or claimed compensation accounted for on a time and materials basis, the following procedures apply:

12.6.2.1 Change Directive work, the compensation or claimed compensation for which is being accounted for on a time and material basis shall be performed, whether by the Contractor's forces or the forces of any of its Subcontractors' or Sub-subcontractors', at actual cost to the entity performing the Work (without any charge for administration, clerical expense, supervision or superintendent of any nature whatsoever). The percent mark-ups for the Contractor, Subcontractors and Sub-subcontractor's shall be as described in subparagraphs 12.4.4 and 12.4.5.

12.6.2.2 Prior to starting the Change Directive work on a time and material basis, the Contractor shall notify the Owner in writing as to what labor, materials, equipment or rentals are to be used for the change or claimed change in the Work. During performance, the Contractor shall submit to the Owner daily time and material tickets, which shall list the categories and amounts of labor and equipment for which Change Directive compensation is to be charged for the previous work day. Such tickets shall specifically include the following information: location and description of the change in the Work, the classification of labor employed, including names and social security numbers of laborers, labor trades used, man hours, wage rates, insurance, taxes and fringe benefits, equipment and materials suppliers' quotations with detailed break-out and pricing, rental equipment hours and rates, and materials quantities and unit prices and such other evidence of cost as the Owner may require.

12.6.2.3 The Contractor shall commence submission of daily time and material tickets immediately upon commencement of the Change Directive work and continue to submit them until completion of the Change Directive work. The Owner may require authentication of all time and material tickets and invoices by persons designated by the Owner for such purpose.

12.6.2.4 No payment will be made to the Contractor for any portion of the Change Directive work that Owner acknowledges to be Extra Work unless and until such daily time and material tickets and invoices are submitted. The submission of any such ticket or invoice shall not constitute an acknowledgment by the Owner that the items thereon were reasonably required for the Change Directive work.

12.6.2.5. For any work performed on a time and material basis, the Contractor shall submit its complete submission of the reasonable actual cost and time to perform the change in the Work within twenty (20) days after such Work has been completed. If Change Directive work includes both Work that Owner acknowledges to be Extra Work and work that Owner disputes to be Extra Work, Contractor shall clearly segregate its accounting for the two. The Owner shall review the costs and time submitted by the

Contractor on the basis of reasonable expenditures and savings of those performing the Change Directive work. If such costs and time are acceptable to the Owner, or if the parties otherwise agree to the actual reasonable cost to perform the Change Directive work, a Change Order will be issued for the cost and time agreed upon. The amounts stated in the Change Order for the cost and time to perform the Change Directive work shall be binding upon the parties.

12.6.3 If Owner elects to have the compensation or claimed compensation accounted for on a lump sum basis, Owner may make a unilateral determination of a reasonable adjustment in Contract Sum and Contract Time due to the Change Directive. Any unresolved dispute about the reasonableness of Owner's unilateral determination shall be subject to Article 13, Claims and Dispute Procedure.

12.7 DECREASES AND WORK NOT PERFORMED (Deductive Change Orders)

12.7.1 Should it be deemed expedient by the Owner to decrease the dimensions, quantity of material or Work, or vary in any other way the Work required by the Contract Documents, the Owner may direct by written Change Order, such decreases to be made or performed without in any way affecting the validity of the Contract. The Contractor shall, comply with the Change Order from the Owner. The difference in expense occasioned by such decrease shall be deducted from the amount payable under this Contract.

12.7.2 When Work is deleted from the Contract by Owner, the amounts to be credited to the Owner shall reflect the same current pricing as if the Work were being added to the Contract at the time the deletion is ordered, and Contractor shall provide documentation for a credit as specified in Article 12.5.4. If such deleted materials and equipment shall have already been purchased and stored on site and cannot be used in other projects, cannot be returned for credit or cannot be returned for credit at the price paid by the Contractor at the time of purchase, the Contractor shall be entitled, upon proper documentation and certification, to an adjustment in the pricing of the credit to avoid hardship to the Contractor. If necessary in order to establish such reasonable value, the Contractor may be required to submit a detailed breakdown of his original bid and all documents upon which Contractor's bid was based for the items or Work involved.

12.7.3 If Work is not performed, and such deletion of Work was not directed or approved by the Owner, the Owner shall ascertain the amount of the credit due.

12.8 CHANGES IN LINE AND GRADE

12.8.1 The Owner reserves the right to make such alterations in the line and grade of various structures or pipe lines shown on the drawings, as may be necessitated by conditions found during construction or that in the judgment of the Owner appears advisable. Such alterations shall in no way affect the validity of the Contract

12.8.1.1 In case of a unit price contract, if such changes increase the amount of the Work or materials, the Contractor will be paid according to the quantity of Work actually done at the prices established for such Work under the Contract.

12.8.1.2 In case of a lump sum contract, the price for the Work shall be determined as specified in Article 12.4, Proposed Change Order.

12.9 SUBSURFACE CONDITIONS FOUND DIFFERENT

12.9.1 Should the Contractor encounter subsurface and/or latent conditions at the site materially differing from those shown on the drawings or indicated in the specifications, he shall immediately give Notice to the

Owner of such conditions before they are disturbed. The Owner shall thereupon promptly investigate the conditions and if he finds that they materially differ from those shown on the drawings or indicated in the specifications, he shall at once make such changes in the drawings and/or specifications as he may find necessary. Any increase or decrease of cost resulting from such changes shall be adjusted in the manner provided herein for adjustments as to extra and/or additional work and changes. Notwithstanding the foregoing, if the Contract Documents indicate elsewhere that excavation is to be on an unclassified basis, Contractor shall not be entitled to any adjustment to the Contract Sum or Contract Time based upon this 12.9.

12.10 OTHER CLAIMS

If the Contractor claims that additional cost or time is involved because of, but not limited to, (1) any written interpretation pursuant to Article 2, Architect/Engineer, (2) any order by the Owner to stop the Work pursuant to Article 3, Owner, where the Contractor was not at fault, (3) failure of payment by the Owner pursuant to Article 9 Payments and Completion, or (4) any written order for a minor change in the Work issued pursuant to Article 12.8, Changes in Line and Grade~~;~~, the Contractor shall make such claim as provided in Section 12, Changes and Modification in the Work~~.~~, and Article 13, Claims and Dispute Procedure.

ARTICLE 13 CLAIMS AND DISPUTE PROCEDURE

Any Claims by the Contractor arising under or relating to the Contract or the Contract Documents shall only be resolved as follows:

13.1. INITIAL NOTICE, SUBMISSION OF CLAIM, AND CONSIDERATION.

a. The Contractor shall give the Owner and the A/E written notice of any Claim within ten (10) days of the beginning of the occurrence of the event leading to the Claim. The written notice shall be a document from the Contractor addressed to the Owner's and A/E's officials or employees designated by the Contract Documents to receive such notice, or if no one is so designated, to the Owner's City Manager and to the A/E. The written notice shall clearly state the Contractor's intention to make a claim, shall describe the occurrence involved, and shall be transmitted in a manner to ensure receipt by the Owner and A/E within the ten (10) days. The Contractor shall submit the Claim and any supporting data to the Owner and A/E within thirty (30) days after the occurrence giving rise to the Claim ends. The burden shall be on the Contractor to substantiate that it has given written notice and submitted its Claim in accordance with this provision.

b. The Claim must (i) be certified under oath as true and correct by a principal of Contractor; (ii) must be for specific relief; (iii) if any money is sought, must specify the dollar amount sought; and (iv) must contain sufficient supporting documentation to reasonably allow its consideration, including without limitation, any documentation required by the Contract Documents. The burden shall be on the Contractor to substantiate the Claim.

c. The Contractor shall comply with all other terms and conditions of the Contract Documents, including without limitation, those in Articles 8 and 12, as applicable. No decision by the A/E on a claim shall be binding on the Owner, but such decision shall have whatever effect on the Contractor that the Contract Documents provide.

d. Following consideration by the A/E, and following initial, informal consideration by the Owner's City Manager or his designee, the parties shall endeavor to resolve any Claim through direct negotiations, and if such direct negotiations fail, and if the Owner requests, by non-binding mediation conducted pursuant to the Rules of the American Arbitration Association, with the site of the mediation being Lynchburg, Virginia.

e. Should the Claim remain unresolved for more than 60 days after it is submitted, then the City Manager or his designee shall, within no later than 90 days after the Claim's submission, render a written decision on the Claim on behalf of the Owner . The Contractor may not institute any legal action with respect to the Claim until after the City Manager or his designee renders his written decision or 90 days from its receipt by the City Manager has passed, whichever comes first. The only effect of the failure by the City Manager or his designee to render a decision within this 90-day period is to allow the Contractor to institute a legal action pursuant to this provision without having to wait for a decision on the Claim concerned.

13.2 APPEAL OF DENIAL OF CLAIM.

a. If the Owner denies in whole or part a Claim by Contractor or more than 90 days have passed since the Claim was received by the City Manager but no written decision has been issued, the Contractor may appeal denial of the claim by instituting an action in the Lynchburg Circuit Court, Lynchburg, Virginia, or if the subject or amount in controversy is within its jurisdiction, the Lynchburg General District Court, Lynchburg, Virginia, and may thereafter pursue all available appeals in Virginia state courts, to the extent they have jurisdiction.

b. The Contractor must initiate its appeal of the Claim within 180 days of the date it first has the right to do so or the Claim will be barred and the Owner’s decision will be binding and conclusive.

c. The Contractor may not amend its Claim on appeal to increase the amount of money sought.

d. In the event of any Claim arising, Contractor shall continue its performance diligently during such Claim's pendency and thereafter as if no Claim had arisen. During the pendency of any Claim in connection with the payments of moneys, Contractor shall be entitled to receive payments for non-disputed items, subject to any right of set-off by Owner.

13.3 Notwithstanding anything in the Contract Documents to the contrary, the Owner may, in its discretion, assert a Claim without first resorting to any procedures contained in the Contract Documents.

13.4 "Claim" means a "claim" as defined in the Lynchburg Public Procurement Code.

13.5 Notwithstanding anything in the Contract Documents to the contrary, Owner shall not be liable to Contractor for any damages or increase in the Contract Sum due to delays to Contractor, any Subcontractor, or any other person except due to extent required by Virginia Code § 2.2-4335.

ARTICLE 14 UNCOVERING AND CORRECTION OF WORK

14.1 UNCOVERING OF WORK

14.1.1 If any portion of the Work should be covered contrary to: (1) the request of the A/E or Owner; (2) requirements specifically expressed in the Contract Documents; or (3) the requirements of applicable permits, it must, if required in writing by the Owner, be uncovered for the Owner’s and A/E’s observation and shall be replaced at the Contractor's expense.

14.1.2 If any other portion of the Work has been covered which the Owner has not specifically requested to observe prior to being covered, the Owner may request to see such Work and it shall be uncovered by the Contractor. If such Work be found in accordance with the Contract Documents, the cost of uncovering and replacement shall, by appropriate Change Order, be charged to the Owner. If such Work be found not in accordance with the Contract Documents, the Contractor shall pay such costs unless it is found that this condition was caused solely by the Owner, in which event the Owner shall be responsible for the payment of such costs. If such Work be found not in accordance with the Contract

Documents and the condition was caused by a separate contractor, Contractor may proceed against said separate contractor as provided in Article 6, Work by Owner or by Separate Contractors.

14.2 WARRANTY AND CORRECTION OF WORK

14.2.1 The Contractor guarantees and warrants to the Owner all Work as follows:

.1 That all materials and equipment furnished under this Contract will be new and the best of its respective kind unless otherwise specified;

.2 That all Work will be of first-class quality and free of omissions and faulty, imperfect or defective material or workmanship;

.3 That the Work shall be entirely watertight and leakproof in accordance with all applicable industry customs and practices, and shall be free of shrinkage and settlement which are attributable to defective materials or workmanship;

.4 That the Work, including but not limited to, mechanical and electrical machines, devices and equipment shall be fit and fully usable for its intended and specified purpose and shall operate satisfactorily with ordinary care;

.5 That consistent with requirements of the Contract Documents the Work shall be installed and oriented in such a manner as to facilitate unrestricted access for the operation and maintenance of fixed equipment; and

.6 That the Work will be free of abnormal or unusual deterioration which occurs because of poor quality materials or workmanship.

14.2.2 All Work not conforming to guarantees and warranties specified in the Contract Documents, including substitutions not properly approved and authorized, may be considered defective. If required by the Owner, the Contractor shall furnish satisfactory evidence as to the kind and quality of materials and equipment furnished and installed.

14.2.3 The Contractor shall within five (5) working days after receipt of written Notice from the Owner during the performance of the Work, reconstruct, replace or correct all Work rejected by the A/E or Owner as defective, as failing to conform to the Contract Documents, or as not in accordance with the guarantees and warranties specified in the Contract Documents , whether observed before or after Substantial Completion and whether or not fabricated, installed or completed. The Contractor shall bear all costs of reconstructing, replacing or correcting such rejected Work, including compensation for the A/E's additional services made necessary thereby.

14.2.4 If, within one (1) year after the Date of Final Completion of the Work or designated portion thereof or within one (1) year after acceptance by the Owner of designated equipment or within such longer period of time as may be prescribed by law or by the terms of any applicable special warranty required by the Contract Documents, any of the Work is found to be defective, not in accordance with the Contract Documents, or not in accordance with the guarantees and warranties specified in the Contract Documents, the Contractor shall correct it within five (5) working days after receipt of a written Notice from the Owner to do so unless the Owner has previously given the Contractor a written acceptance of such condition pursuant to 14.3, Acceptance of Faulty, Defective or Non-Conforming Work. This obligation shall survive termination of the Contract. The Owner shall give such Notice within a reasonable time after discovery of the condition.

14.2.5 Subject to limitation as prescribed by law, if at any time deficiencies in the Work are discovered which are found to have resulted from fraud or misrepresentation, or an intent or attempt to defraud the Owner by the Contractor, any Subcontractor or supplier, the Contractor will be liable for replacement or correction of such Work and any damages which Owner has incurred related thereto, regardless of the time limit of any guarantee or warranty.

14.2.6 Any materials or other portions of the Work, installed, furnished or stored on site which are not of the character or quality required by the specifications, or are otherwise not acceptable to the Owner, shall be immediately removed and replaced by the Contractor to the satisfaction of the Owner, when notified to do so by the Owner.

14.2.7 If the Contractor fails to correct defective or nonconforming Work as required by Articles 13.2.3 and 13.2.4, or if the Contractor fails to remove defective or nonconforming Work from the site, as required by Article 13.2.6, the Owner may elect to either correct such Work in accordance with Article 3.5, Owner's Right to Carry Out the Work, or remove and store materials and equipment at the expense of the Contractor. If the Contractor does not pay the cost of such removal and storage within ten (10) days thereafter, the Owner may, upon ten additional days written Notice, sell such Work at auction or at public or private sale and shall account for the net proceeds thereof, after deducting the costs of the sale and all of the costs that should have been borne by the Contractor, including compensation for the A/E's additional services made necessary thereby. If such proceeds of sale do not cover all costs indicated in the previous sentence, the difference shall be charged to the Contractor and an appropriate Change Order shall be issued. If the payments then or thereafter due the Contractor are not sufficient to cover such amount, the Contractor or its surety shall pay the difference to the Owner.

14.2.8 The Contractor shall bear the cost of making good all work of the Owner, separate contractors or others, destroyed or damaged by such correction or removal required under this Article.

14.3 ACCEPTANCE OF FAULTY, DEFECTIVE OR NON-CONFORMING WORK

If the Owner prefers to accept faulty, defective or nonconforming Work, he may do so instead of requiring its removal and correction, in which case a Change Order will be issued at Owner's option, to reflect a reduction in the Contract Sum in an amount to be determined by the Owner.

ARTICLE 15 TERMINATION OF THE CONTRACT

15.1 CONTRACTOR'S RIGHT TO STOP WORK OR TERMINATE CONTRACT

If the Work should be stopped under an order of any court or other public authority for a period of ninety (90) days through no fault of the Contractor or anyone providing services, materials or equipment through him, or if the Owner should fail to pay to the Contractor within thirty (30) days any sum for which a Certificate of Payment has been certified when no dispute exists as to the sum due and Owner has no right to withhold payment under any provision of the Contract Documents, then the Contractor may, upon ten (10) days written Notice to the Owner, stop Work or terminate the Contract and recover from the Owner payment for the cost of the Work actually performed, together with overhead and profit thereon, but profit on the Work performed shall be recovered only to the extent that the Contractor can demonstrate that he would have had profit on the entire Contract if he had completed the Work. The Contractor may not receive profit or any other type of compensation for parts of the Work not performed. The Contractor may recover the reasonable cost of physically closing down the Site, but no other costs of termination. The Owner may offset any claims it may have against the Contractor against the amounts due to the Contractor. In no event shall termination of the Contract by the Contractor terminate the obligations of the Contractor's surety on its payment and performance bonds.

15.2 OWNER'S RIGHT TO TERMINATE CONTRACT FOR CAUSE

15.2.1 The Owner may terminate the Contract for cause based upon any of the following grounds:

.1 If the Contractor should be adjudged as bankrupt, or if he should make a general assignment for the benefit of his creditors, or if a receiver should be appointed on account of his insolvency.

.2 If the Contractor should refuse or should repeatedly fail, except in cases for which extension of time is provided, to supply enough properly skilled workmen or proper materials and equipment.

.3 If the Contractor should fail to make prompt payment to subcontractors or suppliers of material of labor.

.4 If the Contractor should disregard laws, ordinances, codes, regulations, or the written instructions of the Architect/Engineer or the Owner.

.5 If the Contractor be in substantial violation of any provision of the Contract Documents.

15.2.2 For termination for cause based upon the grounds in 15.2.1.1, Owner may terminate without prior notice and without giving Contractor any opportunity to rectify the basis for termination. For termination for cause based upon any other grounds, prior to termination of the Contract, the Owner shall give the Contractor and his surety Notice followed by a ten (10) day period during which the Contractor and/or his surety may rectify the basis for the Notice. If rectified to the satisfaction of the Owner within said ten (10) days, the Owner may rescind its notice of termination. If not, the termination for cause shall become effective at the end of the ten (10) day notice period. Notwithstanding the foregoing, the Owner may, in writing, postpone the effective date of the termination for cause, at its sole discretion, if it should receive reassurances from the Contractor and/or his surety that the basis for the termination will be remedied within a time and in a manner which the Owner finds acceptable. If at any time after such postponement, the Owner determines that Contractor and/or his surety has not or is not likely to rectify the causes of termination in an acceptable manner or within the time allowed, then the Owner may immediately terminate the Contract for cause, without the necessity of allowing any further opportunity by the Contractor and/or surety to rectify the basis for the Notice, by notifying the Contractor and his surety in writing of the termination. In no event shall termination for cause terminate the obligations of the Contractor’s surety on its payment and performance bonds.

15.2.3 Upon termination of the Contract, the Contractor shall immediately cease Work, and the Owner may take possession of the site and of all materials, tools and equipment thereon and finish the Work by whatever method he may deem expedient. In such case, the Contractor shall not be entitled to receive any further payment until the Owner has finally completed the Work through its own resources or those of a subsequent contractor. If the Owner's damages, including the expense of finishing the Work, compensation for additional design, managerial and administrative services, any liquidated damages, and any claims by the Owner, shall exceed the unpaid balance of the Contract Sum, the Contractor shall pay the difference to the Owner, together with any other expenses of terminating the Contract and having it completed by others. If the unpaid balance of the Contract Sum exceeds Owner's damages, including the costs of finishing the Work, compensation for additional design, managerial and administrative services, any liquidated damages and any claims by Owner, together with any other expenses of terminating the Contract and having it completed by others, such excess shall be paid to the Contractor.

15.2.4 If it should be judicially determined that the Owner improperly terminated this Contract for cause, then the termination shall be deemed to be a termination for the convenience of the Owner, with Contractor's recovery limited to what is allowed for a termination for convenience under the Contract Documents.

15.2.5 Termination of the Contract under this Section is without prejudice to any other right or remedy of the Owner.

15.3 OWNER'S RIGHT TO TERMINATE CONTRACT FOR CONVENIENCE

15.3.1 Owner may terminate this Contract, in whole or in part, at any time without cause upon giving the Contractor written Notice of such termination. Upon such termination, the Contractor shall immediately cease Work and remove from the site all of its labor forces and such of its materials and equipment as Owner elects not to purchase or to assume in the manner hereinafter provided. Upon such termination, the Contractor shall take such steps as Owner may require to assign to the Owner the Contractor's interest in all subcontracts and purchase orders designated by Owner. After all such steps have been taken to Owner's satisfaction, the Contractor shall receive as full compensation for termination and assignment the following:

.1 Amounts due for Work performed in accordance with the Contract through the date of termination.

.2 Reasonable compensation for the actual cost of demobilization incurred by the Contractor as a direct result of such termination. The Contractor shall not be entitled to any compensation or damages for lost profits or for any other type of contractual compensation or damages other than those provided by the preceding sentence. Upon payment of the foregoing, Owner shall have no further obligations to Contractor of any nature.

15.3.2 In no event shall termination for the convenience of the Owner terminate the obligations of the Contractor's surety on its payment and performance bonds.

15.3.3 After receipt of a Notice of termination, the Contractor shall promptly submit to the Owner his termination claim. Such claim shall be submitted no later than forty-five (45) days from the effective date of termination. Upon failure of the Contractor to submit his termination claim within the time allowed, the Owner may determine, on the basis of information available to it, the amount, if any, due to the Contractor by reason of the termination.

15.4 CONTRACTOR'S RESPONSIBILITIES UPON TERMINATION

15.4.1 After receipt of a notice of termination pursuant to 15.3, Owner's Right to Terminate Contract for Convenience, the Contractor shall mitigate any damages to the extent reasonably possible.

15.4.2 In addition to the provisions of 15.4.1, the Contractor shall:

.1 At the option of the Owner, assign to the Owner, in the manner, at the time, and to the extent directed by the Owner, all of the right, title, and interest of the Contractor under the orders and subcontracts so terminated, in which case the Owner shall have the right, in its discretion, to settle or pay any or all claims arising out of the termination of such orders and subcontracts;

.2 Transfer title and deliver to the Owner in the manner, at the times, and to the extent, if any, directed by the Owner:

a) The fabricated or un-fabricated parts, work in process, completed Work, supplies, and other material and equipment procured as a part of, or acquired in connection with the performance of the Work terminated by the Notice of Termination, and

b) The completed or partially completed drawings, releases, information, manuals and other property which, if the Contract had been completed, would have been required to be furnished to the Owner;

.3 Complete performance of such part of the Work as shall not have been terminated by the Notice of Termination; and

.4 Take such action as may be necessary, or as the Owner may direct, for the protection and preservation of the property related to this Contract which is in the possession of the Contractor and in which the Owner has or may acquire an interest.

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LYNCHBURG REGIONAL AIRPORT

AIR TRAFFIC CONTROL TOWER

VOLUME NO. 2 - TECHNICAL SPECIFICATIONS

ARCHITECTURAL
Stephen G. Harrill, AIA

By: _____

Date: _____

CIVIL ENGINEERING
P. Scott Beasley, P.E.

By: _____

Date: _____

CIVIL ENGINEERING
Nicholas J. Patterson, P.E.

By: _____

Date: _____

STRUCTURAL
Randolph L. Musser, P.E.

By: _____

Date: _____

MECHANICAL
Keith Nix, P.E.

By: _____

Date: _____

ELECTRICAL
Timothy Smith, P.E.

By: _____

Date: _____

SPECIAL INSTRUCTIONS TO BIDDERS REGARDING EEO

Notice of Requirement for Affirmative Action (41 CFR Part 60-2 and Executive Order 11246, as amended)

1. The Offeror's or Bidder's attention is called to the "Equal Opportunity Clause" and the "Standard Federal Equal Employment Opportunity Construction Contract Specifications" set forth herein.

2. The goals and timetables for minority and female participation, expressed in percentage terms for the contractor's aggregate work force in each trade on all construction work in the covered area, are as follows:

TIMETABLES

Goals of minority participation in each trade	Goals for female participation in each trade
4.0%	6.9%

(Vol. 45, Fed. Reg., Pg. 65984, 10/03/80)

These goals are applicable to all the contractor's construction work (whether or not it is Federal or Federally assisted) performed in the covered area. If the contractor performs construction work in a geographical area located outside the covered area, it shall apply the goals established for such geographical area where the work is actually performed. With regard to this second area, the contractor also is subject to the goals for both its federally involved and nonfederally involved construction.

The contractor's compliance with the executive order and the regulations in 41 CFR Part 60-4 shall be based on its implementation of the Equal Opportunity Clause, specific affirmative action obligations required by the specifications set forth in 41 CFR Part 60-4.3(a), and its efforts to meet the goals. The hours of minority and female employment and training must be substantially uniform throughout the length of the contract, and in each trade, and the contractor shall make a good faith effort to employ minorities and women evenly on each of its projects. The transfer of minority or female employees or trainees from contractor to contractor or from project to project, for the sole purpose of meeting the contractor's goals, shall be a violation of the contract, the Executive Order, and the regulations in 41 CFR Part 60-4. Compliance with the goals will be measured against the total work hours performed.

3. The contractor shall provide written notification to the Director, OFCCP, within 10 working days of award of any construction subcontract in excess of $10,000 at any tier for construction work under the contract resulting from this solicitation. The notification shall list the name, address, and telephone number of the subcontractor; employer identification number; estimated dollar amount of the subcontract; estimated starting and completion dates of the subcontract; and, the geographical area in which the contract is to be performed.

4. As used in this notice and in the contract resulting from this solicitation, the "covered area" is **Lynchburg, Virginia.**

Certification Regarding Debarment, Suspension, Ineligibility and Voluntary Exclusion (49 CFR PART 29)

The bidder (offeror) certifies, by submission of this proposal or acceptance of this contract, that neither it nor its principals is presently debarred, suspended, proposed for debarment, declared ineligible, or voluntary excluded from participation in this transaction by any Federal department or agency. It further agrees that by submitting this proposal that it will include this clause without modification in all lower tier transactions, solicitations, proposals, contracts, and subcontracts. Where the bidder/offeror/contractor or any lower tier participant is unable to certify to this statement, it shall attach an explanation to this solicitation/proposal.

Certification Regarding Foreign Trade Restrictions (49 CFR PART 30)

The contractor or subcontractor, by submission of an offer and/or execution of a contract, certifies that it:

a. is not owned or controlled by one or more citizens of a foreign country included in the list of countries that discriminate against U.S. firms published by the Office of the United States Trade Representative (USTR);

b. has not knowingly entered into any contract or subcontract for this project with a person that is a citizen or national of a foreign country on said list, or is owned or controlled directly or indirectly by one or more citizens or nationals of a foreign country on said list.

c. has not procured any product nor subcontracted for the supply of any product for use on the project that is produced in a foreign country on said list.

Unless the restrictions of this clause are waived by the Secretary of Transportation in accordance with 49 CFR 30.17, no contract shall be awarded to a contractor or subcontractor who is unable to certify to the above. If the contractor knowingly procures or subcontracts for the supply of any product or service of a foreign country on said list for use on the project; the Federal Aviation Administration may direct, through the Sponsor, cancellation of the contract at no cost to the Government.

Further, the contractor agrees that, if awarded a contract resulting from this solicitation, it will incorporate this provision for certification without modification in each contract and in all lower tier subcontracts. The contractor may rely upon the certification of a prospective subcontractor unless it has knowledge that the certification is erroneous.

The contractor shall provide immediate written notice to the sponsor if the contractor learns that its certification or that of a subcontractor was erroneous when submitted or has become erroneous by reason of changed circumstances. The subcontractor agrees to provide immediate written notice to the contractor, if at any time it learns that its certification was erroneous by reason of changed circumstances.

This certification is a material representation of fact upon which reliance was placed when making the award. If it is later determined that the contractor or subcontractor knowingly rendered an erroneous certification, the Federal Aviation Administration may direct, through the Sponsor, cancellation of the contract or subcontract for default at no cost to the Government.

Nothing contained in the foregoing shall be construed to require establishment of a system of records in order to render, in good faith, the certification required by this provision. The knowledge and information of a contractor is not required to exceed that which is normally possessed by a prudent person in the ordinary course of business dealings.

This certification concerns a matter within the jurisdiction of an agency of the United States of America and the making of a false, fictitious, or fraudulent certification may render the maker subject to prosecution under Title 18, United States Code, Section 1001.

Buy American Certification
(Aviation Safety and Capacity Expansion Act of 1990)

By submitting a bid/proposal under this solicitation, except for those items listed by the offeror below or on a separate and clearly identified attachment to this bid/proposal, the offeror certifies that steel and each manufactured product, is produced in the United States, as defined in the clause Buy American - Steel and Manufactured Products for Construction Contracts, and that components of unknown origin are considered to have been produced or manufactured outside the United States.

Offerors may obtain from **Lynchburg, Virginia** (insert sponsor representative) a listing of articles, materials, and supplies excepted from this provision.

PRODUCT	COUNTRY OF ORIGIN

APPENDIX D

List of Supplies/Materials that the U.S. Government has determined are not produced in the United States in sufficient and reasonably available quantities and of sufficient quality. (January 1991)

- Acetylene, black
- Agar, bulk
- Anise
- Antimony, as metal or oxide
- Asbestos, amosite, chrysolite and crocidolite
- Bananas
- Bauxite
- Beef, corned, canned
- Beef extract
- Bephenium Hydroxynapthoate
- Bismuth
- Books, trade, text, technical, or scientific; newspapers; pamphlets; magazines; periodicals; printed briefs and films; not printed in the United States and for which domestics editions are not available
- Brazil nuts, unroasted
- Cadmium, ores and flue dust
- Calcium cyanamide
- Capers
- Cashew nuts
- Castor beans and castor oil
- Chalk, English
- Chestnuts
- Chicle
- Chrome ore or chromite
- Cinchona bark
- Cobalt, in cathodes, rondelles, or other primary ore and metal forms
- Cocoa beans
- Coconut and coconut meat, unsweetened, in shredded, desiccated or similarly prepared form
- Coffee, raw or green bean
- Colchicine alkaloid, raw
- Copra
- Cork, wood or bark and waste
- Cover glass, microscope slide
- Cryolite, natural
- Emetine, bulk
- Ergot, crude
- Erthrityl tetranitrate
- Fair linen, altar
- Fibers of the following type: abaca, abace, agave, coir, flax, jute, jute burlaps, palmyra and sisal
- Goat and kidskins
- Graphite, natural, chrystalline, crucible grade
- Handsewing needles
- Hemp yarn
- Hog bristles for brushes
- Hyoscine, bulk
- Ipecac, root
- Iodine, crude
- Kaurigum
- Lac
- Leather, sheepskin, hair type
- Lavender oil
- Manganese
- Menthol, natural bulk
- Mica
- Microprocessor chips (brought onto a construction site as separate units for incorporation into building systems during construction or repair and alteration of real property)
- Nickel, primary, in ingots, pigs, shots, cathodes, or similar forms; nickel oxide and nickel salts
- Nitroguanidine (also known as picrite)
- Nux vomica, crude
- Oiticica oil
- Olive oil
- Olives (green), pitted or unpitted, or stuffed, in bulk
- Opium, crude
- Oranges, mandarin, canned
- Petroleum, crude oil, unfinished oils, and finished products (see definitions below)
- Pine needle oil
- Platinum and related group metals, refined, as sponge, powder, ingots, or cast bars

- Dammar gum
- Diamonds, industrial, stones and abrasives
- Pyrethrum flowers
- Quartz crystals

APPENDIX D

List of Supplies/Materials that the U.S. Government has determined are not produced in the United States in sufficient and reasonably available quantities and of sufficient quality. (January 1991) (CONTINUED)

- Quebracho
- Quinidine
- Quinine
- Rabbit fur felt
- Radium salts, source and special nuclear materials
- Rosettes
- Rubber, crude and latex
- Rutile
- Santonin, crude
- Secretin
- Shellac
- Silk, raw and unmanufactured
- Spare and replacement parts for equipment of foreign manufacture, and for which domestic parts are not available
- Spices and herbs, in bulk
- Sugars, raw
- Swords and scabbards
- Talc, block, steatite
- Tantalum
- Tapioca flour and cassava
- Tartar, crude; tartaric acid and cream or tartar in bulk
- Tea in bulk
- Thread, metallic (gold)
- Thyme oil
- Tin in bars, blocks, and pigs
- Triprolidine hydrochloride
- Tungsten
- Vanilla beans
- Venom, cobra
- Wax, canauba
- Woods; logs, veneer, and lumber of the following species: Alaskan yellow cedar, angelique, balsa, ekki, greenhart, lignum vitae, mahogany, and teak
- Yarn, 50 Denier rayon

APPENDIX D

List of Supplies/Materials that the U.S. Government has determined are not produced in the United States in sufficient and reasonably available quantities and of sufficient quality. (January 1991) (CONTINUED)

Petroleum terms are used as follows:

"Crude oil" means crude petroleum, as it is produced at the well head, and liquids (under atmospheric conditions) that have been recovered from mixtures of hydrocarbons that existed in a vaporous phase in a reservoir and that are not natural gas products.

"Finished products" means any one or more of the following petroleum oils, or a mixture or combination of these oils, to be used without further process except blending by mechanical means:

(A) "Asphalt" – a solid or semi-solid cementitious material that (1) gradually liquefies when heated, (2) has bitumens as its predominating constituents, and (3) is obtained in refining crude oil.

(B) "Fuel oil" – a liquid or liquefiable petroleum product burned for lighting or for the generation of heat or power and derived directly or indirectly from crude oil, such as kerosene, range oil, distillate fuel oils, gas oil, diesel fuel, topped crude oil, or residues.

(C) "Gasoline" – a refined petroleum distillate that , by its consumption, is suitable for use as a carburant in internal combustion engines.

(D) "Jet fuel" – a refined petroleum distillate used to fuel jet propulsion engines.

(E) "Liquefied gases" – hydrocarbon gases recovered from natural gas or produced from petroleum refining and kept under pressure to maintain a liquid state at ambient temperatures.

(F) "Lubricating oil" – a refined petroleum distillate or specially treated petroleum residue used to lessen friction between surfaces.

(G) "Naphtha" – a refined petroleum distillate falling within a distillation range overlapping the higher gasoline and the lower kerosenes.

(H) "Natural gas products" – liquids (under atmospheric conditions; including natural gasoline, that -

(1) are recovered by a process of absorption, compression, refrigeration, cycling, or a combination of these processes, from mixtures of hydrocarbons that existed in a vaporous phase in a reservoir, and

(2) when recovered and without processing in a refinery, definitions of products contained in subdivision (B), (C), and (G) above.

(I) "Residual fuel oil" – a topped crude oil or viscous residuum that, as obtained in refining or after blending with other fuel oil, meets or is the equivalent of MILSPEC Mil-F-859 for Navy Special Fuel Oil and any more viscous fuel oil, such as No. 5 or Bunker C.

(J) “Unfinished oils” means one or more the petroleum oils listed under “Finished products” above, or a mixture or combination of these oils, that are to be further processed other than by blending by mechanical means.

CERTIFICATION OF BIDDER REGARDING

EQUAL EMPLOYMENT OPPORTUNITY

GENERAL

BIDDER'S NAME_____
ADDRESS_____

INTERNAL REVENUE SERVICE EMPLOYER IDENTIFICATION NO._____

NONSEGREGATED FACILITIES

NOTICE TO PROSPECTIVE FEDERALLY ASSISTED CONSTRUCTION CONTRACTORS (41 CFR Part 60-1.8)

1 A Certification of Nonsegregated Facilities must be submitted prior to the award of a federally assisted construction contract exceeding $10,000 which is not exempt from the provisions of the Equal Opportunity Clause.

2 Contractors receiving federally assisted construction contract awards exceeding $10,000 which are not exempt from the provisions of the Equal Opportunity Clause will be required to provide for the forwarding of the following notice to prospective subcontractors for supplies and construction contracts where the subcontracts exceed $10,000 and are not exempt from the provisions of the Equal Opportunity Clause.

NOTE: The penalty for making false statements in offers is prescribed in 18 U.S.C. 1001.

NOTICE TO PROSPECTIVE SUBCONTRACTORS OF REQUIREMENTS FOR CERTIFICATION OF NONSEGREGATED FACILITIES

1 A Certification of Nonsegregated Facilities must be submitted prior to the award of a subcontract exceeding $10,000 which is not exempt from the provisions of the Equal Opportunity Clause.

2 Contractors receiving subcontract awards exceeding $10,000 which are not exempt from the provisions of the Equal Opportunity Clause will be required to provide for the forwarding of this notice to prospective subcontractors for supplies and construction contracts where the subcontracts exceed $10,000 and are not exempt from the provisions of the Equal Opportunity Clause.

NOTE: The penalty for making false statements in offers is prescribed in 18 U.S.C. 1001.

CERTIFICATION OF NONSEGREGATED FACILITIES

The federally assisted construction contractor certifies that he does not maintain or provide for his employees any segregated facilities at any of his establishments, and that she or he does not permit his employees to perform their services at any location, under his control, where segregated facilities are maintained. The federally assisted construction contractor certifies that she or he will not maintain or provide for his employees any segregated facilities at any of his establishments, and that he will not permit his employees to perform their services at any location, under his control, where segregated facilities are maintained. The federally assisted construction contractor agrees that a breach of this certification is a violation of the Equal Opportunity Clause in this contract.

As used in this certification, the term "segregated facilities" means any waiting rooms, work areas, restrooms and washrooms, restaurants and other eating areas, time clocks, locker rooms and other storage or dressing areas, parking lots, drinking fountains, recreation or entertainment areas, transportation, and housing facilities provided for employees which are segregated by explicit directives or are, in fact, segregated on the basis of race, color, religion, sex, or national origin, because of habit, local custom, or any other reason. The federally assisted construction contractor agrees that (except where she or he has obtained identical certifications from proposed subcontractors for specific time periods) she or he will obtain identical certifications from proposed subcontractors prior to the award of subcontracts exceeding $10,000 which are not exempt from the provisions of the Equal Opportunity Clause, and that she or he will retain such certifications in his files.

NOTICE TO PROSPECTIVE CONTRACTORS OF REQUIREMENT FOR CERTIFICATION OF NONSEGREGATED FACILITIES

A Certification of Nonsegregated Facilities must be submitted prior to the award of a contract or subcontract exceeding $10,000 which is not exempt from the provisions of the Equal Opportunity Clause.

Certification - The information above is true and complete to the best of my knowledge and belief.

_____

Name and Title of Signer (Please Type)

_____ _____

Signature **Date**

NOTE: The penalty for making false statements in offers is prescribed in 18 U.S.C. 1001.

SECTION A

WAGE, LABOR, EEO, SAFETY AND GENERAL REQUIREMENTS
(Federal Aviation Administration (FAA) Requirements)

A-1 Airport and Airway Improvement Program Project.

The work in this contract is included in New Air Traffic Control Tower **Project No. _____** which is being undertaken and accomplished by the **Lynchburg, Virginia** (Sponsor) in accordance with the terms and conditions of a grant agreement between the Sponsor and the United States, under the Airport and Airway Improvement Act of 1982 (P.L. 97-248) as amended by the Airport and Airway Safety and Capacity Expansion Act of 1987 (P.L. 100-223) and Part 152 of the Federal Aviation Regulations (14 CFR Part 152), pursuant to which the United States has agreed to pay a certain percentage of the costs under those Acts. The United States is not a party to this contract and no reference in this contract to the FAA or any representative thereof, or the United States, by the contract, makes the United States a party to this contract.

A-2 Consent to Assignment.

The contractor shall obtain the prior written consent of the Sponsor to any proposed assignment of any interest in or part of this contract.

A-3 Convict Labor.

No convict labor may be employed under this contract.

A-4 Veterans Preference.

In the employment of labor (except in executive, administrative, and supervisory positions), preference shall be given to veterans of the Vietnam era and disabled veterans as defined in Section 515(c)(1) and (2) of the Airport and Airway Improvement Act of 1982. However, this preference shall apply only where the individuals are available and qualified to perform the work to which the employment relates.

A-5 Withholding: Sponsor from Contractor.

Whether or not payments or advances to the **City of Lynchburg, Virginia** are withheld or suspended by the FAA, the Sponsor may withhold or cause to be withheld from the contractor so much of the accrued payments or advances as may be considered necessary to pay laborers and mechanics employed by the contractor or any subcontractor on the work, the full amount of wages required by this contract.

A-6 Nonpayment of Wages.

If the contractor or subcontractor fails to pay any laborer or mechanic employed or working on the site of the work any of the wages required by this contract, the **City of Lynchburg, Virginia** (Sponsor) may, after written notice to the contractor, take such action as may be necessary to cause the suspension of any further payment or advance of funds until the violations cease.

A-7 FAA inspection and review.

The contractor shall allow any authorized representative of the FAA to inspect and review any work or materials used in the performance of this contract.

A-8 Subcontracts.

The contractor shall insert in each of his subcontracts the provisions contained in paragraphs A-1, A-3, A-4, A-5, A-6, and A-7 requiring the subcontractors to include these provisions in any lower tier subcontracts which they may enter into, together with a clause requiring this insertion in any further subcontracts that may in turn be made.

A-9 Contract termination.

Any violation or breach of the terms of this contract on the part of the contractor or their subcontractors may result in the suspension or termination of this contract or such other action that may be necessary to enforce the rights of the parties of this agreement. He duties and obligations imposed by the Contract Documents and the rights and remedies available thereunder shall be in addition to and not a limitation of any duties, obligations, rights and remedies otherwise imposed or available by law. (49 CFR Part 18).

A-10 Inspection of Records.

The contractor shall maintain an acceptable cost accounting system. The Contractor agrees to provide the Sponsor, the Federal Aviation Administration and the Comptroller General of the United States or any of their duly authorized representatives access to any books, documents, papers, and records of the contractor which are directly pertinent to the specific contract for the purposes of making audit, examination, excerpts and transcriptions. The Contractor agrees to maintain all books, records and reports required under this contract for a period of not less than three years after final payment is made and all other pending matters are closed. (49 CFR Part 18.36(i)).

A-11 Rights to Inventions.

All rights to inventions and materials generated under this contract are subject to regulations issued by the FAA and the Sponsor of the Federal grant under which this contract is executed. Information regarding these rights is available from the FAA and the Sponsor. (49 CFR Part 18.36(i)(8)).

A-12 General Civil Rights Provisions.

The contractor assures that it will comply with pertinent statutes, Executive orders and such rules as are promulgated to assure that no person shall, on the grounds of race, creed, color, national origin, sex, age, or handicap be excluded from participating in any activity conducted with or benefiting from Federal assistance. This provision obligates the tenant/concessionaire/lessee or its transferee for the period during which Federal assistance is extended to the airport a program, except where Federal assistance is to provide, or is in the form of personal property or real property or interest therein or structures or improvements thereon. In these cases the provision obligates the party or any transferee for the longer of the following periods: (a) the period during which the property is used by the airport sponsor or any transferee for a purpose for which Federal assistance is extended, or for another purpose involving the provision of similar services or benefits or (b) the period during which the airport sponsor or any transferee retains ownership or possession of the property. In the case of contractors, this provision binds the contractors from the bid solicitation period through the completion of the contract. This provision is in addition to that required of Title VI of the Civil Rights Act of 1964.

SECTION B

DAVIS-BACON ACT REQUIREMENTS
(29 CFR PART 5)

B-1 Minimum Wages.

(i) All laborers and mechanics employed or working upon the site of the work will be paid unconditionally and not less often than once a week, and without subsequent deduction or rebate on any account (except such payroll deductions as are permitted by the Secretary of Labor under the Copeland Act (29 CFR Part 3)), the full amount of wages and bona fide fringe benefits (or cash equivalent thereof) due at time of payment computed at rates not less than those contained in the wage determination of the Secretary of Labor which is attached hereto and made a part hereof, regardless of any contractual relationship which may be alleged to exist between the contractor and such laborers and mechanics.

Contributions made or costs reasonably anticipated for bona fide fringe benefits under section 1(b)(2) of the Davis-Bacon Act on behalf of laborers or mechanics are considered wages paid to such laborers or mechanics, subject to the provisions of paragraph (1)(iv) of this section; also, regular contributions made or costs incurred for more than a weekly period (but not less often than quarterly) under plans, funds, or programs which cover the particular weekly period, are deemed to be constructively made or incurred during such weekly period. Such laborers and mechanics shall be paid the appropriate wage rate and fringe benefits on the wage determination for the classification of work actually performed, without regard to skill, except as provided in 29 CFR Part 5.5(a)(4). Laborers or mechanics performing work in more than one classification may be compensated at the rate specified for each classification for the time actually worked therein: *Provided*, That the employer's payroll records accurately set forth the time spent in each classification in which work is performed. The wage determination (including any additional classification and wage rates conformed under (1)(ii) of this section) and the Davis-Bacon poster (WH-1321) shall be posted at all times by the contractor and its subcontractors at the site of the work in a prominent and accessible place where it can easily be seen by the workers.

(ii)(A) The contracting officer shall require that any class of laborers or mechanics, including helpers, which is not listed in the wage determination and which is to be employed under the contract shall be classified in conformance with the wage determination. The contracting officer shall approve an additional classification and wage rate and fringe benefits therefore only when the following criteria have been met:

(1) The work to be performed by the classification requested is not performed by a classification in the wage determinations; and

(2) The classification is utilized in the area by the construction industry; and

(3) The proposed wage rate, including any bona fide fringe benefits, bears a reasonable relationship to the wage rates contained in the wage determination.

(B) If the contractor and the laborers and mechanics to be employed in the classification (if known), or their representatives, and the contracting officer agree on the classification and wage rate (including the amount designated for fringe benefits where appropriate), a report of the action taken shall be sent by the contracting officer to the Administrator of the Wage and Hour Division, Employment Standards Administration, U.S. Department of Labor, Washington, D.C. 20210. The Administrator, or an authorized representative, will approve, modify, or disapprove every additional classification action within 30 days of receipt and so advise the contracting officer or will notify the contracting officer within the 30-day period that additional time is necessary.

(C) In the event the contractor, the laborers or mechanics to be employed in the classification or their representatives and the contracting officer do not agree on the proposed classification and wage rate (including the amount designated for fringe benefits where appropriate), the contracting officer shall refer the questions, including the views of all interested parties and the recommendation of the contracting officer, to the Administrator for determination. The Administrator, or an authorized representative, will issue a determination within 30 days of receipt and so advise the contracting officer or will notify the contracting officer within the 30-day period that additional time is necessary.

(D) The wage rate (including fringe benefits where appropriate) determined pursuant to subparagraphs (1)(ii)(B) or (C) of this paragraph, shall be paid to all workers performing work in the classification under this contract from the first day on which work is performed in the classification.

(iii) Whenever the minimum wage rate prescribed in the contract for a class of laborers or mechanics includes a fringe benefit which is not expressed as an hourly rate, the contractor shall either pay the benefit as stated in the wage determination or shall pay another bona fide fringe benefit or an hourly cash equivalent thereof.

(iv) If the contractor does not make payments to a trustee or other third person, the contractor may consider as part of the wages of any laborer or mechanic the amount of any costs reasonably anticipated in providing bona fide fringe benefits under a plan or program, Provided, That the Secretary of Labor has found, upon the written request of the contractor, that the applicable standards of the Davis-Bacon Act have been met. The Secretary of Labor may require the contractor to set aside in a separate account assets for the meeting of obligations under the plan or program. (Approved by the Office of Management and Budget under OMB Control Number 1215-0140).

B-2 Withholding.

The Federal Aviation Administration or the Sponsor shall upon its own action or upon written request of an authorized representative of the Department of Labor withhold or cause to be withheld from the contractor under this contract or any other Federal contract with the same prime contractor, or any other Federally-assisted contract subject to David-Bacon prevailing wage requirements, which is held by the same prime contractor, so much of the accrued payments or advances as may be considered necessary to pay laborers and mechanics, including apprentices, trainees, and helpers, employed by the contractor or any subcontractor the full amount of wages required by the contract. In the event of failure to pay any laborer or mechanic, including any apprentice, trainee, or helper, employed or working on the site of work, all or part of the wages required by the contract, the Federal Aviation Administration may, after written notice to the contractor, sponsor, applicant, or owner, take such action as may be necessary to cause the suspension of any further payment, advance, or guarantee of funds until such violations have ceased.

B-3 Payrolls and basic records.

(i) Payrolls and basic records relating thereto shall be maintained by the contractor during the course of the work and preserved for a period of three years thereafter for all laborers and mechanics working at the site of the work. Such records shall contain the name, address, and social security number of each such worker, his or her correct classification, hourly rates of wages paid (including rates of contributions or costs anticipated for bona fide fringe benefits or cash equivalents thereof of the types described in 1(b)(2)(B) of the Davis-Bacon Act), daily and weekly number of hours worked, deductions made and actual wages paid. Whenever the Secretary of Labor has found under 29 CFR 5.5(a)(1)(iv) that the wages of any laborer or mechanic include the amount of any costs reasonably anticipated in providing benefits under a plan or program described in section 1(b)(2)(B) of the Davis-Bacon Act, the contractor shall maintain records which show that the commitment to provide such benefits is enforceable, that the plan or program is financially responsible, and that the plan or program has been communicated in writing to the laborers or mechanics affected, and records which show the costs anticipated or the actual costs incurred in providing such benefits. Contractors employing apprentices or trainees under approved programs shall maintain written evidence of the registration of apprenticeship programs and certification

of trainee programs, the registration of the apprentices and trainees, and the ratios and wage rates prescribed in the applicable programs.

(ii)(A) The contractor shall submit weekly, for each week in which any contract work is performed, a copy of all payrolls to the applicant, sponsor, or owner, as the case may be, for transmission to the Federal Aviation Administration. The payrolls submitted shall set out accurately and completely all of the information required to be maintained under paragraph 5.5(a)(3)(i) above. This information may be submitted in any form desired. Optional Form WH-347 is available for this purpose and may be purchased from the Superintendent of Documents (Federal Stock Number 029-005-00014-1), U.S. Government Printing Office, Washington, D.C. 20402. The prime contractor is responsible for the submission of copies of payrolls by all subcontractors.

(B) Each payroll submitted shall be accompanied by a "Statement of Compliance," signed by the contractor or subcontractor or his or her agent who pays or supervises the payment of the persons employed under the contract and shall certify the following:

(1) That the payroll for the payroll period contains the information required to be maintained under paragraph (3)(i) above and that such information is correct and complete;

(2) That each laborer and mechanic (including each helper, apprentice and trainee) employed on the contract during the payroll period has been paid the full weekly wages earned, without rebate, either directly or indirectly, and that no deductions have been made either directly or indirectly from the full wages earned, other than permissible deductions as set forth in Regulations 29 CFR Part 3;

(3) That each laborer or mechanic has been paid not less than the applicable wage rates and fringe benefits or cash equivalents for the classification of work performed, as specified in the applicable wage determination incorporated into the contract.

(C) The weekly submission of a properly executed certification set forth on the reverse side of Optional Form WH-347 shall satisfy the requirement for submission of the "Statement of Compliance" required by paragraph (3)(ii)(B) of this section.

(D) The falsification of any of the above certifications may subject the contractor or subcontractor to civil or criminal prosecution under Section 1001 of Title 18 and Section 231 of Title 31 of the United States Code.

(iii) The contractor or subcontractor shall make the records required under paragraph (3)(i) of this section available for inspection, copying or transcription by authorized representatives of the Sponsor, the Federal Aviation Administration or the Department of Labor, and shall permit such representatives to interview employees during working hours on the job. If the contractor or subcontractor fails to submit the required records or to make them available, the Federal agency may, after written notice to the contractor, sponsor, applicant or owner, take such action as may be necessary to cause the suspension of any further payment, advance, or guarantee of funds. Furthermore, failure to submit the required records upon request or to make such records available may be grounds for debarment action pursuant to 29 CFR 5.12.

B-4 Apprentices and Trainees.

(i) Apprentices. Apprentices will be permitted to work at less than the predetermined rate for the work they performed when they are employed pursuant to and individually registered in a bona fide apprenticeship program registered with the U.S. Department of Labor, Employment and Training Administration, Bureau of Apprenticeship and Training, or with a State Apprenticeship Agency recognized by the Bureau, or if a person is employed in his or her first 90 days of probationary employment as an apprentice in such an apprenticeship program, who is not individually registered in the program, but who has been certified by the Bureau of Apprenticeship and Training or a State Apprenticeship Agency (where

appropriate) to be eligible for probationary employment as an apprentice. The allowable ratio of apprentices to journeymen on the job site in any craft classification shall not be greater than the ratio permitted to the contractor as to the entire work force under the registered program. Any worker listed on a payroll at an apprentice wage rate, who is not registered or otherwise employed as stated above, shall be paid not less than the applicable wage rate on the wage determination for the classification of work actually performed. In addition, any apprentice performing work on the job site in excess of the ratio permitted under the registered program shall be paid not less than the applicable wage rate on the wage determination for the work actually performed. Where a contractor is performing construction on a project in a locality other than that in which its program is registered, the ratios and wage rates (expressed in percentages of the journeyman's hourly rate) specified in the contractor's or subcontractor's registered program shall be observed. Every apprentice must be paid at not less than the rate specified in the registered program for the apprentice's level of progress, expressed as a percentage of the journeymen hourly rate specified in the applicable wage determination. Apprentices shall be paid fringe benefits in accordance with the provisions of the apprenticeship program. If the apprenticeship program does not specify fringe benefits, apprentices must be paid the full amount of fringe benefits listed on the wage determination for the applicable classification. If the Administrator determines that a different practice prevails for the applicable apprentice classification, fringes shall be paid in accordance with that determination. In the event the Bureau of Apprenticeship and Training, or a State Apprenticeship Agency recognized by the Bureau, withdraws approval of an apprenticeship program, the contractor will no longer be permitted to utilize apprentices at less than the applicable predetermined rate for the work performed until an acceptable program is approved.

(ii) Trainees. Except as provided in 29 CFR 5.16, trainees will not be permitted to work at less than the predetermined rate for the work performed unless they are employed pursuant to and individually registered in a program which has received prior approval, evidenced by formal certification by the U.S. Department of Labor, Employment and Training Administration. The ratio of trainees to journeymen on the job site shall not be greater than permitted under the plan approved by the Employment and Training Administration. Every trainee must be paid at not less than the rate specified in the approved program for the trainee's level of progress, expressed as a percentage of the journeyman hourly rate specified in the applicable wage determination. Trainees shall be paid fringe benefits in accordance with the provisions of the trainee program. If the trainee program does not mention fringe benefits, trainees shall be paid the full amount of fringe benefits listed on the wage determination unless the Administrator of the Wage and Hour Division determines that there is an apprenticeship program associated with the corresponding journeyman wage rate on the wage determination which provides for less than full fringe benefits for apprentices. Any employee listed on the payroll at a trainee rate who is not registered and participating in a training plan approved by the Employment and Training Administration shall be paid not less than the applicable wage rate on the wage determination for the classification of work actually performed. In addition, any trainee performing work on the job site in excess of the ratio permitted under the registered program shall be paid not less than the applicable wage rate on the wage determination for the work actually performed. In the event the Employment and Training Administration withdraws approval of a training program, the contractor will no longer be permitted to utilize trainees at less than the applicable predetermined rate for the work performed until an acceptable programs approved.

(iii) Equal Employment Opportunity (EEO). The utilization of apprentices, trainees and journeymen under this part shall be in conformity with the equal employment opportunity requirements of Executive Order 11246, as amended, and 29 CFR Part 30.

B-5 Compliance With Copeland Act Requirements.

The contractor shall comply with the requirements of 29 CFR Part 3, which are incorporated by reference in this contract.

B-6 Subcontracts.

The contractor or subcontractor shall insert in any subcontracts the clauses contained in 29 CFR Part 5.5(a)(1) through (10) and such other clauses as the Federal Aviation Administration may by appropriate instructions require, and also a clause requiring the subcontractors to include these clauses in any lower tier subcontracts. The prime contractor shall be responsible for the compliance by any subcontractor or lower tier subcontractor with all the contract clauses in 29 CFR Part 5.5.

B-7 Contract Termination: Debarment.

A breach of the contract clauses in paragraph 1 through 10 of this section may be grounds for termination of the contract, and for the debarment as a contractor and a subcontractor as provided in 29 CFR 5.12

B-8 Compliance With Davis-Bacon and Related Act Requirements.

All rulings and interpretations of the Davis-Bacon and Related Acts contained in 29 CFR Parts 1, 3, and 5 are herein incorporated by reference in this contract.

B-9 Disputes Concerning Labor Standards.

Disputes arising out of the labor standards provisions of this contract shall not be subject to the general disputes clause of this contract. Such disputes shall be resolved in accordance with the procedures of the Department of Labor set forth in 29 CFR Parts 5, 6 and 7. Disputes within the meaning of this clause include disputes between the contractor (or any of its subcontractors) and the contracting agency, the U.S. Department of Labor, or the employees or their representatives.

B-10 Certification of Eligibility.

(i) By entering into this contract, the contractor certifies that neither it (nor he or she) nor any person or firm who has an interest in the contractor's firm is a person or firm ineligible to be awarded Government contracts by virtue of section 3(a) of the Davis-Bacon Act or 29 CFR 5.12(a)(1).

(ii) No part of this contract shall be subcontracted to any person or firm ineligible for award of a Government contract by virtue of section 3(a) of the Davis-Bacon Act or 29 CFR 5.12(a)(1).

(iii) The penalty for making false statements is prescribed in the U.S. Criminal Code, 18 U.S.C. 1001.

SECTION C

CONTRACT WORKHOURS AND SAFETY STANDARDS ACT REQUIREMENTS (29 CFR PART 5)

C-1 Overtime Requirements.

No contractor or subcontractor contracting for any part of the contract work which may require or involve the employment of laborers or mechanics shall require or permit any such laborer or mechanic, including watchmen and guards, in any workweek in which he or she is employed on such work to work in excess of forty hours in such workweek unless such laborer or mechanic receives compensation at a rate not less than one and one-half times the basic rate of pay for all hours worked in excess of forty hours in such workweek.

C-2 Violation; Liability for Unpaid Wages; Liquidated Damages.

In the event of any violation of the clause set forth in paragraph C-1 above, the contractor or any subcontractor responsible therefore shall be liable for the unpaid wages. In addition, such contractor and subcontractor shall be liable to the United States (in the case of work done under contract for the District of Columbia or a territory, to such District or to such territory), for liquidated damages. Such liquidated damages shall be computed with respect to each individual laborer or mechanic, including watchmen and guards, employed in violation of the clause set forth in paragraph C-1 above, in the sum of $10 for each calendar day on which such individual was required or permitted to work in excess of the standard workweek of forty hours without payment of the overtime wages required by the clause set forth in paragraph C-1 above.

C-3 Withholding for Unpaid Wages and Liquidated Damages.

The Federal Aviation Administration or the Sponsor shall upon its own action or upon written request of an authorized representative of the Department of Labor withhold or cause to be withheld, from any monies payable on account of work performed by the contractor or subcontractor under any such contract or any other Federal contract with the same prime contractor, or any other Federally-assisted contract subject to the Contract Work Hours and Safety Standards Act, which is held by the same prime contractor, such sums as may be determined to be necessary to satisfy any liabilities of such contractor or subcontractor for unpaid wages and liquidated damages as provided in the clause set forth in paragraph C-2 above.

C-4 Subcontractors.

The contractor or subcontractor shall insert in any subcontracts the clauses set forth in paragraphs C-1 through C-4 and also a clause requiring the subcontractor to include these clauses in any lower tier subcontracts. The prime contractor shall be responsible for compliance by any subcontractor or lower tier subcontractor with the clauses set forth in paragraphs C-1 through C-4 of this section.

C-5 Working Conditions.

No contractor or subcontractor may require any laborer or mechanic employed in the performance of any contract to work in surroundings or under working conditions that are unsanitary, hazardous or dangerous to his health or safety as determined under construction safety and health standards (29 CFR Part 1926) issued by the Department of Labor.

SECTION D

CLEAN AIR AND WATER POLLUTION CONTROL REQUIREMENTS

D-1 Any other provision herein to the contrary notwithstanding, the contractor in carrying out work under this contract, shall at all times comply with all applicable state and federal air and water quality standards; with all pollution control laws; and with such rules, regulations, and directives as may be lawfully issued by a local, state, or federal agency having within its jurisdiction the protection of the environment in the area surrounding where work under this contract will be performed. In addition, the contractor shall comply with directives given by the Project Engineer in implementation of the letter and intent of FAA Advisory Circular 150/5370-10, Item P-156, Temporary Air and Water Pollution, Soil Erosion and Siltation Control. Copies of this Advisory Circular can be obtained from Department of Transportation, Distribution Unit, TAD-484.3, Washington, D.C. 20590.

D-2 Contractors and subcontractors agree:

a. That any facility to be used in the performance of the contract or subcontract or to benefit from the contract is not listed on the Environmental Protection Agency (EPA) List of Violating Facilities;

b. To comply with all the requirements of Section 114 of the Clean Air Act, as amended, 42 U.S.C. 1857 et seq. and Section 308 of the Federal Water Pollution Control Act, as amended, 33 U.S.C. 1251 et seq. relating to inspection, monitoring, entry, reports, and information, as well as all other requirements specified in Section 114 and Section 308 of the Acts, respectively, and all other regulations and guidelines issued thereunder;

c. That, as a condition for the award of this contract, the contractor or subcontractor will notify the awarding official of the receipt of any communication from the EPA indicating that a facility to be used for the performance of or benefit from the contract is under consideration to be listed on the EPA List of Violating Facilities;

d. To include or cause to be included in any construction contract or subcontract which exceeds $100,000 the aforementioned criteria and requirements.

SECTION E

CONTRACTOR CONTRACTUAL REQUIREMENTS PURSUANT TO CIVIL RIGHTS ACT OF 1964, TITLE VI (49 CFR PART 21)

During the performance of this contract, the contractor, for itself, its assignees and successors in interest (hereinafter referred to as the "contractor") agrees as follows:

E-1 Compliance with Regulations. The contractor shall comply with the Regulations relative to nondiscrimination in federally assisted programs of the Department of Transportation (hereinafter, "DOT") Title 49, Code of Federal Regulations, Part 21, as they may be amended from time to time (hereinafter referred to as the Regulations), which are herein incorporated by reference and made a part of this contract.

E-2 Nondiscrimination. The contractor, with regard to the work performed by it during the contract, shall not discriminate on the grounds of race, color, or national origin in the selection and retention of subcontractors, including procurements of materials and leases of equipment. The contractor shall not participate either directly or indirectly in the discrimination prohibited by section 21.5 of the Regulations, including employment practices when the contract covers a program set forth in Appendix B of the Regulations.

E-3 Solicitations for Subcontracts, Including Procurements of Materials and Equipment. In all solicitations either by competitive bidding or negotiation made by the contractor for work to be performed under a subcontract, including procurements of materials or leases of equipment, each potential subcontractor or supplier shall be notified by the contractor of the contractor's obligations under this contract and the Regulations relative to nondiscrimination on the grounds of race, color, or national origin.

E-4 Information and Reports. The contractor shall provide all information and reports required by the Regulations or directives issued pursuant thereto and shall permit access to its books, records, accounts, other sources of information, and its facilities as may be determined by the Sponsor or the Federal Aviation Administration (FAA) to be pertinent to ascertain compliance with such Regulations, orders, and instructions. Where any information required of a contractor is in the exclusive possession of another who fails or refuses to furnish this information, the contractor shall so certify to the sponsor or the FAA, as appropriate, and shall set forth what efforts it has made to obtain the information.

E-5 Sanctions for Noncompliance. In the event of the contractor's noncompliance with the nondiscrimination provisions of this contract, the sponsor shall impose such contract sanctions as it or the FAA may determine to be appropriate, including, but not limited to:

a. Withholding of payments to the contractor under the contract until the contractor complies, and/or

b. Cancellation, termination, or suspension of the contract, in whole or in part.

E-6 Incorporation of Provisions. The contractor shall include the provisions of paragraphs 1 through 5 in every subcontract, including procurements of materials and leases of equipment, unless exempt by the Regulations or directives issued pursuant thereto. The contractor shall take such action with respect to any subcontract or procurement as the sponsor or the FAA may direct as a means of enforcing such provisions including sanctions for noncompliance. Provided, however, that in the event a contractor becomes involved in, or is threatened with, litigation with a subcontractor or supplier as a result of such direction, the contractor may request the Sponsor to enter into such litigation to protect the interests of the sponsor and, in addition, the contractor may request the United States to enter into such litigation to protect the interests of the United States.

SECTION F

TERMINATION OF CONTRACT
(49 CFR PART 18)

F-1 The Sponsor may, by written notice, terminate this contract in whole or in part at any time, either for the Sponsor's convenience or because of failure to fulfill the contract obligations. Upon receipt of such notice services shall be immediately discontinued (unless the notice directs otherwise) and all materials as may have been accumulated in performing this contract, whether completed or in progress, delivered to the Sponsor.

F-2 If the termination is for the convenience of the Sponsor, an equitable adjustment in the contract price shall be made, but no amount shall be allowed for anticipated profit on unperformed services.

F-3 If the termination is due to failure to fulfill the contractor's obligations, the Sponsor may take over the work and prosecute the same to completion by contract or otherwise. In such case, the contractor shall be liable to the Sponsor for any additional cost occasioned to the Sponsor thereby.

F-4 If, after notice of termination for failure to fulfill contract obligations, it is determined that the contractor had not so failed, the termination shall be deemed to have been effected for the convenience of the Sponsor. In such event, adjustment in the contract price shall be made as provided in paragraph 2 of this clause.

F-5 The rights and remedies of the sponsor provided in this clause are in addition to any other rights and remedies provided by law or under this contract.

SECTION G

BUY AMERICAN - STEEL AND MANUFACTURED PRODUCTS FOR CONSTRUCTION CONTRACTS (Aviation Safety and Capacity Expansion Act of 1990)

(a) The Aviation Safety and Capacity Expansion Act of 1990 provides that preference be given to steel and manufactured products produced in the United States when funds are expended pursuant to a grant issued under the Airport Improvement Program. The following terms apply:

1. Steel and manufactured products. As used in this clause, steel and manufactured products include (1) those produced in the United States or (2) a manufactured product produced in the United States, if the cost of its components mined, produced or manufactured in the United States exceeds 60 percent of the cost of all its components and final assembly has taken place in the United States. Components of foreign origin of the same class or kind as the products referred to in subparagraphs b. (1) or (2) shall be treated as domestic.

2. Components. As used in this clause, components means those articles, materials, and supplies incorporated directly into steel and manufactured products.

3. Cost of Components. This means the cost for production of the components, exclusive of final assembly labor costs.

(b) The successful bidder will be required to assure that only domestic steel and manufactured products will be used by the Contractor, subcontractors, materialmen, and suppliers in the performance of this contract, except those:

1. that the U.S. Department of Transportation has determined, under the Aviation Safety and Capacity Expansion Act of 1990, are not produced in the United States in sufficient and reasonably available quantities and of a satisfactory quality;

2. that the U.S. Department of Transportation has determined, under the Aviation Safety and Capacity Expansion Act of 1990, that domestic preference would be inconsistent with the public interest; or

3. that inclusion of domestic material will increase the cost of the overall project contract by more than 25 percent.

SECTION H

EQUAL EMPLOYMENT OPPORTUNITY
(41 CFR PART 60-1.4(b))

During the performance of this contract, the contractor agrees as follows:

H-1 The contractor will not discriminate against any employee or applicant for employment because of race, color, religion, sex, or national origin. The contractor will take affirmative action to ensure that applicants are employed, and that employees are treated during employment without regard to their race, color, religion, sex, or national origin. Such action shall include, but not be limited to the following:

Employment, upgrading, demotion, or transfer; recruitment or recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship. The contractor agrees to post in conspicuous places, available to employees and applicants for employment, notices to be provided setting forth the provisions of this nondiscrimination clause.

H-2 The contractor will, in all solicitations or advertisements for employees placed by or on behalf of the contractor, state that all qualified applicants will receive considerations for employment without regard to race, color, religion, sex, or national origin.

H-3 The contractor will send to each labor union or representative of workers with which s/he has a collective bargaining agreement or other contract or understanding, a notice to be provided advising the said labor union or workers' representatives of the contractor's commitments under this section, and shall post copies of the notice in conspicuous places available to employees and applicants for employment.

H-4 The contractor will comply with all provisions of Executive Order 11246 of September 24, 1965, as amended, and of the rules, regulations, and relevant orders of the Secretary of Labor.

H-5 The contractor will furnish all information and reports required by Executive Order 11246 of September 24, 1965, and by rules, regulations, and orders of the Secretary of Labor, or pursuant thereto, and will permit access to his books, records, and accounts by the administering agency and the Secretary of Labor for purposes of investigation to ascertain compliance with such rules, regulations, and orders.

H-6 In the event of the contractor's noncompliance with the nondiscrimination clauses of this contract or with any of the said rules, regulations, or orders, this contract may be canceled, terminated or suspended in whole or in part and the contractor may be declared ineligible for further Government contracts or federally assisted construction contracts in accordance with procedure authorized in Executive Order 11246 of September 24, 1965, and such other sanctions may be imposed and remedies invoked as provided in Executive Order 11246 of September 24, 1965, or by rule, regulation, or order of the Secretary of Labor, or as otherwise provided by law.

H-7 The contractor will include the portion of the sentence immediately preceding paragraph D-1 and the provisions of paragraphs D-1 through D-7 in every subcontract or purchase order unless exempted by rules, regulations, or orders of the Secretary of Labor issued pursuant to section 204 of Executive Order 11246 of September 24, 1965, so that such provisions will be binding upon each subcontractor or vendor. The contractor will take such action with respect to any subcontract or purchase order as the administering agency may direct as a means of enforcing such provision, including sanctions for noncompliance: *Provided, however*, that in the event a contractor becomes involved in, or is threatened with, litigation with a subcontractor or vendor as a result of such direction by the administering agency the contractor may request the United States to enter into such litigation to protect the interests of the United States.

SECTION I

STANDARD FEDERAL EQUAL EMPLOYMENT OPPORTUNITY CONSTRUCTION CONTRACT SPECIFICATIONS (41 CFR 60-4.3)

I-1 As used in these specifications:

a. "Covered area" means the geographical area described in the solicitation from which this contract resulted;

b. "Director" means Director, Office of Federal Contract Compliance Programs (OFCCP), U.S. Department of Labor, or any person to whom the Director delegates authority;

c. "Employer identification number" means the Federal social security number used on the Employer's Quarterly Federal Tax Return, U.S. Treasury Department Form 941;

d. "Minority" includes:

(1) Black (all) persons having origins in any of the Black African racial groups not of Hispanic origin);

2) Hispanic (all persons of Mexican, Puerto Rican, Cuban, Central or South American, or other Spanish culture or origin regardless of race);

(3) Asian and Pacific Islander (all persons having origins in any of the original peoples of the Far East, Southeast Asia, the Indian Subcontinent, or the Pacific Islands); and

(4) American Indian or Alaskan native (all persons having origins in any of the original peoples of North America and maintaining identifiable tribal affiliations through membership and participation or community identification).

I-2 Whenever the contractor, or any subcontractor at any tier, subcontracts a portion of the work involving any construction trade, it shall physically include in each subcontract in excess of $10,000 the provisions of these specifications and the Notice which contains the applicable goals for minority and female participation and which is set forth in the solicitations from which this contract resulted.

I-3 If the contractor is participating (pursuant to 41 CFR 60-4.5) in a Hometown Plan approved by the U.S. Department of Labor in the covered area either individually or through an association, its affirmative action obligations on all work in the Plan area (including goals and timetables) shall be in accordance with that Plan for those trades which have unions participating in the Plan. Contractors shall be able to demonstrate their participation in and compliance with the provisions of any such Hometown Plan. Each contractor or subcontractor participating in an approved plan is individually required to comply with its obligations under the EEO clause and to make a good faith effort to achieve each goal under the Plan in each trade in which it has employees. The overall good faith performance by other contractors or subcontractors toward a goal in an approved Plan does not excuse any covered contractor's or subcontractor's failure to take good faith efforts to achieve the Plan goals and timetables.

I-4 The contractor shall implement the specific affirmative action standards provided in paragraphs 7a through 7p of these specifications. The goals set forth in the solicitation from which this contract resulted are expressed as percentages of the total hours of employment and training of minority and female utilization the contractor should reasonably be able to achieve in each construction trade in which it has employees in the covered area. Covered construction contractors performing construction work in a geographical area where they do not have a Federal or federally assisted construction contract shall

apply the minority and female goals established for the geographical area where the work is being performed. Goals are published periodically in the Federal Register in notice form, and such notices may be obtained from any Office of Federal Contract Compliance Programs office or from Federal procurement contracting officers. The contractor is expected to make substantially uniform progress in meeting its goals in each craft during the period specified.

I-5 Neither the provisions of any collective bargaining agreement nor the failure by a union with whom the contractor has a collective bargaining agreement to refer either minorities or women shall excuse the contractor's obligations under these specifications, Executive Order 11246 or the regulations promulgated pursuant thereto.

I-6 In order for the non-working training hours of apprentices and trainees to be counted in meeting the goals, such apprentices and trainees shall be employed by the contractor during the training period and the contractor shall have made a commitment to employ the apprentices and trainees at the completion of their training, subject to the availability of employment opportunities. Trainees shall be trained pursuant to training programs approved by the U.S. Department of Labor.

I-7 The contractor shall take specific affirmative actions to ensure equal employment opportunity. The evaluation of the contractor's compliance with these specifications shall be based upon its effort to achieve maximum results from its actions. The contractor shall document these efforts fully and shall implement affirmative action steps at least as extensive as the following:

a. Ensure and maintain a working environment free of harassment, intimidation, and coercion at all sites, and in all facilities at which the contractor's employees are assigned to work. The contractor, where possible, will assign two or more women to each construction project. The contractor shall specifically ensure that all foremen, superintendents, and other onsite supervisory personnel are aware of and carry out the contractor's obligation to maintain such a working environment, with specific attention to minority or female individuals working at such sites or in such facilities.

b. Establish and maintain a current list of minority and female recruitment sources, provide written notification to minority and female recruitment sources and to community organizations when the contractor or its unions have employment opportunities available, and maintain a record of the organizations' responses.

c. Maintain a current file of the names, addresses, and telephone numbers of each minority and female off-the-street applicant and minority or female referral from a union, a recruitment source, or community organization and of what action was taken with respect to each such individual. If such individual was sent to the union hiring hall for referral and was not referred back to the contractor by the union or, if referred, not employed by the contractor, this shall be documented in the file with the reason therefore along with whatever additional actions the contractor may have taken.

d. Provide immediate written notification to the Director when the union or unions with which the contractor has a collective bargaining agreement has not referred to the contractor a minority person or female sent by the contractor, or when the contractor has other information that the union referral process has impeded the contractor's efforts to meet its obligations.

e. Develop on-the-job training opportunities and/or participate in training programs for the area which expressly include minorities and women, including upgrading programs and apprenticeship and trainee programs relevant to the contractor's employment needs, especially those programs funded or approved by the Department of Labor. The contractor shall provide notice of these programs to the sources compiled under 7b above.

f. Disseminate the contractor's EEO policy by providing notice of the policy to unions and training programs and requesting their cooperation in assisting the contractor in meeting its EEO obligations; by including it in any policy manual and collective bargaining agreement; by publicizing it in the company

newspaper, annual report, etc.; by specific review of the policy with all management personnel and with all minority and female employees at least once a year; and by posting the company EEO policy on bulletin boards accessible to all employees at each location where construction work is performed.

g. Review, at least annually, the company's EEO policy and affirmative action obligations under these specifications with all employees having any responsibility for hiring, assignment, layoff, termination, or other employment decisions including specific review of these items with onsite supervisory personnel such a superintendents, general foremen, etc., prior to the initiation of construction work at any job site. A written record shall be made and maintained identifying the time and place of these meetings, persons attending, subject matter discussed, and disposition of the subject matter.

h. Disseminate the contractor's EEO policy externally by including it in any advertising in the news media, specifically including minority and female news media, and providing written notification to and discussing the contractor's EEO policy with other contractors and subcontractors with whom the contractor does or anticipates doing business.

i. Direct its recruitment efforts, both oral and written, to minority, female, and community organizations, to schools with minority and female students; and to minority and female recruitment and training organizations serving the contractor's recruitment area and employment needs. Not later than one month prior to the date for the acceptance of applications for apprenticeship or other training by any recruitment source, the contractor shall send written notification to organizations, such as the above, describing the openings, screening procedures, and tests to be used in the selection process.

j. Encourage present minority and female employees to recruit other minority persons and women and, where reasonable provide after school, summer, and vacation employment to minority and female youth both on the site and in other areas of a contractor's workforce.

k. Validate all tests and other selection requirements where there is an obligation to do so under 41 CFR Part 60-3.

l. Conduct, at least annually, an inventory and evaluation at least of all minority and female personnel, for promotional opportunities and encourage these employees to seek or to prepare for, through appropriate training, etc., such opportunities.

m. Ensure that seniority practices, job classifications, work assignments, and other personnel practices do not have a discriminatory effect by continually monitoring all personnel and employment related activities to ensure that the EEO policy and the contractor's obligations under these specifications are being carried out.

n. Ensure that all facilities and company activities are nonsegregated except that separate or single user toilet and necessary changing facilities shall be provided to assure privacy between the sexes.

o. Document and maintain a record of all solicitations of offers for subcontracts from minority and female construction contractors and suppliers, including circulation of solicitations to minority and female contractor associations and other business associations.

p. Conduct a review, at least annually, of all supervisor's adherence to and performance under the contractor's EEO policies and affirmative action obligations.

I-8 Contractors are encouraged to participate in voluntary associations which assist in fulfilling one or more of their affirmative action obligations (7a through 7p). The efforts of a contractor association, joint contractor union, contractor community, or other similar groups of which the contractor is a member and participant, may be asserted as fulfilling any one or more of its obligations under 7a through 7p of these specifications provided that the contractor actively participates in the group, makes every effort to assure that the group has a positive impact on the employment of minorities and women in the industry, ensures

that the concrete benefits of the program are reflected in the contractor's minority and female workforce participation, makes a good faith effort to meet its individual goals and timetables, and can provide access to documentation which demonstrates the effectiveness of actions taken on behalf of the contractor. The obligation to comply, however, is the contractor's and failure of such a group to fulfill an obligation shall not be a defense for the contractor's noncompliance.

I-9 A single goal for minorities and a separate single goal for women have been established. The contractor, however, is required to provide equal employment opportunity and to take affirmative action for all minority groups, both male and female, and all women, both minority and non minority. Consequently, if the particular group is employed in a substantially disparate manner (for example, even though the contractor has achieved its goals for women generally,) the contractor may be in violation of the Executive Order if a specific minority group of women is underutilized.

I-10 The contractor shall not use the goals and timetables or affirmative action standards to discriminate against any person because of race, color, religion, sex, or national origin.

I-11 The contractor shall not enter into any subcontract with any person or firm debarred from Government contracts pursuant to Executive Order 11246.

I-12 The contractor shall carry out such sanctions and penalties for violation of these specifications and of the Equal Opportunity Clause, including suspension, termination, and cancellation of existing subcontracts as may be imposed or ordered pursuant to Executive Order 11246, as amended, and its implementing regulations, by the Office of Federal Contract Compliance Programs. Any contractor who fails to carry out such sanctions and penalties shall be in violation of these specifications and Executive Order 11246, as amended.

I-13 The contractor, in fulfilling its obligations under these specifications, shall implement specific affirmative action steps, at least as extensive as those standards prescribed in paragraph 7 of these specifications, so as to achieve maximum results from its efforts to ensure equal employment opportunity. If the contractor fails to comply with the requirements of the Executive Order, the implementing regulations, or these specifications, the Director shall proceed in accordance with 41 CFR 60-4.8.

I-14 The contractor shall designate a responsible official to monitor all employment related activity to ensure that the company EEO policy is being carried out, to submit reports relating to the provisions hereof as may be required by the Government, and to keep records. Records shall at least include for each employee, the name, address, telephone number, construction trade, union affiliation if any, employee identification number when assigned, social security number, race, sex, status (e.g., mechanic, apprentice, trainee, helper, or laborer), dates of changes in status, hours worked per week in the indicated trade, rate of pay, and locations at which the work was performed. Records shall be maintained in an easily understandable and retrievable form; however, to the degree that existing records satisfy this requirement, contractors shall not be required to maintain separate records.

I-15 Nothing herein provided shall be construed as a limitation upon the application of other laws which establish different standards of compliance or upon the application of requirements for the hiring of local or other area residents (e.g., those under the Public Works Employment Act of 1977 and the Community Development Block Grant Program).

SECTION J

MANDATORY REQUIREMENT FOR ALL AIP FUNDED CONSTRUCTION PROJECTS INVOLVING ELECTRICAL ENERGY OR OTHER HAZARDOUS ENERGY SOURCES

For projects involving electrical energy or other hazardous energy source, the contractor shall submit a copy of their Lockout/Tagout program which meets the requirements of 29 CFR 1910.331, Safety Related Work Practices (OSHA). During the performance of electrical work, it is recommended than an unannounced inspection be performed by the airport sponsor or his agent to determine if the Lockout/Tagout program is being followed. Immediate action shall be taken to correct noncompliance, including suspension of work when necessary.

SECTION K

DISADVANTAGED BUSINESS ENTERPRISE CONTRACT PROVISIONS (49 CFR PART 26)

PART A

Policy. The requirements of 49 CFR Part 26, Regulations of the U.S. Department of Transportation, apply to this contract. It is the policy of the City of Pensacola, Florida, to practice nondiscrimination based on race, color, sex, or national origin in the award or performance of this contract. All firms qualifying under this solicitation are encouraged to submit bids/proposals. Award of this contract will be conditioned upon satisfying the requirements of this bid specification. These requirements apply to all bidders/offerors, including those who qualify as a DBE. A DBE contract goal of **4 percent** has been established for this contract. The bidder/offeror shall make good faith efforts, as defined in Appendix A, 49 CFR Part 26 (Attachment 1), to meet the contract goal for DBE participation in the performance of this contract.

Contract Assurance (§26.13). The contractor or subcontractor shall not discriminate on the basis of race, color, national origin, or sex in the performance of this contract. The contractor shall carry out applicable requirements of 49 CFR Part 26 in the award and administration of DOT assisted contracts. Failure by the contractor to carry out these requirements is a material breach of this contract, which may result in the termination of this contract or such other remedy, as the recipient deems appropriate.

Prompt Payment (§26.29). The prime contractor agrees to pay each subcontractor under this prime contract for satisfactory performance of its contract no later than 7 days from the receipt of each payment the prime contractor receives from the **Lynchburg Regional Airport, Lynchburg, Virginia**. The prime contractor agrees further to return retainage payments to each subcontractor within 7 days after the subcontractor's work is satisfactorily completed. Any delay or postponement of payment from the above referenced time frame may occur only for good cause following written approval of the **Lynchburg Regional Airport, Lynchburg, Virginia**. This clause applies to both DBE and non-DBE subcontractors.

DBE Participation. DBE Participation in this contract may be in form of a prime contract, subcontract, joint venture, or another arrangement that qualifies under 49 CFR Sections 26.55, "How is DBE participation counted toward goals?" or 26.53(g), both of which are included as Attachment 1.

Subcontract Clauses. All bidders and potential contractors hereby assure that they will include the above clauses in all subcontracts which offers further subcontracting opportunities.

PART B

It is further understood and agreed:

The award procedure for this solicitation will include the selection criteria of 49 CFR Part 26 to ensure that prime contracts are awarded to competitors that meet Disadvantaged Business Enterprise (DBE) goals.

Notification is hereby given that DBE goals are established for this prime contract. The goal for firms owned and controlled by socially and economically disadvantaged individuals is **4 percent** of the dollar value of this contract.

The bidder/offeror will be required to submit the following information: (1) the names and addresses of DBE firms that will participate in the contract; (2) a description of the work that each DBE firm will perform; (3) the dollar amount of the participation of each DBE firm participating; (4) written documentation of the bidder/offeror's commitment to use a DBE subcontractor whose participation it submits to meet the

contract goal; (5) written confirmation from the DBE that it is participating in the contract as provided in the commitment made under (4); and (6) if the contract goal is not met, evidence of good faith efforts.

Agreements between bidder/proposer and a DBE in which the DBE promises not to provide sub-contracting quotations to other bidders/proposers are prohibited. All bidders and proposers shall make a good faith effort to replace a DBE subcontractor that is unable to perform successfully with another DBE subcontractor.

The bidder shall establish and maintain records and submit regular reports, as required, which will identify and assess progress in achieving DBE subcontract goals and other DBE affirmative action efforts.

SECTION L

ENERGY CONSERVATION REQUIREMENTS
(49 CFR PART 18.36(i)(13))

The contractor agrees to comply with mandatory standards and policies relating to energy efficiency that are contained in the state energy conservation plan issued in compliance with the Energy Policy and Conservation Act (Public Law 94-163).

SECTION M

LOBBYING AND INFLUENCING FEDERAL EMPLOYEES (49 CFR PART 20, APPENDIX A)

(1) No Federal appropriated funds shall be paid, by or on behalf of the contractor, to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with the making of any Federal grant and the amendment or modification of any Federal grant.

(2) If any funds other than Federal appropriated funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with any Federal grant, the contractor shall complete and submit Standard Form-LLL, “Disclosure of Lobby Activities”, in accordance with its instructions.

General Provisions

Section 10 Definition of Terms

Where portions of text have been lined through (~~example~~) this text has been deleted and does not apply to this project. Where portions of text have been added with bold/italic font (***example***), this text has been added and is binding to this project.

Whenever the following terms are used in these specifications, in the contract, or in any documents or other instruments pertaining to construction where these specifications govern, the intent and meaning shall be interpreted as follows:

10-01 AASHTO. The American Association of State Highway and Transportation Officials, the successor association to AASHO.

10-02 Access road. The right-of-way, the roadway and all improvements constructed thereon connecting the airport to a public highway.

10-03 Advertisement. A public announcement, as required by local law, inviting bids for work to be performed and materials to be furnished.

10-04 Airport Improvement Program (AIP). A grant-in-aid program, administered by the Federal Aviation Administration (FAA).

10-05 Air operations area (AOA). For the purpose of these specifications, the term air operations area (AOA) shall mean any area of the airport used or intended to be used for the landing, takeoff, or surface maneuvering of aircraft. An air operation area shall include such paved or unpaved areas that are used or intended to be used for the unobstructed movement of aircraft in addition to its associated runway, taxiway, or apron.

10-06 Airport. Airport means an area of land or water which is used or intended to be used for the landing and takeoff of aircraft; an appurtenant area used or intended to be used for airport buildings or other airport facilities or rights of way; and airport buildings and facilities located in any of these areas, and includes a heliport.

10-07 ASTM International (ASTM). Formerly known as the American Society for Testing and Materials (ASTM).

10-08 Award. The Owner's notice to the successful bidder of the acceptance of the submitted bid.

10-09 Bidder. Any individual, partnership, firm, or corporation, acting directly or through a duly authorized representative, who submits a proposal for the work contemplated.

10-10 Building area. An area on the airport to be used, considered, or intended to be used for airport buildings or other airport facilities or rights-of-way together with all airport buildings and facilities located thereon.

10-11 Calendar day. Every day shown on the calendar.

10-12 Change order. A written order to the Contractor covering changes in the plans, specifications, or proposal quantities and establishing the basis of payment and contract time adjustment, if any, for the work affected by such changes. The work, covered by a change order, must be within the scope of the contract.

10-13 Contract. The written agreement covering the work to be performed. The awarded contract shall include, but is not limited to: Advertisement, Contract Form, Proposal, Performance Bond, Payment Bond, any required insurance certificates, Specifications, Plans, and any addenda issued to bidders.

10-14 Contract item (pay item). A specific unit of work for which a price is provided in the contract.

10-15 Contract time. The number of calendar days or working days, stated in the proposal, allowed for completion of the contract, including authorized time extensions. If a calendar date of completion is stated in the proposal, in lieu of a number of calendar or working days, the contract shall be completed by that date.

10-16 Contractor. The individual, partnership, firm, or corporation primarily liable for the acceptable performance of the work contracted and for the payment of all legal debts pertaining to the work who acts directly or through lawful agents or employees to complete the contract work.

10-17 Contractor's laboratory. The Contractor's quality control organization in accordance with the Contractor Quality Control Program.

10-18 Construction Safety and Phasing Plan (CSPP). The overall plan for safety and phasing of a construction project developed by the airport operator, or developed by the airport operator's consultant and approved by the airport operator. It is included in the invitation for bids and becomes part of the project specifications.

10-19 Drainage system. The system of pipes, ditches, and structures by which surface or subsurface waters are collected and conducted from the airport area.

10-20 Engineer. The individual, partnership, firm, or corporation duly authorized by the Owner to be responsible for engineering observation and inspection of the contract work and acting directly or through an authorized representative.

10-21 Equipment. All machinery, together with the necessary supplies for upkeep and maintenance, and also all tools and apparatus necessary for the proper construction and acceptable completion of the work.

10-22 Extra work. An item of work not provided for in the awarded contract as previously modified by change order or supplemental agreement, but which is found by the Engineer to be necessary to complete the work within the intended scope of the contract as previously modified.

10-23 FAA. The Federal Aviation Administration of the U.S. Department of Transportation. When used to designate a person, FAA shall mean the Administrator or his or her duly authorized representative.

10-24 Federal specifications. The Federal Specifications and Standards, Commercial Item Descriptions, and supplements, amendments, and indices thereto are prepared and issued by the General Services Administration of the Federal Government.

10-25 Force account. Force account work is planning, engineering, or construction work done by the Sponsor's employees.

10-26 Inspector. An authorized representative of the Engineer assigned to make all necessary inspections, observations and/or tests of the work performed or being performed, or of the materials furnished or being furnished by the Contractor.

10-27 Intention of terms. Whenever, in these specifications or on the plans, the words "directed," "required," "permitted," "ordered," "designated," "prescribed," or words of like import are used, it shall be understood that the direction, requirement, permission, order, designation, or prescription of the Engineer is intended; and similarly, the words "approved," "acceptable," "satisfactory," or words of like import, shall mean approved by, or acceptable to, or satisfactory to the Engineer, subject in each case to the final determination of the Owner.

Any reference to a specific requirement of a numbered paragraph of the contract specifications or a cited standard shall be interpreted to include all general requirements of the entire section, specification item, or cited standard that may be pertinent to such specific reference.

10-28 Laboratory. The official testing laboratories of the Owner or such other laboratories as may be designated by the Engineer. Also referred to as "Engineer's Laboratory" or "quality assurance laboratory."

10-29 Lighting. A system of fixtures providing or controlling the light sources used on or near the airport or within the airport buildings. The field lighting includes all luminous signals, markers, floodlights, and illuminating devices used on or near the airport or to aid in the operation of aircraft landing at, taking off from, or taxiing on the airport surface.

10-29A Liquidated Damages. Monetary damages paid by the Contractor to the Owner for each calendar or working day or night after the applicable contract time has elapsed until the work is completed and accepted by the Owner and Engineer.

10-30 Major and minor contract items. A major contract item shall be any item that is listed in the proposal, the total cost of which is equal to or greater than 20% of the total amount of the award contract. All other items shall be considered minor contract items.

10-31 Materials. Any substance specified for use in the construction of the contract work.

10-32 Notice to Proceed (NTP). A written notice to the Contractor to begin the actual contract work on a previously agreed to date. If applicable, the Notice to Proceed shall state the date on which the contract time begins.

10-33 Owner. The term "Owner" shall mean the party of the first part or the contracting agency signatory to the contract. Where the term "Owner" is capitalized in this document, it shall mean airport Sponsor only.

10-34 Passenger Facility Charge (PFC). Per 14 CFR Part 158 and 49 USC § 40117, a PFC is a charge imposed by a public agency on passengers enplaned at a commercial service airport it controls."

10-35 Pavement. The combined surface course, base course, and subbase course, if any, considered as a single unit.

10-36 Payment bond. The approved form of security furnished by the Contractor and his or her surety as a guaranty that the Contractor will pay in full all bills and accounts for materials and labor used in the construction of the work.

10-37 Performance bond. The approved form of security furnished by the Contractor and his or her surety as a guaranty that the Contractor will complete the work in accordance with the terms of the contract.

10-38 Plans. The official drawings or exact reproductions which show the location, character, dimensions and details of the airport and the work to be done and which are to be considered as a part of the contract, supplementary to the specifications.

10-39 Project. The agreed scope of work for accomplishing specific airport development with respect to a particular airport.

10-40 Proposal. The written offer of the bidder (when submitted on the approved proposal form) to perform the contemplated work and furnish the necessary materials in accordance with the provisions of the plans and specifications.

10-41 Proposal guaranty. The security furnished with a proposal to guarantee that the bidder will enter into a contract if his or her proposal is accepted by the Owner.

10-42 Runway. The area on the airport prepared for the landing and takeoff of aircraft.

10-43 Specifications. A part of the contract containing the written directions and requirements for completing the contract work. Standards for specifying materials or testing which are cited in the contract specifications by reference shall have the same force and effect as if included in the contract physically.

10-44 Sponsor. A Sponsor is defined in 49 USC § 47102(24) as a public agency that submits to the FAA for an AIP grant; or a private Owner of a public-use airport that submits to the FAA an application for an AIP grant for the airport.

10-45 Structures. Airport facilities such as bridges; culverts; catch basins, inlets, retaining walls, cribbing; storm and sanitary sewer lines; water lines; underdrains; electrical ducts, manholes, handholes, lighting fixtures and bases; transformers; flexible and rigid pavements; navigational aids; buildings; vaults; and, other manmade features of the airport that may be encountered in the work and not otherwise classified herein.

10-46 Subgrade. The soil that forms the pavement foundation.

10-47 Superintendent. The Contractor's executive representative who is present on the work during progress, authorized to receive and fulfill instructions from the Engineer, and who shall supervise and direct the construction.

10-48 Supplemental agreement. A written agreement between the Contractor and the Owner covering (1) work that would increase or decrease the total amount of the awarded contract, or any major contract item, by more than 25%, such increased or decreased work being within the scope of the originally awarded contract; or (2) work that is not within the scope of the originally awarded contract.

10-49 Surety. The corporation, partnership, or individual, other than the Contractor, executing payment or performance bonds that are furnished to the Owner by the Contractor.

10-50 Taxiway. For the purpose of this document, the term taxiway means the portion of the air operations area of an airport that has been designated by competent airport authority for movement of aircraft to and from the airport's runways, aircraft parking areas, and terminal areas.

10-51 Work. The furnishing of all labor, materials, tools, equipment, and incidentals necessary or convenient to the Contractor's performance of all duties and obligations imposed by the contract, plans, and specifications.

10-52 Working day. A working day shall be any day other than a legal holiday, Saturday, or Sunday on which the normal working forces of the Contractor may proceed with regular work for at least six (6) hours toward completion of the contract. When work is suspended for causes beyond the Contractor's control, it will not be counted as a working day. Saturdays, Sundays and holidays on which the Contractor's forces engage in regular work will be considered as working days.

END OF SECTION 10

Section 20 Proposal Requirements and Conditions

20-01 Advertisement (Notice to Bidders).

The Owner, or their authorized agent, shall publish the advertisement at such places and at such times as are required by local law or ordinances. The published advertisement shall state the time and place for submitting sealed proposals; a description of the proposed work; instructions to bidders as to obtaining proposal forms, plans, and specifications; proposal guaranty required; and the Owner's right to reject any and all bids. If the Owner prequalifies bidders, they shall publish the advertisement at such places and at such times as are required by local law or ordinances.

20-02 Qualification of bidders. Each bidder shall furnish the Owner satisfactory evidence of his or her competency to perform the proposed work. Such evidence of competency, unless otherwise specified, shall consist of statements covering the bidder's past experience on similar work, a list of equipment that would be available for the work, and a list of key personnel that would be available. In addition, each bidder shall furnish the Owner satisfactory evidence of his or her financial responsibility. Such evidence of financial responsibility, unless otherwise specified, shall consist of a confidential statement or report of the bidder's financial resources and liabilities as of the last calendar year or the bidder's last fiscal year. Such statements or reports shall be certified by a public accountant. At the time of submitting such financial statements or reports, the bidder shall further certify whether his or her financial responsibility is approximately the same as stated or reported by the public accountant. If the bidder's financial responsibility has changed, the bidder shall qualify the public accountant's statement or report to reflect the bidder's true financial condition at the time such qualified statement or report is submitted to the Owner.

Unless otherwise specified, a bidder may submit evidence that he or she is prequalified with the State Highway Division and is on the current "bidder's list" of the state in which the proposed work is located. Such evidence of State Highway Division prequalification may be submitted as evidence of financial responsibility in lieu of the certified statements or reports specified above.

Each bidder shall submit "evidence of competency" and "evidence of financial responsibility" to the Owner at the time of bid opening.

20-03 Contents of proposal forms. The Owner shall furnish bidders with proposal forms. All papers bound with or attached to the proposal forms are necessary parts and must not be detached.

The plans, specifications, and other documents designated in the proposal form shall be considered a part of the proposal whether attached or not.

20-04 Issuance of proposal forms. The Owner reserves the right to refuse to issue a proposal form to a prospective bidder should such bidder be in default for any of the following reasons:

a. Failure to comply with any prequalification regulations of the Owner, if such regulations are cited, or otherwise included, in the proposal as a requirement for bidding.

b. Failure to pay, or satisfactorily settle, all bills due for labor and materials on former contracts in force with the Owner at the time the Owner issues the proposal to a prospective bidder.

c. Documented record of Contractor default under previous contracts with the Owner.

d. Documented record of unsatisfactory work on previous contracts with the Owner.

e. Documented record of Contractor interest in any litigation or other claim with the Owner or Engineer.

20-05 Interpretation of estimated proposal quantities. An estimate of quantities of work to be done and materials to be furnished under these specifications is given in the proposal. It is the result of careful calculations and is believed to be correct. It is given only as a basis for comparison of proposals and the award of the contract. The Owner does not expressly, or by implication, agree that the actual quantities involved will correspond exactly therewith; nor shall the bidder plead misunderstanding or deception because of such estimates of quantities, or of the character, location, or other conditions pertaining to the work. Payment to the Contractor will be made only for the actual quantities of work performed or materials furnished in accordance with the plans and specifications. It is understood that the quantities may be increased or decreased as hereinafter provided in the subsection 40-02 titled ALTERATION OF WORK AND QUANTITIES of Section 40 without in any way invalidating the unit bid prices.

20-06 Examination of plans, specifications, and site. The bidder is expected to carefully examine the site of the proposed work, the proposal, plans, specifications, and contract forms. Bidders shall satisfy themselves as to the character, quality, and quantities of work to be performed, materials to be furnished, and as to the requirements of the proposed contract. The submission of a proposal shall be prima facie evidence that the bidder has made such examination and is satisfied as to the conditions to be encountered in performing the work and as to the requirements of the proposed contract, plans, and specifications.

Boring logs and other records of subsurface investigations and tests are available for inspection of bidders. It is understood and agreed that such subsurface information, whether included in the plans, specifications, or otherwise made available to the bidder, was obtained and is intended for the Owner's design and estimating purposes only. Such information has been made available for the convenience of all bidders. It is further understood and agreed that each bidder is solely responsible for all assumptions, deductions, or conclusions which the bidder may make or obtain from his or her examination of the boring logs and other records of subsurface investigations and tests that are furnished by the Owner.

20-07 Preparation of proposal. The bidder shall submit his or her proposal on the forms furnished by the Owner. All blank spaces in the proposal forms must be correctly filled in where indicated for each and every item for which a quantity is given. The bidder shall state the price (written in ink or typed) both in words and numerals for which they propose to do for each pay item furnished in the proposal. In case of conflict between words and numerals, the words, unless obviously incorrect, shall govern.

The bidder shall sign the proposal correctly and in ink. If the proposal is made by an individual, his or her name and post office address must be shown. If made by a partnership, the name and post office address of each member of the partnership must be shown. If made by a corporation, the person signing the proposal shall give the name of the state under the laws of which the corporation was chartered and the name, titles, and business address of the president, secretary, and the treasurer. Anyone signing a proposal as an agent shall file evidence of his or her authority to do so and that the signature is binding upon the firm or corporation.

20-08 Responsive and responsible bidder. A responsive bid conforms to all significant terms and conditions contained in the Sponsor's invitation for bid. It is the Sponsor's responsibility to decide if the exceptions taken by a bidder to the solicitation are material or not and the extent of deviation it is willing to accept.

A responsible bidder has the ability to perform successfully under the terms and conditions of a proposed procurement, as defined in 49 CFR § 18.36(b)(8). This includes such matters as Contractor integrity, compliance with public policy, record of past performance, and financial and technical resources.

20-09 Irregular proposals. Proposals shall be considered irregular for the following***, but not limited to,*** reasons:

a. If the proposal is on a form other than that furnished by the Owner, or if the Owner's form is altered, or if any part of the proposal form is detached.

b. If there are unauthorized additions, conditional or alternate pay items, or irregularities of any kind that make the proposal incomplete, indefinite, or otherwise ambiguous.

c. If the proposal does not contain a unit price for each pay item listed in the proposal, except in the case of authorized alternate pay items, for which the bidder is not required to furnish a unit price.

d. If the proposal contains unit prices that are obviously unbalanced ***as interpreted by the Owner and Engineer***.

e. If the proposal is not accompanied by the proposal guaranty specified by the Owner.

The Owner reserves the right to reject any irregular proposal and the right to waive technicalities if such waiver is in the best interest of the Owner and conforms to local laws and ordinances pertaining to the letting of construction contracts.

20-10 Bid guarantee. Each separate proposal shall be accompanied by a certified check, or other specified acceptable collateral, in the amount specified in the proposal form. Such check, or collateral, shall be made payable to the Owner. ***The bid guarantee shall be equivalent to 5% of the total bid price.***

20-11 Delivery of proposal. Each proposal submitted shall be placed in a sealed envelope plainly marked with the project number, location of airport, and name and business address of the bidder on the outside. When sent by mail, preferably registered, the sealed proposal, marked as indicated above, should be enclosed in an additional envelope. No proposal will be considered unless received at the place specified in the advertisement or as modified by Addendum before the time specified for opening all bids. Proposals received after the bid opening time shall be returned to the bidder unopened.

20-12 Withdrawal or revision of proposals. A bidder may withdraw or revise (by withdrawal of one proposal and submission of another) a proposal provided that the bidder's request for withdrawal is received by the Owner in writing or by fax/email before the time specified for opening bids. Revised proposals must be received at the place specified in the advertisement before the time specified for opening all bids.

20-13 Public opening of proposals. Proposals shall be opened, and read, publicly at the time and place specified in the advertisement. Bidders, their authorized agents, and other interested persons are invited to attend. Proposals that have been withdrawn (by written or telegraphic request) or received after the time specified for opening bids shall be returned to the bidder unopened.

20-14 Disqualification of bidders. A bidder shall be considered disqualified for any of the following***, but not limited to,*** reasons:

a. Submitting more than one proposal from the same partnership, firm, or corporation under the same or different name.

b. Evidence of collusion among bidders. Bidders participating in such collusion shall be disqualified as bidders for any future work of the Owner until any such participating bidder has been reinstated by the Owner as a qualified bidder.

c. If the bidder is considered to be in "default" for any reason specified in the subsection 20-04 titled ISSUANCE OF PROPOSAL FORMS of this section.

d. Where the Bidder has an interest in any litigation or other claim against the Owner or Engineer.

e. Lack of competency as revealed by the Statement of Bidder's Qualifications.

f. Uncompleted work which, in the judgment of the Owner, will hinder or prevent the prompt completion of additional work, if awarded.

g. Previous projects where, in the judgment of the Owner, the Bidder performed unsatisfactorily and did not complete and close out the project in a timely manner.

END OF SECTION 20

Section 30 Award and Execution of Contract

30-01 Consideration of proposals. After the proposals are publicly opened and read, they will be compared on the basis of the summation of the products obtained by multiplying the estimated quantities shown in the proposal by the unit bid prices. If a bidder's proposal contains a discrepancy between unit bid prices written in words and unit bid prices written in numbers, the unit price written in words shall govern.

Until the award of a contract is made, the Owner reserves the right to reject a bidder's proposal for any of the following reasons:

a. If the proposal is irregular as specified in the subsection 20-09 titled IRREGULAR PROPOSALS of Section 20.

b. If the bidder is disqualified for any of the reasons specified in the subsection 20-14 titled DISQUALIFICATION OF BIDDERS of Section 20.

In addition, until the award of a contract is made, the Owner reserves the right to reject any or all proposals, waive technicalities, if such waiver is in the best interest of the Owner and is in conformance with applicable state and local laws or regulations pertaining to the letting of construction contracts; advertise for new proposals; or proceed with the work otherwise. All such actions shall promote the Owner's best interests.

30-02 Award of contract. The award of a contract, if it is to be awarded, shall be made within 120 calendar days of the date specified for publicly opening proposals, unless otherwise specified herein.

Award of the contract shall be made by the Owner to the lowest, qualified bidder whose proposal conforms to the cited requirements of the Owner.

30-03 Cancellation of award. The Owner reserves the right to cancel the award without liability to the bidder, except return of proposal guaranty, at any time before a contract has been fully executed by all parties and is approved by the Owner in accordance with the subsection 30-07 titled APPROVAL OF CONTRACT of this section.

30-04 Return of proposal guaranty. All proposal guaranties, except those of the two lowest bidders, will be returned immediately after the Owner has made a comparison of bids as specified in the subsection 30-01 titled CONSIDERATION OF PROPOSALS of this section. Proposal guaranties of the two lowest bidders will be retained by the Owner until such time as an award is made, at which time, the unsuccessful bidder's proposal guaranty will be returned. The successful bidder's proposal guaranty will be returned as soon as the Owner receives the contract bonds as specified in the subsection 30-05 titled REQUIREMENTS OF CONTRACT BONDS of this section.

30-05 Requirements of contract bonds. At the time of the execution of the contract, the successful bidder shall furnish the Owner a surety bond or bonds that have been fully executed by the bidder and the surety guaranteeing the performance of the work and the payment of all legal debts that may be incurred by reason of the Contractor's performance of the work. The surety and the form of the bond or bonds shall be acceptable to the Owner. Unless otherwise specified in this subsection, the surety bond or bonds shall be in a sum equal to the full amount of the contract.

30-06 Execution of contract. The successful bidder shall sign (execute) the necessary agreements for entering into the contract and return the signed contract to the Owner, along with the fully executed surety bond or bonds specified in the subsection 30-05 titled REQUIREMENTS OF CONTRACT BONDS of this section, within 15 calendar days from the date mailed or otherwise delivered to the successful bidder.

30-07 Approval of contract. Upon receipt of the contract and contract bond or bonds that have been executed by the successful bidder, the Owner shall complete the execution of the contract in accordance with local laws or ordinances, and return the fully executed contract to the Contractor. Delivery of the fully executed contract to the Contractor shall constitute the Owner's approval to be bound by the successful bidder's proposal and the terms of the contract.

30-08 Failure to execute contract. Failure of the successful bidder to execute the contract and furnish an acceptable surety bond or bonds within the 15 calendar day period specified in the subsection 30-06 titled EXECUTION OF CONTRACT of this section shall be just cause for cancellation of the award and forfeiture of the proposal guaranty, not as a penalty, but as liquidation of damages to the Owner.

END OF SECTION 30

Section 40 Scope of Work

40-01 Intent of contract. The intent of the contract is to provide for construction and completion, in every detail, of the work described. It is further intended that the Contractor shall furnish all labor, materials, equipment, tools, transportation, and supplies required to complete the work in accordance with the plans, specifications, and terms of the contract.

40-02 Alteration of work and quantities. The Owner reserves and shall have the right to make such alterations in the work as may be necessary or desirable to complete the work originally intended in an acceptable manner. Unless otherwise specified herein, the Engineer shall be and is hereby authorized to make such alterations in the work as may increase or decrease the originally awarded contract quantities, provided that the aggregate of such alterations does not change the total contract cost or the total cost of any major contract item by more than 25% (total cost being based on the unit prices and estimated quantities in the awarded contract). Alterations that do not exceed the 25% limitation shall not invalidate the contract nor release the surety, and the Contractor agrees to accept payment for such alterations as if the altered work had been a part of the original contract. These alterations that are for work within the general scope of the contract shall be covered by "Change Orders" issued by the Engineer. Change orders for altered work shall include extensions of contract time where, in the Engineer's opinion, such extensions are commensurate with the amount and difficulty of added work.

Should the aggregate amount of altered work exceed the 25% limitation hereinbefore specified, such excess altered work shall be covered by supplemental agreement. If the Owner and the Contractor are unable to agree on a unit adjustment for any contract item that requires a supplemental agreement, the Owner reserves the right to terminate the contract with respect to the item and make other arrangements for its completion.

Supplemental agreements shall be approved by the FAA and shall include all applicable Federal contract provisions for procurement and contracting required under AIP. Supplemental agreements shall also require consent of the Contractor's surety and separate performance and payment bonds.

40-03 Omitted items. The Engineer may, in the Owner's best interest, omit from the work any contract item, except major contract items. Major contract items may be omitted by a supplemental agreement. Such omission of contract items shall not invalidate any other contract provision or requirement.

Should a contract item be omitted or otherwise ordered to be non-performed, the Contractor shall be paid for all work performed toward completion of such item prior to the date of the order to omit such item. Payment for work performed shall be in accordance with the subsection 90-04 titled PAYMENT FOR OMITTED ITEMS of Section 90.

40-04 Extra work. Should acceptable completion of the contract require the Contractor to perform an item of work for which no basis of payment has been provided in the original contract or previously issued change orders or supplemental agreements, the same shall be called "Extra Work." Extra Work that is within the general scope of the contract shall be covered by written change order. Change orders for such Extra Work shall contain agreed unit prices for performing the change order work in accordance with the requirements specified in the order, and shall contain any adjustment to the contract time that, in the Engineer's opinion, is necessary for completion of such Extra Work.

When determined by the Engineer to be in the Owner's best interest, the Engineer may order the Contractor to proceed with Extra Work as provided in the subsection 90-05 titled PAYMENT FOR EXTRA WORK of Section 90. Extra Work that is necessary for acceptable completion of the project, but is not within the general scope of the work covered by the original contract shall be covered by a Supplemental Agreement as defined in the subsection 10-48 titled SUPPLEMENTAL AGREEMENT of Section 10.

Any claim for payment of Extra Work that is not covered by written agreement (change order or supplemental agreement) shall be rejected by the Owner.

40-05 Maintenance of traffic. It is the explicit intention of the contract that the safety of aircraft, as well as the Contractor's equipment and personnel, is the most important consideration.

a. It is understood and agreed that the Contractor shall provide for the free and unobstructed movement of aircraft in the air operations areas (AOAs) of the airport with respect to his or her own operations and the operations of all subcontractors as specified in the subsection 80-04 titled LIMITATION OF OPERATIONS of Section 80. It is further understood and agreed that the Contractor shall provide for the uninterrupted operation of visual and electronic signals (including power supplies thereto) used in the guidance of aircraft while operating to, from, and upon the airport as specified in the subsection 70-15 titled CONTRACTOR'S RESPONSIBILITY FOR UTILITY SERVICE AND FACILITIES OF OTHERS in Section 70.

b. With respect to his or her own operations and the operations of all subcontractors, the Contractor shall provide marking, lighting, and other acceptable means of identifying personnel, equipment, vehicles, storage areas, and any work area or condition that may be hazardous to the operation of aircraft, fire-rescue equipment, or maintenance vehicles at the airport.

c. When the contract requires the maintenance of vehicular traffic on an existing road, street, or highway during the Contractor's performance of work that is otherwise provided for in the contract, plans, and specifications, the Contractor shall keep such road, street, or highway open to all traffic and shall provide such maintenance as may be required to accommodate traffic. The Contractor shall be responsible for the repair of any damage caused by the Contractor's equipment and personnel. The Contractor shall furnish, erect, and maintain barricades, warning signs, flag person, and other traffic control devices in reasonable conformity with the Manual on Uniform Traffic Control Devices (MUTCD) (http://mutcd.fhwa.dot.gov/), unless otherwise specified. The Contractor shall also construct and maintain in a safe condition any temporary connections necessary for ingress to and egress from abutting property or intersecting roads, streets or highways. Unless otherwise specified herein, the Contractor will not be required to furnish snow removal for such existing road, street, or highway.

40-06 Removal of existing structures. All existing structures encountered within the established lines, grades, or grading sections shall be removed by the Contractor, unless such existing structures are otherwise specified to be relocated, adjusted up or down, salvaged, abandoned in place, reused in the work or to remain in place. The cost of removing such existing structures shall not be measured or paid for directly, but shall be included in the various contract items.

Should the Contractor encounter an existing structure (above or below ground) in the work for which the disposition is not indicated on the plans, the Engineer shall be notified prior to disturbing such structure. The disposition of existing structures so encountered shall be immediately determined by the Engineer in accordance with the provisions of the contract.

Except as provided in the subsection 40-07 titled RIGHTS IN AND USE OF MATERIALS FOUND IN THE WORK of this section, it is intended that all existing materials or structures that may be encountered (within the lines, grades, or grading sections established for completion of the work) shall be used in the work as otherwise provided for in the contract and shall remain the property of the Owner when so used in the work.

40-07 Rights in and use of materials found in the work. Should the Contractor encounter any material such as (but not restricted to) sand, stone, gravel, slag, or concrete slabs within the established lines, grades, or grading sections, the use of which is intended by the terms of the contract to be either embankment or waste, the Contractor may at his or her option either:

a. Use such material in another contract item, providing such use is approved by the Engineer and is in conformance with the contract specifications applicable to such use; or,

b. Remove such material from the site, upon written approval of the Engineer; or

c. Use such material for the Contractor's own temporary construction on site; or,

d. Use such material as intended by the terms of the contract.

Should the Contractor wish to exercise option a., b., or c., the Contractor shall request the Engineer's approval in advance of such use.

Should the Engineer approve the Contractor's request to exercise option a., b., or c., the Contractor shall be paid for the excavation or removal of such material at the applicable contract price. The Contractor shall replace, at his or her own expense, such removed or excavated material with an agreed equal volume of material that is acceptable for use in constructing embankment, backfills, or otherwise to the extent that such replacement material is needed to complete the contract work. The Contractor shall not be charged for use of such material used in the work or removed from the site.

Should the Engineer approve the Contractor's exercise of option a., the Contractor shall be paid, at the applicable contract price, for furnishing and installing such material in accordance with requirements of the contract item in which the material is used.

It is understood and agreed that the Contractor shall make no claim for delays by reason of his or her exercise of option a., b., or c.

The Contractor shall not excavate, remove, or otherwise disturb any material, structure, or part of a structure which is located outside the lines, grades, or grading sections established for the work, except where such excavation or removal is provided for in the contract, plans, or specifications.

40-08 Final cleanup. Upon completion of the work and before acceptance and final payment will be made, the Contractor shall remove from the site all machinery, equipment, surplus and discarded materials, rubbish, temporary structures, and stumps or portions of trees. The Contractor shall cut all brush and woods within the limits indicated and shall leave the site in a neat and presentable condition. Material cleared from the site and deposited on adjacent property will not be considered as having been disposed of satisfactorily, unless the Contractor has obtained the written permission of such property Owner.

END OF SECTION 40

Section 50 Control of Work

50-01 Authority of the Engineer. The Engineer shall decide any and all questions which may arise as to the quality and acceptability of materials furnished, work performed, and as to the manner of performance and rate of progress of the work. The Engineer shall decide all questions that may arise as to the interpretation of the specifications or plans relating to the work. The Engineer shall determine the amount and quality of the several kinds of work performed and materials furnished which are to be paid for the under contract.

The Engineer does not have the authority to accept pavements that do not conform to FAA specification requirements.

50-02 Conformity with plans and specifications. All work and all materials furnished shall be in reasonably close conformity with the lines, grades, grading sections, cross-sections, dimensions, material requirements, and testing requirements that are specified (including specified tolerances) in the contract, plans or specifications.

If the Engineer finds the materials furnished, work performed, or the finished product not within reasonably close conformity with the plans and specifications but that the portion of the work affected will, in his or her opinion, result in a finished product having a level of safety, economy, durability, and workmanship acceptable to the Owner, the Engineer will advise the Owner of his or her determination that the affected work be accepted and remain in place. In this event, the Engineer will document the determination and recommend to the Owner a basis of acceptance that will provide for an adjustment in the contract price for the affected portion of the work. The Engineer's determination and recommended contract price adjustments will be based on sound engineering judgment and such tests or retests of the affected work as are, in the Engineer's opinion, needed. Changes in the contract price shall be covered by contract change order or supplemental agreement as applicable.

If the Engineer finds the materials furnished, work performed, or the finished product are not in reasonably close conformity with the plans and specifications and have resulted in an unacceptable finished product, the affected work or materials shall be removed and replaced or otherwise corrected by and at the expense of the Contractor in accordance with the Engineer's written orders.

For the purpose of this subsection, the term "reasonably close conformity" shall not be construed as waiving the Contractor's responsibility to complete the work in accordance with the contract, plans, and specifications. The term shall not be construed as waiving the Engineer's responsibility to insist on strict compliance with the requirements of the contract, plans, and specifications during the Contractor's execution of the work, when, in the Engineer's opinion, such compliance is essential to provide an acceptable finished portion of the work.

For the purpose of this subsection, the term "reasonably close conformity" is also intended to provide the Engineer with the authority, after consultation with the FAA, to use sound engineering judgment in his or her determinations as to acceptance of work that is not in strict conformity, but will provide a finished product equal to or better than that intended by the requirements of the contract, plans and specifications.

The Owner shall keep the FAA advised of the Engineer's determinations as to acceptance of the work that is not in reasonably close conformity to the contract, plans, and specifications. Change orders or supplemental agreements must be reviewed by the FAA.

The Engineer will not be responsible for the Contractor's means, methods, techniques, sequences, or procedures of construction or the safety precautions incident thereto.

50-03 Coordination of contract, plans, and specifications. The contract, plans, specifications, and all referenced standards cited are essential parts of the contract requirements. A requirement occurring in one

is as binding as though occurring in all. They are intended to be complementary and to describe and provide for a complete work. In case of discrepancy, calculated dimensions will govern over scaled dimensions; contract technical specifications shall govern over contract general provisions, plans, cited standards for materials or testing, and cited advisory circulars (ACs); contract general provisions shall govern over plans, cited standards for materials or testing, and cited ACs; plans shall govern over cited standards for materials or testing and cited ACs. If any paragraphs contained in the Special Provisions conflict with General Provisions or Technical Specifications, the Special Provisions shall govern.

From time to time, discrepancies within cited testing standards occur due to the timing of the change, edits, and/or replacement of the standards. If the Contractor discovers any apparent discrepancy within standard test methods, the Contractor shall immediately ask the Engineer for an interpretation and decision, and such decision shall be final.

~~LIST OF SPECIAL PROVISIONS~~

50-04 Cooperation of Contractor. The Contractor will be supplied with five copies each of the plans and specifications. The Contractor shall have available on the work at all times one copy each of the plans and specifications. Additional copies of plans and specifications may be obtained by the Contractor for the cost of reproduction.

The Contractor shall give constant attention to the work to facilitate the progress thereof, and shall cooperate with the Engineer and his or her inspectors and with other contractors in every way possible. The Contractor shall have a competent superintendent on the work at all times who is fully authorized as his or her agent on the work. The superintendent shall be capable of reading and thoroughly understanding the plans and specifications and shall receive and fulfill instructions from the Engineer or his or her authorized representative.

50-05 Cooperation between contractors. The Owner reserves the right to contract for and perform other or additional work on or near the work covered by this contract.

When separate contracts are let within the limits of any one project, each Contractor shall conduct the work so as not to interfere with or hinder the progress of completion of the work being performed by other Contractors. Contractors working on the same project shall cooperate with each other as directed.

Each Contractor involved shall assume all liability, financial or otherwise, in connection with his or her contract and shall protect and save harmless the Owner from any and all damages or claims that may arise because of inconvenience, delays, or loss experienced because of the presence and operations of other Contractors working within the limits of the same project.

The Contractor shall arrange his or her work and shall place and dispose of the materials being used so as not to interfere with the operations of the other Contractors within the limits of the same project. The Contractor shall join his or her work with that of the others in an acceptable manner and shall perform it in proper sequence to that of the others.

50-06 Construction layout and stakes. The Engineer shall establish horizontal and vertical control only ***unless otherwise specified in the contract documents***. The Contractor must establish all layout required for the construction of the work. Such stakes and markings as the Engineer may set for either their own or the Contractor's guidance shall be preserved by the Contractor. In case of negligence on the part of the Contractor, or their employees, resulting in the destruction of such stakes or markings, an amount equal to the cost of replacing the same may be deducted from subsequent estimates due the Contractor at the discretion of the Engineer.

The Contractor will be required to furnish all lines, grades and measurements from the control points necessary for the proper execution and control of the work contracted for under these specifications.

The Contractor must give copies of survey notes to the Engineer for each area of construction and for each placement of material as specified to allow the Engineer to make periodic checks for conformance with plan grades, alignments and grade tolerances required by the applicable material specifications. All surveys must be provided to the Engineer prior to commencing work items that will cover or disturb the survey staking as set by the Contractor's surveyor. Survey(s) and notes shall be provided in the following format(s): ***AutoCAD and PDF***. In the case of error, on the part of the Contractor, their surveyor, employees or subcontractors, resulting in established grades, alignment or grade tolerances that do not concur with those specified or shown on the plans, the Contractor is solely responsible for correction, removal, replacement and all associated costs at no additional cost to the Owner.

~~No direct payment will be made, unless otherwise specified in contract documents, for this labor, materials, or other expenses. The cost shall be included in the price of the bid for the various items of the Contract.~~

Construction Staking and Layout includes but is not limited to:

a. Clearing and Grubbing perimeter staking

b. Rough Grade slope stakes at 100-foot (30-m) stations

c. Drainage Swales slope stakes and flow line blue tops at 50-foot (15-m) stations

Subgrade blue tops at 25-foot (7.5-m) stations and 25-foot (7.5-m) offset distance (maximum) for the following section locations:

a. Runway – minimum five (5) per station

b. Taxiways – minimum three (3) per station

c. Holding apron areas – minimum three (3) per station

d. Roadways – minimum three (3) per station

Base Course blue tops at 25-foot (7.5-m) stations and 25-foot (7.5-m) offset distance (maximum) for the following section locations:

a. Runway – minimum five (5) per station

b. Taxiways – minimum three (3) per station

c. Holding apron areas – minimum three (3) per station

Pavement areas:

a. Edge of Pavement hubs and tacks (for stringline by Contractor) at 100-foot (30-m) stations.

b. Between Lifts at 25-foot (7.5-m) stations for the following section locations:

(1) Runways – each paving lane width

(2) Taxiways – each paving lane width

(3) Holding areas – each paving lane width

c. After finish paving operations at 50-foot (15-m) stations:

(1) All paved areas – Edge of each paving lane prior to next paving lot

d. Shoulder and safety area blue tops at 50-foot (15-m) stations and at all break points with maximum of 50-foot (15-m) offsets.

e. Fence lines at 100-foot (30-m) stations minimum.

f. Electrical and Communications System locations, lines and grades including but not limited to duct runs, connections, fixtures, signs, lights, Visual Approach Slope Indicators (VASIs), Precision Approach Path Indicators (PAPIs), Runway End Identifier Lighting (REIL), Wind Cones, Distance Markers (signs), pull boxes and manholes.

g. Drain lines, cut stakes and alignment on 25-foot (7.5-m) stations, inlet and manholes.

h. Painting and Striping layout (pinned with 1.5 inch PK nails) marked for paint Contractor. (All nails shall be removed after painting).

i. Laser, or other automatic control devices, shall be checked with temporary control point or grade hub at a minimum of once per 400 feet (120 m) per pass (that is, paving lane).

The establishment of Survey Control and/or reestablishment of survey control shall be by a State Licensed Land Surveyor.

Controls and stakes disturbed or suspect of having been disturbed shall be checked and/or reset as directed by the Engineer without additional cost to the Owner.

50-07 Automatically controlled equipment. Whenever batching or mixing plant equipment is required to be operated automatically under the contract and a breakdown or malfunction of the automatic controls occurs, the equipment may be operated manually or by other methods for a period 48 hours following the breakdown or malfunction, provided this method of operations will produce results which conform to all other requirements of the contract.

50-08 Authority and duties of inspectors. Inspectors shall be authorized to inspect all work done and all material furnished. Such inspection may extend to all or any part of the work and to the preparation, fabrication, or manufacture of the materials to be used. Inspectors are not authorized to revoke, alter, or waive any provision of the contract. Inspectors are not authorized to issue instructions contrary to the plans and specifications or to act as foreman for the Contractor.

Inspectors are authorized to notify the Contractor or his or her representatives of any failure of the work or materials to conform to the requirements of the contract, plans, or specifications and to reject such nonconforming materials in question until such issues can be referred to the Engineer for a decision.

50-09 Inspection of the work. All materials and each part or detail of the work shall be subject to inspection. The Engineer shall be allowed access to all parts of the work and shall be furnished with such information and assistance by the Contractor as is required to make a complete and detailed inspection.

If the Engineer requests it, the Contractor, at any time before acceptance of the work, shall remove or uncover such portions of the finished work as may be directed. After examination, the Contractor shall restore said portions of the work to the standard required by the specifications. Should the work thus exposed or examined prove acceptable, the uncovering, or removing, and the replacing of the covering or making good of the parts removed will be paid for as extra work; but should the work so exposed or examined prove unacceptable, the uncovering, or removing, and the replacing of the covering or making good of the parts removed will be at the Contractor's expense.

Any work done or materials used without supervision or inspection by an authorized representative of the Owner may be ordered removed and replaced at the Contractor's expense unless the Owner's representative failed to inspect after having been given reasonable notice in writing that the work was to be performed.

Should the contract work include relocation, adjustment, or any other modification to existing facilities, not the property of the (contract) Owner, authorized representatives of the Owners of such facilities shall have the right to inspect such work. Such inspection shall in no sense make any facility owner a party to the contract, and shall in no way interfere with the rights of the parties to this contract.

50-10 Removal of unacceptable and unauthorized work. All work that does not conform to the requirements of the contract, plans, and specifications will be considered unacceptable, unless otherwise determined acceptable by the Engineer as provided in the subsection 50-02 titled CONFORMITY WITH PLANS AND SPECIFICATIONS of this section.

Unacceptable work, whether the result of poor workmanship, use of defective materials, damage through carelessness, or any other cause found to exist prior to the final acceptance of the work, shall be removed immediately and replaced in an acceptable manner in accordance with the provisions of the subsection 70-14 titled CONTRACTOR'S RESPONSIBILITY FOR WORK of Section 70.

~~No removal work made under provision of this subsection shall be done without lines and grades having been established by the Engineer.~~ Work done contrary to the instructions of the Engineer, work done beyond the lines shown on the plans or as established by the Engineer, except as herein specified, or any extra work done without authority, will be considered as unauthorized and will not be paid for under the provisions of the contract. Work so done may be ordered removed or replaced at the Contractor's expense.

Upon failure on the part of the Contractor to comply with any order of the Engineer made under the provisions of this subsection, the Engineer will have authority to cause unacceptable work to be remedied or removed and replaced and unauthorized work to be removed and to deduct the costs incurred by the Owner from any monies due or to become due the Contractor.

50-11 Load restrictions. The Contractor shall comply with all legal load restrictions in the hauling of materials on public roads beyond the limits of the work. A special permit will not relieve the Contractor of liability for damage that may result from the moving of material or equipment.

The operation of equipment of such weight or so loaded as to cause damage to structures or to any other type of construction will not be permitted. Hauling of materials over the base course or surface course under construction shall be limited as directed. No loads will be permitted on a concrete pavement, base, or structure before the expiration of the curing period. The Contractor shall be responsible for all damage done by his or her hauling equipment and shall correct such damage at his or her own expense.

50-12 Maintenance during construction. The Contractor shall maintain the work during construction and until the work is accepted. Maintenance shall constitute continuous and effective work prosecuted day by day, with adequate equipment and forces so that the work is maintained in satisfactory condition at all times.

In the case of a contract for the placing of a course upon a course or subgrade previously constructed, the Contractor shall maintain the previous course or subgrade during all construction operations.

All costs of maintenance work during construction and before the project is accepted shall be included in the unit prices bid on the various contract items, and the Contractor will not be paid an additional amount for such work.

50-13 Failure to maintain the work. Should the Contractor at any time fail to maintain the work as provided in the subsection 50-12 titled MAINTENANCE DURING CONSTRUCTION of this section, the Engineer shall immediately notify the Contractor of such noncompliance. Such notification shall specify a reasonable time within which the Contractor shall be required to remedy such unsatisfactory maintenance condition. The time specified will give due consideration to the exigency that exists.

Should the Contractor fail to respond to the Engineer's notification, the Owner may suspend any work necessary for the Owner to correct such unsatisfactory maintenance condition, depending on the exigency that exists. Any maintenance cost incurred by the Owner, shall be deducted from monies due or to become due the Contractor.

50-14 Partial acceptance. If at any time during the execution of the project the Contractor substantially completes a usable unit or portion of the work, the occupancy of which will benefit the Owner, the

Contractor may request the Engineer to make final inspection of that unit. If the Engineer finds upon inspection that the unit has been satisfactorily completed in compliance with the contract, the Engineer may accept it as being complete, and the Contractor may be relieved of further responsibility for that unit. Such partial acceptance and beneficial occupancy by the Owner shall not void or alter any provision of the contract. ***Partial acceptance of any part of the work shall not constitute acceptance from a warranty standpoint. The warranty for any work completed and accepted shall not begin until the entire project is complete and accepted by the Owner.***

50-15 Final acceptance. Upon due notice from the Contractor of presumptive completion of the entire project, the Engineer and Owner will make an inspection. If all construction provided for and contemplated by the contract is found to be complete in accordance with the contract, plans, and specifications, such inspection shall constitute the final inspection. The Engineer shall notify the Contractor in writing of final acceptance as of the date of the final inspection.

If, however, the inspection discloses any work, in whole or in part, as being unsatisfactory, the Engineer will give the Contractor the necessary instructions for correction of same and the Contractor shall immediately comply with and execute such instructions. Upon correction of the work, another inspection will be made which shall constitute the final inspection, provided the work has been satisfactorily completed. In such event, the Engineer will make the final acceptance and notify the Contractor in writing of this acceptance as of the date of final inspection.

50-16 Claims for adjustment and disputes. If for any reason the Contractor deems that additional compensation is due for work or materials not clearly provided for in the contract, plans, or specifications or previously authorized as extra work, the Contractor shall notify the Engineer in writing of his or her intention to claim such additional compensation before the Contractor begins the work on which the Contractor bases the claim. If such notification is not given or the Engineer is not afforded proper opportunity by the Contractor for keeping strict account of actual cost as required, then the Contractor hereby agrees to waive any claim for such additional compensation. Such notice by the Contractor and the fact that the Engineer has kept account of the cost of the work shall not in any way be construed as proving or substantiating the validity of the claim. When the work on which the claim for additional compensation is based has been completed, the Contractor shall, within 10 calendar days, submit a written claim to the Engineer who will present it to the Owner for consideration in accordance with local laws or ordinances.

Nothing in this subsection shall be construed as a waiver of the Contractor's right to dispute final payment based on differences in measurements or computations.

~~[**50-17 Cost reduction incentive**. The provisions of this subsection will apply only to contracts awarded to the lowest bidder pursuant to competitive bidding.~~

~~On projects with original contract amounts in excess of $100,000, the Contractor may submit to the Engineer, in writing, proposals for modifying the plans, specifications or other requirements of the contract for the sole purpose of reducing the cost of construction. The cost reduction proposal shall not impair, in any manner, the essential functions or characteristics of the project, including but not limited to service life, economy of operation, ease of maintenance, desired appearance, design and safety standards. This provision shall not apply unless the proposal submitted is specifically identified by the Contractor as being presented for consideration as a value engineering proposal.~~

~~Not eligible for cost reduction proposals are changes in the basic design of a pavement type, runway and taxiway lighting, visual aids, hydraulic capacity of drainage facilities, or changes in grade or alignment that reduce the geometric standards of the project.~~

~~As a minimum, the following information shall be submitted by the Contractor with each proposal:~~

~~a. A description of both existing contract requirements for performing the work and the proposed changes, with a discussion of the comparative advantages and disadvantages of each.~~

~~b. An itemization of the contract requirements that must be changed if the proposal is adopted.~~

~~c. A detailed estimate of the cost of performing the work under the existing contract and under the proposed changes.~~

~~d. A statement of the time by which a change order adopting the proposal must be issued.~~

~~e. A statement of the effect adoption of the proposal will have on the time for completion of the contract.~~

~~f. The contract items of work affected by the proposed changes, including any quantity variation attributable to them.~~

~~The Contractor may withdraw, in whole or in part, any cost reduction proposal not accepted by the Engineer, within the period specified in the proposal. The provisions of this subsection shall not be construed to require the Engineer to consider any cost reduction proposal that may be submitted.~~

~~The Contractor shall continue to perform the work in accordance with the requirements of the contract until a change order incorporating the cost reduction proposal has been issued. If a change order has not been issued by the date upon which the Contractor's cost reduction proposal specifies that a decision should be made, or such other date as the Contractor may subsequently have requested in writing, such cost reduction proposal shall be deemed rejected.~~

~~The Engineer shall be the sole judge of the acceptability of a cost reduction proposal and of the estimated net savings from the adoption of all or any part of such proposal. In determining the estimated net savings, the Engineer may disregard the contract bid prices if, in the Engineer's judgment such prices do not represent a fair measure of the value of the work to be performed or deleted.~~

~~The Owner may require the Contractor to share in the Owner's costs of investigating a cost reduction proposal submitted by the Contractor as a condition of considering such proposal. Where such a condition is imposed, the Contractor shall acknowledge acceptance of it in writing. Such acceptance shall constitute full authority for the Owner to deduct the cost of investigating a cost reduction proposal from amounts payable to the Contractor under the contract.~~

~~If the Contractor's cost reduction proposal is accepted in whole or in part, such acceptance will be by a contract change order that shall specifically state that it is executed pursuant to this subsection. Such change order shall incorporate the changes in the plans and specifications which are necessary to permit the cost reduction proposal or such part of it as has been accepted and shall include any conditions upon which the Engineer's approval is based. The change order shall also set forth the estimated net savings attributable to the cost reduction proposal. The net savings shall be determined as the difference in costs between the original contract costs for the involved work items and the costs occurring as a result of the proposed change. The change order shall also establish the net savings agreed upon and shall provide for adjustment in the contract price that will divide the net savings equally between the Contractor and the Owner.~~

~~The Contractor's 50% share of the net savings shall constitute full compensation to the Contractor for the cost reduction proposal and the performance of the work.~~

~~Acceptance of the cost-reduction proposal and performance of the cost-reduction work shall not extend the time of completion of the contract unless specifically provided for in the contract change order.]~~

END OF SECTION 50

Section 60 Control of Materials

60-01 Source of supply and quality requirements. The materials used in the work shall conform to the requirements of the contract, plans, and specifications. Unless otherwise specified, such materials that are manufactured or processed shall be new (as compared to used or reprocessed).

In order to expedite the inspection and testing of materials, the Contractor shall furnish complete statements to the Engineer as to the origin, composition, and manufacture of all materials to be used in the work. Such statements shall be furnished promptly after execution of the contract but, in all cases, prior to delivery of such materials.

For projects funded under the Airport Improvement Program (AIP), Contractor shall supply steel and manufactured products that conform to the Buy American provisions established under 49 USC Section 50101 as follows: "Steel products must be 100% U.S. domestic product Manufactured Products. Preference shall be given to products that are 100% manufactured and assembled in the U.S. Manufactured products not meeting the 100% U.S. domestic preference may only be used on the project if the FAA has officially granted a permissible waiver to Buy American Preferences. Submittals for all manufactured products must include certification of compliance with Buy American requirements as established under 49 USC Section 50101. Submittal must include sufficient information to confirm compliance or submittal will be returned with no action."

At the Engineer's option, materials may be approved at the source of supply before delivery is stated. If it is found after trial that sources of supply for previously approved materials do not produce specified products, the Contractor shall furnish materials from other sources.

The Contractor shall furnish airport lighting equipment that conforms to the requirements of cited materials specifications. In addition, where an FAA specification for airport lighting equipment is cited in the plans or specifications, the Contractor shall furnish such equipment that is:

a. Listed in advisory circular (AC) 150/5345-53, Airport Lighting Equipment Certification Program, and Addendum that is in effect on the date of advertisement; and,

b. Produced by the manufacturer as listed in the Addendum cited above for the certified equipment part number.

~~The following airport lighting equipment is required for this contract and is to be furnished by the Contractor in accordance with the requirements of this subsection: [___].~~

****

The Engineer shall list all airport lighting equipment required for the contract and to be furnished by the Contractor. As a minimum, the Engineer will include the following information for each item:

- **Equipment name**
- **Cited FAA specifications**
- **Effective AC or approval letter for equipment and manufacturer**

The design Engineer shall furnish the above listing after having conformed the list to those specifications cited on the plans or in the technical specifications. Both the individual FAA material specifications and the AC 150/5345-53, Airport Lighting Equipment Certification Program, should be listed to indicate the edition that is effective on the date the contract is advertised.

****

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RS&H: The Engineer should list all relevant FAA material specifications, advisory circulars and approved manufacturers within the various technical specifications of the contract documents rather than here under section b. so that potential omissions do not occur between the technical specifications, advisory circulars and approved manufacturers listed in the technical specifications and this section.

****

60-02 Samples, tests, and cited specifications. Unless otherwise designated, all materials used in the work shall be inspected, tested, and approved by the Engineer before incorporation in the work. Any work in which untested materials are used without approval or written permission of the Engineer shall be performed at the Contractor's risk. Materials found to be unacceptable and unauthorized will not be paid for and, if directed by the Engineer, shall be removed at the Contractor's expense.

Unless otherwise designated, quality assurance tests in accordance with the cited standard methods of ASTM, American Association of State Highway and Transportation Officials (AASHTO), Federal Specifications, Commercial Item Descriptions, and all other cited methods, which are current on the date of advertisement for bids, will be made by and at the expense of the ~~Engineer~~ ***Owner***.

The Contractor shall notify the Engineer when items of work are ready for acceptance testing. Passing acceptance tests shall be paid for by the Owner. The cost of failing acceptance tests and re-testing shall be at the expense of the Contractor and deducted from the amount due the Contractor at the time of final payment.

The testing organizations performing on-site quality assurance field tests shall have copies of all referenced standards on the construction site for use by all technicians and other personnel, including the Contractor's representative at his or her request. Unless otherwise designated, samples for quality assurance will be taken by a qualified representative of the Engineer. All materials being used are subject to inspection, test, or rejection at any time prior to or during incorporation into the work. Copies of all tests will be furnished to the Contractor's representative at their request after review and approval of the Engineer.

The Contractor shall employ a testing organization to perform all Contractor required Quality Control tests. The Contractor shall submit to the Engineer resumes on all testing organizations and individual persons who will be performing the tests. The Engineer will determine if such persons are qualified. All the test data shall be reported to the Engineer after the results are known. A legible, handwritten copy of all test data shall be given to the Engineer daily, along with printed reports, in an approved format, on a weekly basis. After completion of the project, and prior to final payment, the Contractor shall submit a final report to the Engineer showing all test data reports, plus an analysis of all results showing ranges, averages, and corrective action taken on all failing tests.

60-03 Certification of compliance. The Engineer may permit the use, prior to sampling and testing, of certain materials or assemblies when accompanied by manufacturer's certificates of compliance stating that such materials or assemblies fully comply with the requirements of the contract. The certificate shall be signed by the manufacturer. Each lot of such materials or assemblies delivered to the work must be accompanied by a certificate of compliance in which the lot is clearly identified.

Materials or assemblies used on the basis of certificates of compliance may be sampled and tested at any time and if found not to be in conformity with contract requirements will be subject to rejection whether in place or not.

The form and distribution of certificates of compliance shall be as approved by the Engineer.

When a material or assembly is specified by "brand name or equal" and the Contractor elects to furnish the specified "brand name," the Contractor shall be required to furnish the manufacturer's certificate of compliance for each lot of such material or assembly delivered to the work. Such certificate of compliance shall clearly identify each lot delivered and shall certify as to:

a. Conformance to the specified performance, testing, quality or dimensional requirements; and,

b. Suitability of the material or assembly for the use intended in the contract work.

Should the Contractor propose to furnish an "or equal" material or assembly, the Contractor shall furnish the manufacturer's certificates of compliance as hereinbefore described for the specified brand name material or assembly. However, the Engineer shall be the sole judge as to whether the proposed "or equal" is suitable for use in the work.

The Engineer reserves the right to refuse permission for use of materials or assemblies on the basis of certificates of compliance.

60-04 Plant inspection. The Engineer or his or her authorized representative may inspect, at its source, any specified material or assembly to be used in the work. Manufacturing plants may be inspected from time to time for the purpose of determining compliance with specified manufacturing methods or materials to be used in the work and to obtain samples required for acceptance of the material or assembly.

Should the Engineer conduct plant inspections, the following conditions shall exist:

a. The Engineer shall have the cooperation and assistance of the Contractor and the producer with whom the Engineer has contracted for materials.

b. The Engineer shall have full entry at all reasonable times to such parts of the plant that concern the manufacture or production of the materials being furnished.

c. If required by the Engineer, the Contractor shall arrange for adequate office or working space that may be reasonably needed for conducting plant inspections. Office or working space should be conveniently located with respect to the plant.

It is understood and agreed that the Owner shall have the right to retest any material that has been tested and approved at the source of supply after it has been delivered to the site. The Engineer shall have the right to reject only material which, when retested, does not meet the requirements of the contract, plans, or specifications.

60-05 Engineer's field office. **[** ~~The Contractor shall furnish for the duration of the project one building for the use of the field Engineers and inspectors, as a field office. This facility shall be an approved weatherproof building meeting the current State Highway Specifications (for example, Class I Field Office or Type C Structure). This building shall be located conveniently near to the construction and shall be separate from any building used by the Contractor. The Contractor shall furnish~~ **[** ~~facsimile (FAX) machine, photocopy machine, water, sanitary facilities, heat, air conditioning, and electricity~~ **]**. ~~The Contractor and the Contractor's superintendent shall provide all reasonable facilities to enable to the Engineer to inspect the workmanship and materials used into the work.~~ **] [** An Engineer's field office is not required. **]**

60-06 Storage of materials. Materials shall be so stored as to assure the preservation of their quality and fitness for the work. Stored materials, even though approved before storage, may again be inspected prior to their use in the work. Stored materials shall be located to facilitate their prompt inspection. The Contractor shall coordinate the storage of all materials with the Engineer. Materials to be stored on airport property shall not create an obstruction to air navigation nor shall they interfere with the free and unobstructed movement of aircraft. Unless otherwise shown on the plans, the storage of materials and the location of the Contractor's plant and parked equipment or vehicles shall be as directed by the Engineer.

Private property shall not be used for storage purposes without written permission of the Owner or lessee of such property. The Contractor shall make all arrangements and bear all expenses for the storage of materials on private property. Upon request, the Contractor shall furnish the Engineer a copy of the property Owner's permission.

All storage sites on private or airport property shall be restored to their original condition by the Contractor at his or her entire expense, except as otherwise agreed to (in writing) by the Owner or lessee of the property.

60-07 Unacceptable materials. Any material or assembly that does not conform to the requirements of the contract, plans, or specifications shall be considered unacceptable and shall be rejected. The Contractor shall remove any rejected material or assembly from the site of the work, unless otherwise instructed by the Engineer.

Rejected material or assembly, the defects of which have been corrected by the Contractor, shall not be returned to the site of the work until such time as the Engineer has approved its use in the work.

60-08 Owner furnished materials. The Contractor shall furnish all materials required to complete the work, except those specified, if any, to be furnished by the Owner. Owner-furnished materials shall be made available to the Contractor at the location specified.

All costs of handling, transportation from the specified location to the site of work, storage, and installing Owner-furnished materials shall be included in the unit price bid for the contract item in which such Owner-furnished material is used.

After any Owner-furnished material has been delivered to the location specified, the Contractor shall be responsible for any demurrage, damage, loss, or other deficiencies that may occur during the Contractor's handling, storage, or use of such Owner-furnished material. The Owner will deduct from any monies due or to become due the Contractor any cost incurred by the Owner in making good such loss due to the Contractor's handling, storage, or use of Owner-furnished materials.

END OF SECTION 60

Section 70 Legal Regulations and Responsibility to Public

70-01 Laws to be observed. The Contractor shall keep fully informed of all Federal and state laws, all local laws, ordinances, and regulations and all orders and decrees of bodies or tribunals having any jurisdiction or authority, which in any manner affect those engaged or employed on the work, or which in any way affect the conduct of the work. The Contractor shall at all times observe and comply with all such laws, ordinances, regulations, orders, and decrees; and shall protect and indemnify the Owner and all his or her officers, agents, or servants***, and the Engineer*** against any claim or liability arising from or based on the violation of any such law, ordinance, regulation, order, or decree, whether by the Contractor or the Contractor's employees.

70-02 Permits, licenses, and taxes. The Contractor shall procure all permits and licenses, pay all charges, fees, and taxes, and give all notices necessary and incidental to the due and lawful execution of the work.

70-03 Patented devices, materials, and processes. If the Contractor is required or desires to use any design, device, material, or process covered by letters of patent or copyright, the Contractor shall provide for such use by suitable legal agreement with the Patentee or Owner. The Contractor and the surety shall indemnify and hold harmless the Owner, ***Engineer,*** any third party, or political subdivision from any and all claims for infringement by reason of the use of any such patented design, device, material or process, or any trademark or copyright, and shall indemnify the Owner ***and Engineer*** for any costs, expenses, and damages which it may be obliged to pay by reason of an infringement, at any time during the execution or after the completion of the work.

70-04 Restoration of surfaces disturbed by others. The Owner reserves the right to authorize the construction, reconstruction, or maintenance of any public or private utility service, FAA or National Oceanic and Atmospheric Administration (NOAA) facility, or a utility service of another government agency at any time during the progress of the work. To the extent that such construction, reconstruction, or maintenance has been coordinated with the Owner, such authorized work (by others) is indicated as follows: ***as shown on the plans*.**

Except as listed ~~above~~ ***in the plans***, the Contractor shall not permit any individual, firm, or corporation to excavate or otherwise disturb such utility services or facilities located within the limits of the work without the written permission of the Engineer.

Should the Owner of public or private utility service, FAA, or NOAA facility, or a utility service of another government agency be authorized to construct, reconstruct, or maintain such utility service or facility during the progress of the work, the Contractor shall cooperate with such Owners by arranging and performing the work in this contract to facilitate such construction, reconstruction or maintenance by others whether or not such work by others is listed above. When ordered as extra work by the Engineer, the Contractor shall make all necessary repairs to the work which are due to such authorized work by others, unless otherwise provided for in the contract, plans, or specifications. It is understood and agreed that the Contractor shall not be entitled to make any claim for damages due to such authorized work by others or for any delay to the work resulting from such authorized work.

70-05 Federal aid participation. For Airport Improvement Program (AIP) contracts, the United States Government has agreed to reimburse the Owner for some portion of the contract costs. Such reimbursement is made from time to time upon the Owner's request to the FAA. In consideration of the United States Government's (FAA's) agreement with the Owner, the Owner has included provisions in this contract pursuant to the requirements of Title 49 of the USC and the Rules and Regulations of the FAA that pertain to the work.

As required by the USC, the contract work is subject to the inspection and approval of duly authorized representatives of the FAA Administrator, and is further subject to those provisions of the rules and regulations that are cited in the contract, plans, or specifications.

No requirement of the USC, the rules and regulations implementing the USC, or this contract shall be construed as making the Federal Government a party to the contract nor will any such requirement interfere, in any way, with the rights of either party to the contract.

70-06 Sanitary, health, and safety provisions. The Contractor shall provide and maintain in a neat, sanitary condition such accommodations for the use of his or her employees as may be necessary to comply with the requirements of the state and local Board of Health, or of other bodies or tribunals having jurisdiction.

Attention is directed to Federal, state, and local laws, rules and regulations concerning construction safety and health standards. The Contractor shall not require any worker to work in surroundings or under conditions that are unsanitary, hazardous, or dangerous to his or her health or safety.

70-07 Public convenience and safety. The Contractor shall control his or her operations and those of his or her subcontractors and all suppliers, to assure the least inconvenience to the traveling public. Under all circumstances, safety shall be the most important consideration.

The Contractor shall maintain the free and unobstructed movement of aircraft and vehicular traffic with respect to his or her own operations and those of his or her subcontractors and all suppliers in accordance with the subsection 40-05 titled MAINTENANCE OF TRAFFIC of Section 40 hereinbefore specified and shall limit such operations for the convenience and safety of the traveling public as specified in the subsection 80-04 titled LIMITATION OF OPERATIONS of Section 80 hereinafter.

70-08 Barricades, warning signs, and hazard markings. The Contractor shall furnish, erect, and maintain all barricades, warning signs, and markings for hazards necessary to protect the public and the work. When used during periods of darkness, such barricades, warning signs, and hazard markings shall be suitably illuminated. Unless otherwise specified, barricades, warning signs, and markings for hazards that are in the air operations area (AOAs) shall be a maximum of 18 inches (0.5 m) high. Unless otherwise specified, barricades shall be spaced not more than 4 feet (1.2 m) apart. Barricades, warning signs, and markings shall be paid for under subsection 40-05.

For vehicular and pedestrian traffic, the Contractor shall furnish, erect, and maintain barricades, warning signs, lights and other traffic control devices in reasonable conformity with the Manual on Uniform Traffic Control Devices.

When the work requires closing an air operations area of the airport or portion of such area, the Contractor shall furnish, erect, and maintain temporary markings and associated lighting conforming to the requirements of advisory circular (AC) 150/5340-1, Standards for Airport Markings***, current edition***.

The Contractor shall furnish, erect, and maintain markings and associated lighting of open trenches, excavations, temporary stock piles, and the Contractor's parked construction equipment that may be hazardous to the operation of emergency fire-rescue or maintenance vehicles on the airport in reasonable conformance to AC 150/5370-2, Operational Safety on Airports During Construction***, current edition***.

The Contractor shall identify each motorized vehicle or piece of construction equipment in reasonable conformance to AC 150/5370-2***, current edition***.

The Contractor shall furnish and erect all barricades, warning signs, and markings for hazards prior to commencing work that requires such erection and shall maintain the barricades, warning signs, and markings for hazards until their removal is directed by the Engineer.

Open-flame type lights shall not be permitted.

70-09 Use of explosives. ~~When the use of explosives is necessary for the execution of the work, the Contractor shall exercise the utmost care not to endanger life or property, including new work. The Contractor shall be responsible for all damage resulting from the use of explosives.~~

~~All explosives shall be stored in a secure manner in compliance with all laws and ordinances, and all such storage places shall be clearly marked. Where no local laws or ordinances apply, storage shall be provided satisfactory to the Engineer and, in general, not closer than 1,000 feet (300 m) from the work or from any building, road, or other place of human occupancy.~~

~~The Contractor shall notify each property Owner and public utility company having structures or facilities in proximity to the site of the work of his or her intention to use explosives. Such notice shall be given sufficiently in advance to enable them to take such steps as they may deem necessary to protect their property from injury.~~

~~The use of electrical blasting caps shall not be permitted on or within 1,000 feet (300 m) of the airport property.~~

70-10 Protection and restoration of property and landscape. The Contractor shall be responsible for the preservation of all public and private property, and shall protect carefully from disturbance or damage all land monuments and property markers until the Engineer has witnessed or otherwise referenced their location and shall not move them until directed.

The Contractor shall be responsible for all damage or injury to property of any character, during the execution of the work, resulting from any act, omission, neglect, or misconduct in manner or method of executing the work, or at any time due to defective work or materials, and said responsibility shall not be released until the project has been completed and accepted.

When or where any direct or indirect damage or injury is done to public or private property by or on account of any act, omission, neglect, or misconduct in the execution of the work, or in consequence of the non-execution thereof by the Contractor, the Contractor shall restore, at his or her own expense, such property to a condition similar or equal to that existing before such damage or injury was done, by repairing, or otherwise restoring as may be directed, or the Contractor shall make good such damage or injury in an acceptable manner.

70-11 Responsibility for damage claims. The Contractor shall indemnify and save harmless the Engineer and the Owner and their officers, and employees from all suits, actions, or claims, of any character, brought because of any injuries or damage received or sustained by any person, persons, or property on account of the operations of the Contractor; or on account of or in consequence of any neglect in safeguarding the work; or through use of unacceptable materials in constructing the work; or because of any act or omission, neglect, or misconduct of said Contractor; or because of any claims or amounts recovered from any infringements of patent, trademark, or copyright; or from any claims or amounts arising or recovered under the "Workmen's Compensation Act," or any other law, ordinance, order, or decree. Money due the Contractor under and by virtue of his or her contract considered necessary by the Owner for such purpose may be retained for the use of the Owner or, in case no money is due, his or her surety may be held until such suits, actions, or claims for injuries or damages shall have been settled and suitable evidence to that effect furnished to the Owner, except that money due the Contractor will not be withheld when the Contractor produces satisfactory evidence that he or she is adequately protected by public liability and property damage insurance.

The Contractor shall be required to include the Owner and Engineer as additional insureds on the Contractor's liability insurance policies.

70-12 Third party beneficiary clause. It is specifically agreed between the parties executing the contract that it is not intended by any of the provisions of any part of the contract to create for the public or any

member thereof, a third party beneficiary or to authorize anyone not a party to the contract to maintain a suit for personal injuries or property damage pursuant to the terms or provisions of the contract.

70-13 Opening sections of the work to traffic. Should it be necessary for the Contractor to complete portions of the contract work for the beneficial occupancy of the Owner prior to completion of the entire contract, such "phasing" of the work shall be specified herein and indicated on the plans. When so specified, the Contractor shall complete such portions of the work on or before the date specified or as otherwise specified. The Contractor shall make his or her own estimate of the difficulties involved in arranging the work to permit such beneficial occupancy by the Owner as described ~~below:~~ ***in the plans.***

Upon completion of any portion of the work listed above, such portion shall be accepted by the Owner in accordance with the subsection 50-14 titled PARTIAL ACCEPTANCE of Section 50.

No portion of the work may be opened by the Contractor for public use until ordered by the Engineer in writing. Should it become necessary to open a portion of the work to public traffic on a temporary or intermittent basis, such openings shall be made when, in the opinion of the Engineer, such portion of the work is in an acceptable condition to support the intended traffic. Temporary or intermittent openings are considered to be inherent in the work and shall not constitute either acceptance of the portion of the work so opened or a waiver of any provision of the contract. Any damage to the portion of the work so opened that is not attributable to traffic which is permitted by the Owner shall be repaired by the Contractor at his or her expense.

The Contractor shall make his or her own estimate of the inherent difficulties involved in completing the work under the conditions herein described and shall not claim any added compensation by reason of delay or increased cost due to opening a portion of the contract work.

Contractor shall be required to conform to safety standards contained AC 150/5370-2***, current edition*** ~~(see Special Provisions)~~.

Contractor shall refer to the approved Construction Safety Phasing Plan (CSPP) to identify barricade requirements and other safety requirements prior to opening up sections of work to traffic.

70-14 Contractor's responsibility for work. Until the Engineer's final written acceptance of the entire completed work, excepting only those portions of the work accepted in accordance with the subsection 50-14 titled PARTIAL ACCEPTANCE of Section 50, the Contractor shall have the charge and care thereof and shall take every precaution against injury or damage to any part due to the action of the elements or from any other cause, whether arising from the execution or from the non-execution of the work. The Contractor shall rebuild, repair, restore, and make good all injuries or damages to any portion of the work occasioned by any of the above causes before final acceptance and shall bear the expense thereof except damage to the work due to unforeseeable causes beyond the control of and without the fault or negligence of the Contractor, including but not restricted to acts of God such as earthquake, tidal wave, tornado, hurricane or other cataclysmic phenomenon of nature, or acts of the public enemy or of government authorities.

If the work is suspended for any cause whatever, the Contractor shall be responsible for the work and shall take such precautions necessary to prevent damage to the work. The Contractor shall provide for normal drainage and shall erect necessary temporary structures, signs, or other facilities at his or her expense. During such period of suspension of work, the Contractor shall properly and continuously maintain in an acceptable growing condition all living material in newly established planting, seeding, and sodding furnished under the contract, and shall take adequate precautions to protect new tree growth and other important vegetative growth against injury.

70-15 Contractor's responsibility for utility service and facilities of others. As provided in the subsection 70-04 titled RESTORATION OF SURFACES DISTURBED BY OTHERS of this section, the Contractor shall cooperate with the Owner of any public or private utility service, FAA or NOAA, or a

utility service of another government agency that may be authorized by the Owner to construct, reconstruct or maintain such utility services or facilities during the progress of the work. In addition, the Contractor shall control their operations to prevent the unscheduled interruption of such utility services and facilities.

To the extent that such public or private utility services, FAA, or NOAA facilities, or utility services of another governmental agency are known to exist within the limits of the contract work, the approximate locations have been indicated on the plans and the Owners are indicated ~~as follows:~~ ***on the plans.***

It is understood and agreed that the Owner does not guarantee the accuracy or the completeness of the location information relating to existing utility services, facilities, or structures that may be shown on the plans or encountered in the work. Any inaccuracy or omission in such information shall not relieve the Contractor of the responsibility to protect such existing features from damage or unscheduled interruption of service.

It is further understood and agreed that the Contractor shall, upon execution of the contract, notify the Owners of all utility services or other facilities of his or her plan of operations. Such notification shall be in writing addressed to THE PERSON TO CONTACT as provided in this subsection and subsection 70-04 titled RESTORATION OF SURFACES DISTURBED BY OTHERS of this section. A copy of each notification shall be given to the Engineer.

In addition to the general written notification provided, it shall be the responsibility of the Contractor to keep such individual Owners advised of changes in their plan of operations that would affect such Owners.

Prior to beginning the work in the general vicinity of an existing utility service or facility, the Contractor shall again notify each such Owner of their plan of operation. If, in the Contractor's opinion, the Owner's assistance is needed to locate the utility service or facility or the presence of a representative of the Owner is desirable to observe the work, such advice should be included in the notification. Such notification shall be given by the most expeditious means to reach the utility owner's PERSON TO CONTACT no later than two normal business days prior to the Contractor's commencement of operations in such general vicinity. The Contractor shall furnish a written summary of the notification to the Engineer.

The Contractor's failure to give the two days' notice shall be cause for the Owner to suspend the Contractor's operations in the general vicinity of a utility service or facility.

Where the outside limits of an underground utility service have been located and staked on the ground, the Contractor shall be required to use hand excavation methods within 3 feet (1 m) of such outside limits at such points as may be required to ensure protection from damage due to the Contractor's operations.

Should the Contractor damage or interrupt the operation of a utility service or facility by accident or otherwise, the Contractor shall immediately notify the proper authority and the Engineer and shall take all reasonable measures to prevent further damage or interruption of service. The Contractor, in such events, shall cooperate with the utility service or facility owner and the Engineer continuously until such damage has been repaired and service restored to the satisfaction of the utility or facility owner.

The Contractor shall bear all costs of damage and restoration of service to any utility service or facility due to their operations whether due to negligence or accident. The Owner reserves the right to deduct such costs from any monies due or which may become due the Contractor, or his or her surety.

70-15.1 FAA facilities and cable runs. The Contractor is hereby advised that the construction limits of the project include existing facilities and buried cable runs that are owned, operated and maintained by the FAA. The Contractor, during the execution of the project work, shall comply with the following:

a. The Contractor shall permit FAA maintenance personnel the right of access to the project work site for purposes of inspecting and maintaining all existing FAA owned facilities.

b. The Contractor shall provide notice to the FAA Air Traffic Organization (ATO)/Technical Operations/System Support Center (SSC) Point-of-Contact through the airport [Owner] ~~[operator] [manager] [ ]~~ a minimum of seven (7) calendar days prior to commencement of construction activities in order to permit sufficient time to locate and mark existing buried cables and to schedule any required facility outages.

c. If execution of the project work requires a facility outage, the Contractor shall contact the FAA Point-of-Contact a minimum of 72 hours prior to the time of the required outage.

d. Any damage to FAA cables, access roads, or FAA facilities during construction caused by the Contractor's equipment or personnel whether by negligence or accident will require the Contractor to repair or replace the damaged cables, access road, or FAA facilities to FAA requirements. The Contractor shall not bear the cost to repair damage to underground facilities or utilities improperly located by the FAA.

e. If the project work requires the cutting or splicing of FAA owned cables, the FAA Point-of-Contact shall be contacted a minimum of 72 hours prior to the time the cable work commences. The FAA reserves the right to have a FAA representative on site to observe the splicing of the cables as a condition of acceptance. All cable splices are to be accomplished in accordance with FAA specifications and require approval by the FAA Point-of-Contact as a condition of acceptance by the Owner. The Contractor is hereby advised that FAA restricts the location of where splices may be installed. If a cable splice is required in a location that is not permitted by FAA, the Contractor shall furnish and install a sufficient length of new cable that eliminates the need for any splice.

70-16 Furnishing rights-of-way. The Owner will be responsible for furnishing all rights-of-way upon which the work is to be constructed in advance of the Contractor's operations.

70-17 Personal liability of public officials. In carrying out any of the contract provisions or in exercising any power or authority granted by this contract, there shall be no liability upon the Engineer, his or her authorized representatives, or any officials of the Owner either personally or as an official of the Owner. It is understood that in such matters they act solely as agents and representatives of the Owner.

70-18 No waiver of legal rights. Upon completion of the work, the Owner will expeditiously make final inspection and notify the Contractor of final acceptance. Such final acceptance, however, shall not preclude or stop the Owner from correcting any measurement, estimate, or certificate made before or after completion of the work, nor shall the Owner be precluded or stopped from recovering from the Contractor or his or her surety, or both, such overpayment as may be sustained, or by failure on the part of the Contractor to fulfill his or her obligations under the contract. A waiver on the part of the Owner of any breach of any part of the contract shall not be held to be a waiver of any other or subsequent breach.

The Contractor, without prejudice to the terms of the contract, shall be liable to the Owner for latent defects, fraud, or such gross mistakes as may amount to fraud, or as regards the Owner's rights under any warranty or guaranty.

70-19 Environmental protection. The Contractor shall comply with all Federal, state, and local laws and regulations controlling pollution of the environment. The Contractor shall take necessary precautions to prevent pollution of streams, lakes, ponds, and reservoirs with fuels, oils, bitumens, chemicals, or other harmful materials and to prevent pollution of the atmosphere from particulate and gaseous matter.

70-20 Archaeological and historical findings. Unless otherwise specified in this subsection, the Contractor is advised that the site of the work is not within any property, district, or site, and does not contain any building, structure, or object listed in the current National Register of Historic Places published by the United States Department of Interior.

Should the Contractor encounter, during his or her operations, any building, part of a building, structure, or object that is incongruous with its surroundings, the Contractor shall immediately cease operations in

that location and notify the Engineer. The Engineer will immediately investigate the Contractor's finding and the Owner will direct the Contractor to either resume operations or to suspend operations as directed.

Should the Owner order suspension of the Contractor's operations in order to protect an archaeological or historical finding, or order the Contractor to perform extra work, such shall be covered by an appropriate contract change order or supplemental agreement as provided in the subsection 40-04 titled EXTRA WORK of Section 40 and the subsection 90-05 titled PAYMENT FOR EXTRA WORK of Section 90. If appropriate, the contract change order or supplemental agreement shall include an extension of contract time in accordance with the subsection 80-07 titled DETERMINATION AND EXTENSION OF CONTRACT TIME of Section 80.

END OF SECTION 70

Section 80 Execution and Progress

80-01 Subletting of contract. The Owner ***and Engineer*** will not recognize any subcontractor on the work. The Contractor shall at all times when work is in progress be represented either in person, by a qualified superintendent, or by other designated, qualified representative who is duly authorized to receive and execute orders of the Engineer.

The Contractor shall provide copies of all subcontracts to the Engineer. The Contractor shall perform, with his organization, an amount of work equal to at least 25 percent of the total contract cost.

Should the Contractor elect to assign his or her contract, said assignment shall be concurred in by the surety, shall be presented for the consideration and approval of the Owner, and shall be consummated only on the written approval of the Owner.

80-02 Notice to proceed. The notice to proceed shall state the date on which it is expected the Contractor will begin the construction and from which date contract time will be charged. The Contractor shall begin the work to be performed under the contract within 10 days of the date set by the ~~Engineer~~ ***Owner*** in the written notice to proceed, but in any event, the Contractor shall notify the Engineer at least ~~24~~ ***48*** hours in advance of the time actual construction operations will begin. The Contractor shall not commence any actual construction prior to the date on which the notice to proceed is issued by the Owner.

80-03 Execution and progress. Unless otherwise specified, the Contractor shall submit their progress schedule for the Engineer's approval within 10 ***calendar*** days after the effective date of the notice to proceed. The Contractor's progress schedule, when approved by the Engineer, may be used to establish major construction operations and to check on the progress of the work. The Contractor shall provide sufficient materials, equipment, and labor to guarantee the completion of the project in accordance with the plans and specifications within the time set forth in the proposal.

If the Contractor falls significantly behind the submitted schedule, the Contractor shall, upon the Engineer's request, submit a revised schedule for completion of the work within the contract time and modify their operations to provide such additional materials, equipment, and labor necessary to meet the revised schedule. Should the execution of the work be discontinued for any reason, the Contractor shall notify the Engineer at least ~~24~~ ***48*** hours in advance of resuming operations.

The Contractor shall not commence any actual construction prior to the date on which the notice to proceed is issued by the Owner.

80-04 Limitation of operations. The Contractor shall control his or her operations and the operations of his or her subcontractors and all suppliers to provide for the free and unobstructed movement of aircraft in the air operations areas (AOA) of the airport.

When the work requires the Contractor to conduct his or her operations within an AOA of the airport, the work shall be coordinated with airport operations (through the Engineer) at least 48 hours prior to commencement of such work. The Contractor shall not close an AOA until so authorized by the Engineer and until the necessary temporary marking and associated lighting is in place as provided in the subsection 70-08 titled BARRICADES, WARNING SIGNS, AND HAZARD MARKINGS of Section 70.

When the contract work requires the Contractor to work within an AOA of the airport on an intermittent basis (intermittent opening and closing of the AOA), the Contractor shall maintain constant communications as specified; immediately obey all instructions to vacate the AOA; immediately obey all instructions to resume work in such AOA. Failure to maintain the specified communications or to obey instructions shall be cause for suspension of the Contractor's operations in the AOA until the satisfactory conditions are provided. The following AOA cannot be closed to operating aircraft to permit the

Contractor's operations on a continuous basis and will therefore be closed to aircraft operations intermittently as follows: ***see plans for this information.***

Contractor shall be required to conform to safety standards contained in AC 150/5370-2, Operational Safety on Airports During Construction***, current edition*** ~~(see Special Provisions)~~.

80-04.1 Operational safety on airport during construction. All Contractors' operations shall be conducted in accordance with the project Construction Safety and Phasing Plan (CSPP) and the provisions set forth within the current version of AC 150/5370-2. The CSPP included within the contract documents conveys minimum requirements for operational safety on the airport during construction activities. The Contractor shall prepare and submit a Safety Plan Compliance Document that details how it proposes to comply with the requirements presented within the CSPP.

The Contractor shall implement all necessary safety plan measures prior to commencement of any work activity. The Contractor shall conduct routine checks to assure compliance with the safety plan measures.

The Contractor is responsible to the Owner for the conduct of all subcontractors it employs on the project. The Contractor shall assure that all subcontractors are made aware of the requirements of the CSPP and that they implement and maintain all necessary measures.

No deviation or modifications may be made to the approved CSPP unless approved in writing by the Owner or Engineer.

80-05 Character of workers, methods, and equipment. The Contractor shall, at all times, employ sufficient labor and equipment for prosecuting the work to full completion in the manner and time required by the contract, plans, and specifications.

All workers shall have sufficient skill and experience to perform properly the work assigned to them. Workers engaged in special work or skilled work shall have sufficient experience in such work and in the operation of the equipment required to perform the work satisfactorily.

Any person employed by the Contractor or by any subcontractor who violates any operational regulations or operational safety requirements and, in the opinion of the Engineer, does not perform his work in a proper and skillful manner or is intemperate or disorderly shall, at the written request of the Engineer, be removed forthwith by the Contractor or subcontractor employing such person, and shall not be employed again in any portion of the work without approval of the Engineer.

Should the Contractor fail to remove such persons or person, or fail to furnish suitable and sufficient personnel for the proper execution of the work, the Engineer may suspend the work by written notice until compliance with such orders.

In addition, the following requirements shall apply concerning all workers utilized on the project:

a. The Contractor shall provide and maintain, at all times on the project site of the work during its progress, adequate and competent superintendence of all operations for and in connection with the work. The Contractor shall provide a capable superintendent acceptable to the Owner. Such representative shall be able to read, write and speak English fluently and shall be authorized to receive instructions from the Engineer or his authorized representative. Said superintendent shall have authority to see that the work is carried out in accordance with the Contract Documents and in a thorough and workmanlike manner in every respect.

b. Incompetent, disorderly, intemperate or incorrigible employees of any authority level shall be dismissed from the project by the Contractor or his representative when requested by the Engineer or the Owner, and such persons shall not again be permitted to return to the work site without the written consent of the Owner..

c. Any Contrctor or subcontractor employee who violates the security and/or badging regulations of the Airport will be removed from the Airport and not allowed back on Airport property without the prior approval of the Owner.

All equipment that is proposed to be used on the work shall be of sufficient size and in such mechanical condition as to meet requirements of the work and to produce a satisfactory quality of work. Equipment used on any portion of the work shall be such that no injury to previously completed work, adjacent property, or existing airport facilities will result from its use.

When the methods and equipment to be used by the Contractor in accomplishing the work are not prescribed in the contract, the Contractor is free to use any methods or equipment that will accomplish the work in conformity with the requirements of the contract, plans, and specifications.

When the contract specifies the use of certain methods and equipment, such methods and equipment shall be used unless others are authorized by the Engineer. If the Contractor desires to use a method or type of equipment other than specified in the contract, the Contractor may request authority from the Engineer to do so. The request shall be in writing and shall include a full description of the methods and equipment proposed and of the reasons for desiring to make the change. If approval is given, it will be on the condition that the Contractor will be fully responsible for producing work in conformity with contract requirements. If, after trial use of the substituted methods or equipment, the Engineer determines that the work produced does not meet contract requirements, the Contractor shall discontinue the use of the substitute method or equipment and shall complete the remaining work with the specified methods and equipment. The Contractor shall remove any deficient work and replace it with work of specified quality, or take such other corrective action as the Engineer may direct. No change will be made in basis of payment for the contract items involved nor in contract time as a result of authorizing a change in methods or equipment under this subsection.

80-06 Temporary suspension of the work. The Owner shall have the authority to suspend the work wholly, or in part, for such period or periods as the Owner may deem necessary, due to unsuitable weather, or such other conditions as are considered unfavorable for the execution of the work, or for such time as is necessary due to the failure on the part of the Contractor to carry out orders given or perform any or all provisions of the contract.

In the event that the Contractor is ordered by the Owner, in writing, to suspend work for some unforeseen cause not otherwise provided for in the contract and over which the Contractor has no control, the Contractor may be reimbursed for actual money expended on the work during the period of shutdown. No allowance will be made for anticipated profits. The period of shutdown shall be computed from the effective date of the Engineer's order to suspend work to the effective date of the Engineer's order to resume the work. Claims for such compensation shall be filed with the Engineer within the time period stated in the Engineer's order to resume work. The Contractor shall submit with his or her claim information substantiating the amount shown on the claim. The Engineer will forward the Contractor's claim to the Owner for consideration in accordance with local laws or ordinances. No provision of this article shall be construed as entitling the Contractor to compensation for delays due to inclement weather, for suspensions made at the request of the Owner, or for any other delay provided for in the contract, plans, or specifications.

If it should become necessary to suspend work for an indefinite period, the Contractor shall store all materials in such manner that they will not become an obstruction nor become damaged in any way. The Contractor shall take every precaution to prevent damage or deterioration of the work performed and provide for normal drainage of the work. The Contractor shall erect temporary structures where necessary to provide for traffic on, to, or from the airport.

80-07 Determination and extension of contract time. The number of calendar or working days allowed for completion of the work shall be stated in the proposal and contract and shall be known as the CONTRACT TIME.

Should the contract time require extension for reasons beyond the Contractor's control, it shall be adjusted as follows:

a. CONTRACT TIME based on WORKING DAYS shall be calculated weekly by the Engineer. The Engineer will furnish the Contractor a copy of his or her weekly statement of the number of working days charged against the contract time during the week and the number of working days currently specified for completion of the contract (the original contract time plus the number of working days, if any, that have been included in approved CHANGE ORDERS or SUPPLEMENTAL AGREEMENTS covering EXTRA WORK).

The Engineer shall base his or her weekly statement of contract time charged on the following considerations:

(1) No time shall be charged for days on which the Contractor is unable to proceed with the principal item of work under construction at the time for at least six (6) hours with the normal work force employed on such principal item. Should the normal work force be on a double-shift, 12 hours shall be used. Should the normal work force be on a triple-shift, 18 hours shall apply. Conditions beyond the Contractor's control such as strikes, lockouts, unusual delays in transportation, temporary suspension of the principal item of work under construction or temporary suspension of the entire work which have been ordered by the Owner for reasons not the fault of the Contractor, shall not be charged against the contract time.

(2) The Engineer will not make charges against the contract time prior to the effective date of the notice to proceed.

(3) The Engineer will begin charges against the contract time on the first working day after the effective date of the notice to proceed.

(4) The Engineer will not make charges against the contract time after the date of final acceptance as defined in the subsection 50-15 titled FINAL ACCEPTANCE of Section 50.

(5) The Contractor will be allowed one (1) week in which to file a written protest setting forth his or her objections to the Engineer's weekly statement. If no objection is filed within such specified time, the weekly statement shall be considered as acceptable to the Contractor.

~~The contract time (stated in the proposal) is based on the originally estimated quantities as described in the subsection 20-05 titled INTERPRETATION OF ESTIMATED PROPOSAL QUANTITIES of Section 20. Should the satisfactory completion of the contract require performance of work in greater quantities than those estimated in the proposal, the contract time shall be increased in the same proportion as the cost of the actually completed quantities bears to the cost of the originally estimated quantities in the proposal. Such increase in contract time shall not consider either the cost of work or the extension of contract time that has been covered by change order or supplemental agreement and shall be made at the time of final payment.~~

b. Contract Time based on calendar days shall consist of the number of calendar days stated in the contract counting from the effective date of the notice to proceed and including all Saturdays, Sundays, holidays, and non-work days. All calendar days elapsing between the effective dates of the Owner's orders to suspend and resume all work, due to causes not the fault of the Contractor, shall be excluded.

~~At the time of final payment, the contract time shall be increased in the same proportion as the cost of the actually completed quantities bears to the cost of the originally estimated quantities in the proposal. Such increase in the contract time shall not consider either cost of work or the extension of contract time~~

~~that has been covered by a change order or supplemental agreement. Charges against the contract time will cease as of the date of final acceptance.~~

c. When the contract time is a specified completion date, it shall be the date on which all contract work shall be substantially complete.

If the Contractor finds it impossible for reasons beyond his or her control to complete the work within the contract time as specified, or as extended in accordance with the provisions of this subsection, the Contractor may, at any time prior to the expiration of the contract time as extended, make a written request to the Owner for an extension of time setting forth the reasons which the Contractor believes will justify the granting of his or her request. Requests for extension of time on calendar day projects, caused by inclement weather, shall be supported with National Weather Bureau data showing the actual amount of inclement weather exceeded what could normally be expected during the contract period. The Contractor's plea that insufficient time was specified is not a valid reason for extension of time. If the supporting documentation justify the work was delayed because of conditions beyond the control and without the fault of the Contractor, the Owner may extend the time for completion by a change order that adjusts the contract time or completion date. The extended time for completion shall then be in full force and effect, the same as though it were the original time for completion.

Normal inclement weather days shall be established by the Contractor obtaining the previous five (5) years of inclement weather data from the nearest National Oceanographic and Atmospheric Administration (NOAA) site and averaging the previous five (5) years of each type of inclement weather for each month and comparing it to each month of construction activities to determine if the number of inclement weather days occurring in any given month exceeds the average for that month over the past five (5) years for that type of inclement weather, i.e. rain, snow, etc. If the Contractor is unable to work at least 50% of the normal work day on pre-determined controlling work items due to abnormal inclement weather conditions, the Contractor may not be charged a calendar day provided the Contractor submits the required data and records documenting abnormal inclement weather.

80-08 Failure to complete on time. For each calendar day or working day, as specified in the contract, that any work remains uncompleted after the contract time (including all extensions and adjustments as provided in the subsection 80-07 titled DETERMINATION AND EXTENSION OF CONTRACT TIME of this Section) the sum specified in the contract and proposal as liquidated damages will be deducted from any money due or to become due the Contractor or his or her surety. Such deducted sums shall not be deducted as a penalty but shall be considered as liquidation of a reasonable portion of damages including but not limited to additional engineering services that will be incurred by the Owner should the Contractor fail to complete the work in the time provided in their contract.

Schedule	Liquidated Damages Cost	Allowed Construction Time
	$1,000	220

~~The maximum construction time allowed for Schedules [___] will be the sum of the time allowed for individual schedules but not more than [___] days.~~ Permitting the Contractor to continue and finish the work or any part of it after the time fixed for its completion, or after the date to which the time for completion may have been extended, will in no way operate as a wavier on the part of the Owner of any of its rights under the contract.

80-09 Default and termination of contract. The Contractor shall be considered in default of his or her contract and such default will be considered as cause for the Owner to terminate the contract for any of the following***, but not limited to,*** reasons if the Contractor:

a. Fails to begin the work under the contract within the time specified in the Notice to Proceed, or

b. Fails to perform the work or fails to provide sufficient workers, equipment and/or materials to assure completion of work in accordance with the terms of the contract, or

c. Performs the work unsuitably or neglects or refuses to remove materials or to perform anew such work as may be rejected as unacceptable and unsuitable, or

d. Discontinues the execution of the work, or

e. Fails to resume work which has been discontinued within a reasonable time after notice to do so, or

f. Becomes insolvent or is declared bankrupt, or commits any act of bankruptcy or insolvency, or

g. Allows any final judgment to stand against the Contractor unsatisfied for a period of 10 days, or

h. Makes an assignment for the benefit of creditors, or

i. For any other cause whatsoever, fails to carry on the work in an acceptable manner.

Should the Engineer consider the Contractor in default of the contract for any reason above, the Engineer shall immediately give written notice to the Contractor and the Contractor's surety as to the reasons for considering the Contractor in default and the Owner's intentions to terminate the contract.

If the Contractor or surety, within a period of 10 days after such notice, does not proceed in accordance therewith, then the Owner will, upon written notification from the Engineer of the facts of such delay, neglect, or default and the Contractor's failure to comply with such notice, have full power and authority without violating the contract, to take the execution of the work out of the hands of the Contractor. The Owner may appropriate or use any or all materials and equipment that have been mobilized for use in the work and are acceptable and may enter into an agreement for the completion of said contract according to the terms and provisions thereof, or use such other methods as in the opinion of the Engineer will be required for the completion of said contract in an acceptable manner.

All costs and charges incurred by the Owner, together with the cost of completing the work under contract, will be deducted from any monies due or which may become due the Contractor. If such expense exceeds the sum which would have been payable under the contract, then the Contractor and the surety shall be liable and shall pay to the Owner the amount of such excess.

80-10 Termination for national emergencies. The Owner shall terminate the contract or portion thereof by written notice when the Contractor is prevented from proceeding with the construction contract as a direct result of an Executive Order of the President with respect to the execution of war or in the interest of national defense.

When the contract, or any portion thereof, is terminated before completion of all items of work in the contract, payment will be made for the actual number of units or items of work completed at the contract price or as mutually agreed for items of work partially completed or not started. No claims or loss of anticipated profits shall be considered.

Reimbursement for organization of the work, and other overhead expenses, (when not otherwise included in the contract) and moving equipment and materials to and from the job will be considered, the intent being that an equitable settlement will be made with the Contractor.

Acceptable materials, obtained or ordered by the Contractor for the work and that are not incorporated in the work shall, at the option of the Contractor, be purchased from the Contractor at actual cost as shown by receipted bills and actual cost records at such points of delivery as may be designated by the Engineer.

Termination of the contract or a portion thereof shall neither relieve the Contractor of his or her responsibilities for the completed work nor shall it relieve his or her surety of its obligation for and concerning any just claim arising out of the work performed.

80-11 Work area, storage area and sequence of operations. The Contractor shall obtain approval from the Engineer prior to beginning any work in all areas of the airport. No operating runway, taxiway, or air operations area (AOA) shall be crossed, entered, or obstructed while it is operational. The Contractor shall plan and coordinate his or her work in such a manner as to ensure safety and a minimum of hindrance to flight operations. All Contractor equipment and material stockpiles shall be stored a minimum or **250** feet from the centerline of an active runway. No equipment will be allowed to park within the approach area of an active runway at any time. No equipment shall be within **250** feet of an active runway at any time.

END OF SECTION 80

Section 90 Measurement and Payment

90-01 Measurement of quantities. All work completed under the contract will be measured by the Engineer, or his or her authorized representatives, using United States Customary Units of Measurement or the International System of Units.

The method of measurement and computations to be used in determination of quantities of material furnished and of work performed under the contract will be those methods generally recognized as conforming to good engineering practice.

Unless otherwise specified, longitudinal measurements for area computations will be made horizontally, and no deductions will be made for individual fixtures (or leave-outs) having an area of 9 square feet (0.8 square meters) or less. Unless otherwise specified, transverse measurements for area computations will be the neat dimensions shown on the plans or ordered in writing by the Engineer.

Structures will be measured according to neat lines shown on the plans or as altered to fit field conditions.

Unless otherwise specified, all contract items which are measured by the linear foot such as electrical ducts, conduits, pipe culverts, underdrains, and similar items shall be measured parallel to the base or foundation upon which such items are placed.

In computing volumes of excavation the average end area method or other acceptable methods will be used.

The thickness of plates and galvanized sheet used in the manufacture of corrugated metal pipe, metal plate pipe culverts and arches, and metal cribbing will be specified and measured in decimal fraction of inch.

The term “ton” will mean the short ton consisting of 2,000 lb (907 km) avoirdupois. All materials that are measured or proportioned by weights shall be weighed on accurate, approved scales by competent, qualified personnel at locations designed by the Engineer. If material is shipped by rail, the car weight may be accepted provided that only the actual weight of material is paid for. However, car weights will not be acceptable for material to be passed through mixing plants. Trucks used to haul material being paid for by weight shall be weighed empty daily at such times as the Engineer directs, and each truck shall bear a plainly legible identification mark.

Materials to be measured by volume in the hauling vehicle shall be hauled in approved vehicles and measured therein at the point of delivery. Vehicles for this purpose may be of any size or type acceptable for the materials hauled, provided that the body is of such shape that the actual contents may be readily and accurately determined. All vehicles shall be loaded to at least their water level capacity, and all loads shall be leveled when the vehicles arrive at the point of delivery.

When requested by the Contractor and approved by the Engineer in writing, material specified to be measured by the cubic yard (cubic meter) may be weighed, and such weights will be converted to cubic yards (cubic meters) for payment purposes. Factors for conversion from weight measurement to volume measurement will be determined by the Engineer and shall be agreed to by the Contractor before such method of measurement of pay quantities is used.

Bituminous materials will be measured by the gallon (liter) or ton (kg). When measured by volume, such volumes will be measured at 60°F (16°C) or will be corrected to the volume at 60°F (16°C) using ASTM D1250 for asphalts or ASTM D633 for tars.

Net certified scale weights or weights based on certified volumes in the case of rail shipments will be used as a basis of measurement, subject to correction when bituminous material has been lost from the car or the distributor, wasted, or otherwise not incorporated in the work.

When bituminous materials are shipped by truck or transport, net certified weights by volume, subject to correction for loss or foaming, may be used for computing quantities.

Cement will be measured by the ton (kg) or hundredweight (km).

Timber will be measured by the thousand feet board measure (MFBM) actually incorporated in the structure. Measurement will be based on nominal widths and thicknesses and the extreme length of each piece.

The term “lump sum” when used as an item of payment will mean complete payment for the work described in the contract.

When a complete structure or structural unit (in effect, “lump sum” work) is specified as the unit of measurement, the unit will be construed to include all necessary fittings and accessories.

Rental of equipment will be measured by time in hours of actual working time and necessary traveling time of the equipment within the limits of the work. Special equipment ordered by the Engineer in connection with force account work will be measured as agreed in the change order or supplemental agreement authorizing such force account work as provided in the subsection 90-05 titled PAYMENT FOR EXTRA WORK of this section.

When standard manufactured items are specified such as fence, wire, plates, rolled shapes, pipe conduit, etc., and these items are identified by gauge, unit weight, section dimensions, etc., such identification will be considered to be nominal weights or dimensions. Unless more stringently controlled by tolerances in cited specifications, manufacturing tolerances established by the industries involved will be accepted.

Scales for weighing materials which are required to be proportioned or measured and paid for by weight shall be furnished, erected, and maintained by the Contractor, or be certified permanently installed commercial scales.

Scales shall be accurate within 1/2% of the correct weight throughout the range of use. The Contractor shall have the scales checked under the observation of the inspector before beginning work and at such other times as requested. The intervals shall be uniform in spacing throughout the graduated or marked length of the beam or dial and shall not exceed one-tenth of 1% of the nominal rated capacity of the scale, but not less than 1 pound (454 grams). The use of spring balances will not be permitted.

Beams, dials, platforms, and other scale equipment shall be so arranged that the operator and the inspector can safely and conveniently view them.

Scale installations shall have available ten standard 50-pound (2.3 km) weights for testing the weighing equipment or suitable weights and devices for other approved equipment.

Scales must be tested for accuracy and serviced before use at a new site. Platform scales shall be installed and maintained with the platform level and rigid bulkheads at each end.

Scales “overweighing” (indicating more than correct weight) will not be permitted to operate, and all materials received subsequent to the last previous correct weighting-accuracy test will be reduced by the percentage of error in excess of one-half of 1%.

In the event inspection reveals the scales have been underweighing (indicating less than correct weight), they shall be adjusted, and no additional payment to the Contractor will be allowed for materials previously weighed and recorded.

All costs in connection with furnishing, installing, certifying, testing, and maintaining scales; for furnishing check weights and scale house; and for all other items specified in this subsection, for the weighing of materials for proportioning or payment, shall be included in the unit contract prices for the various items of the project.

When the estimated quantities for a specific portion of the work are designated as the pay quantities in the contract, they shall be the final quantities for which payment for such specific portion of the work will be made, unless the dimensions of said portions of the work shown on the plans are revised by the Engineer. If revised dimensions result in an increase or decrease in the quantities of such work, the final quantities for payment will be revised in the amount represented by the authorized changes in the dimensions.

90-02 Scope of payment. The Contractor shall receive and accept compensation provided for in the contract as full payment for furnishing all materials, for performing all work under the contract in a complete and acceptable manner, and for all risk, loss, damage, or expense of whatever character arising out of the nature of the work or the execution thereof, subject to the provisions of the subsection 70-18 titled NO WAIVER OF LEGAL RIGHTS of Section 70.

When the "basis of payment" subsection of a technical specification requires that the contract price (price bid) include compensation for certain work or material essential to the item, this same work or material will not also be measured for payment under any other contract item which may appear elsewhere in the contract, plans, or specifications.

90-03 Compensation for altered quantities. When the accepted quantities of work vary from the quantities in the proposal, the Contractor shall accept as payment in full, so far as contract items are concerned, payment at the original contract price for the accepted quantities of work actually completed and accepted. No allowance, except as provided for in the subsection 40-02 titled ALTERATION OF WORK AND QUANTITIES of Section 40 will be made for any increased expense, loss of expected reimbursement, or loss of anticipated profits suffered or claimed by the Contractor which results directly from such alterations or indirectly from his or her unbalanced allocation of overhead and profit among the contract items, or from any other cause.

90-04 Payment for omitted items. As specified in the subsection 40-03 titled OMITTED ITEMS of Section 40, the Engineer shall have the right to omit from the work (order nonperformance) any contract item, except major contract items, in the best interest of the Owner.

Should the Engineer omit or order nonperformance of a contract item or portion of such item from the work, the Contractor shall accept payment in full at the contract prices for any work actually completed and acceptable prior to the Engineer's order to omit or non-perform such contract item.

Acceptable materials ordered by the Contractor or delivered on the work prior to the date of the Engineer's order will be paid for at the actual cost to the Contractor and shall thereupon become the property of the Owner.

In addition to the reimbursement hereinbefore provided, the Contractor shall be reimbursed for all actual costs incurred for the purpose of performing the omitted contract item prior to the date of the Engineer's order. Such additional costs incurred by the Contractor must be directly related to the deleted contract item and shall be supported by certified statements by the Contractor as to the nature the amount of such costs.

90-05 Payment for extra work. Extra work, performed in accordance with the subsection 40-04 titled EXTRA WORK of Section 40, will be paid for at the contract prices or agreed prices specified in the change order or supplemental agreement authorizing the extra work.

90-06 Partial payments. Partial payments will be made to the Contractor at least once each month as the work progresses. Said payments will be based upon estimates, prepared by the Engineer, of the value of the work performed and materials complete and in place, in accordance with the contract, plans, and specifications. Such partial payments may also include the delivered actual cost of those materials stockpiled and stored in accordance with the subsection 90-07 titled PAYMENT FOR MATERIALS ON HAND of this section. No partial payment will be made when the amount due to the Contractor since the last estimate amounts to less than five hundred dollars.

The Contractor is required to pay all subcontractors for satisfactory performance of their contracts no later than 30 days after the Contractor has received a partial payment. The Owner must ensure prompt and full payment of retainage from the prime Contractor to the subcontractor within 30 days after the subcontractor's work is satisfactorily completed. A subcontractor's work is satisfactorily completed when all the tasks called for in the subcontract have been accomplished and documented as required by the Owner. When the Owner has made an incremental acceptance of a portion of a prime contract, the work of a subcontractor covered by that acceptance is deemed to be satisfactorily completed.

From the total of the amount determined to be payable on a partial payment, 10% percent of such total amount will be deducted and retained by the Owner until the final payment is made, except as may be provided (at the Contractor's option) in the subsection 90-08 titled PAYMENT OF WITHHELD FUNDS of this section. The balance [90%] of the amount payable, less all previous payments, shall be certified for payment. Should the Contractor exercise his or her option, as provided in the subsection 90-08 titled PAYMENT OF WITHHELD FUNDS of this section, no such percent retainage shall be deducted.

When at least 95% of the work has been completed, the Engineer shall, at the Owner's discretion and with the consent of the surety, prepare estimates of both the contract value and the cost of the remaining work to be done.

The Owner may retain an amount not less than twice the contract value or estimated cost, whichever is greater, of the work remaining to be done. The remainder, less all previous payments and deductions, will then be certified for payment to the Contractor.

It is understood and agreed that the Contractor shall not be entitled to demand or receive partial payment based on quantities of work in excess of those provided in the proposal or covered by approved change orders or supplemental agreements, except when such excess quantities have been determined by the Engineer to be a part of the final quantity for the item of work in question.

No partial payment shall bind the Owner to the acceptance of any materials or work in place as to quality or quantity. All partial payments are subject to correction at the time of final payment as provided in the subsection 90-09 titled ACCEPTANCE AND FINAL PAYMENT of this section.

The Contractor shall deliver to the Owner a complete release of all claims for labor and material arising out of this contract before the final payment is made. If any subcontractor or supplier fails to furnish such a release in full, the Contractor may furnish a bond or other collateral satisfactory to the Owner to indemnify the Owner against any potential lien or other such claim. The bond or collateral shall include all costs, expenses, and attorney fees the Owner may be compelled to pay in discharging any such lien or claim.

90-07 Payment for materials on hand. Partial payments may be made to the extent of the delivered cost of materials to be incorporated in the work, provided that such materials meet the requirements of the contract, plans, and specifications and are delivered to acceptable sites on the airport property or at other sites in the vicinity that are acceptable to the Owner. Such delivered costs of stored or stockpiled materials may be included in the next partial payment after the following conditions are met:

a. The material has been stored or stockpiled in a manner acceptable to the Engineer at or on an approved site.

b. The Contractor has furnished the Engineer with acceptable evidence of the quantity and quality of such stored or stockpiled materials.

c. The Contractor has furnished the Engineer with satisfactory evidence that the material and transportation costs have been paid.

d. The Contractor has furnished the Owner legal title (free of liens or encumbrances of any kind) to the material so stored or stockpiled.

e. The Contractor has furnished the Owner evidence that the material so stored or stockpiled is insured against loss by damage to or disappearance of such materials at any time prior to use in the work.

It is understood and agreed that the transfer of title and the Owner's payment for such stored or stockpiled materials shall in no way relieve the Contractor of his or her responsibility for furnishing and placing such materials in accordance with the requirements of the contract, plans, and specifications.

In no case will the amount of partial payments for materials on hand exceed the contract price for such materials or the contract price for the contract item in which the material is intended to be used.

No partial payment will be made for stored or stockpiled living or perishable plant materials.

The Contractor shall bear all costs associated with the partial payment of stored or stockpiled materials in accordance with the provisions of this subsection.

~~**90-08 Payment of withheld funds**. At the Contractor's option, if an Owner withholds retainage in accordance with the methods described in subsection 90-06 PARTIAL PAYMENTS, the Contractor may request that the Owner deposit the retainage into an escrow account. The Owner's deposit of retainage into an escrow account is subject to the following conditions:~~

~~**a.** The Contractor shall bear all expenses of establishing and maintaining an escrow account and escrow agreement acceptable to the Owner.~~

~~**b.** The Contractor shall deposit to and maintain in such escrow only those securities or bank certificates of deposit as are acceptable to the Owner and having a value not less than the retainage that would otherwise be withheld from partial payment.~~

~~**c.** The Contractor shall enter into an escrow agreement satisfactory to the Owner.~~

~~**d.** The Contractor shall obtain the written consent of the surety to such agreement.~~

90-09 Acceptance and final payment. When the contract work has been accepted in accordance with the requirements of the subsection 50-15 titled FINAL ACCEPTANCE of Section 50, the Engineer will prepare the final estimate of the items of work actually performed. The Contractor shall approve the Engineer's final estimate or advise the Engineer of the Contractor's objections to the final estimate which are based on disputes in measurements or computations of the final quantities to be paid under the contract as amended by change order or supplemental agreement. The Contractor and the Engineer shall resolve all disputes (if any) in the measurement and computation of final quantities to be paid within 30 calendar days of the Contractor's receipt of the Engineer's final estimate. If, after such 30-day period, a dispute still exists, the Contractor may approve the Engineer's estimate under protest of the quantities in dispute, and such disputed quantities shall be considered by the Owner as a claim in accordance with the subsection 50-16 titled CLAIMS FOR ADJUSTMENT AND DISPUTES of Section 50.

After the Contractor has approved, or approved under protest, the Engineer's final estimate, and after the Engineer's receipt of the project closeout documentation required in subsection 90-11 Project Closeout, final payment will be processed based on the entire sum, or the undisputed sum in case of approval under protest, determined to be due the Contractor less all previous payments and all amounts to be deducted under the provisions of the contract. All prior partial estimates and payments shall be subject to correction in the final estimate and payment.

Should elements of work require delay in final payment due to seasonal or other reasons, the Owner may retain or withhold an agreed upon amount from items of work associated with the delayed items and hold that retainage, even after final payment less the retained amounts, until the Contractor has fulfilled the elements of work delayed to the satisfaction of the Owner. The Owner shall release the retained amount after all associated work for which the delay item has been accepted by the Owner.

If the Contractor has filed a claim for additional compensation under the provisions of the subsection 50-16 titled CLAIMS FOR ADJUSTMENTS AND DISPUTES of Section 50 or under the provisions of this subsection, such claims will be considered by the Owner in accordance with local laws or ordinances. Upon final adjudication of such claims, any additional payment determined to be due the Contractor will be paid pursuant to a supplemental final estimate.

90-10 Construction warranty.

a. In addition to any other warranties in this contract, the Contractor warrants that work performed under this contract conforms to the contract requirements and is free of any defect in equipment, material, workmanship, or design furnished, or performed by the Contractor or any subcontractor or supplier at any tier.

b. This warranty shall continue for a period of one year from the date of final acceptance of ~~the~~ ***all*** work. ~~If the Owner takes possession of any part of the work before final acceptance, this warranty shall continue for a period of one year from the date the Owner takes possession. However, this will not relieve the Contractor from corrective items required by the final acceptance of the project work.~~

c. The Contractor shall remedy at the Contractor's expense any failure to conform, or any defect. In addition, the Contractor shall remedy at the Contractor's expense any damage to Owner real or personal property, when that damage is the result of:

(1) The Contractor's failure to conform to contract requirements; or

(2) Any defect of equipment, material, workmanship, or design furnished by the Contractor.

d. The Contractor shall restore any work damaged in fulfilling the terms and conditions of this clause. The Contractor's warranty with respect to work repaired or replaced will run for one year from the date of repair or replacement.

e. The Owner will notify the Contractor, in writing, within **[** seven (7) **]** ***calendar*** days after the discovery of any failure, defect, or damage.

f. If the Contractor fails to remedy any failure, defect, or damage within **[** 14 **]** ***calendar*** days after receipt of notice, the Owner shall have the right to replace, repair, or otherwise remedy the failure, defect, or damage at the Contractor's expense.

g. With respect to all warranties, express or implied, from subcontractors, manufacturers, or suppliers for work performed and materials furnished under this contract, the Contractor shall: (1) Obtain all warranties that would be given in normal commercial practice; (2) Require all warranties to be executed, in writing, for the benefit of the Owner, as directed by the Owner, and (3) Enforce all warranties for the benefit of the Owner.

h. This warranty shall not limit the Owner's rights with respect to latent defects, gross mistakes, or fraud.

90-11 Project closeout. Approval of final payment to the Contractor is contingent upon completion and submittal of the items listed below. The final payment will not be approved until the Engineer approves the Contractor's final submittal. The Contractor shall:

a. Provide two (2) copies of all manufacturers warranties specified for materials, equipment, and installations.

b. Provide weekly payroll records (not previously received) from the general Contractor and all subcontractors.

c. Complete final cleanup in accordance with subsection 40-08, FINAL CLEANUP.

d. Complete all punch list items identified during the Final Inspection.

e. Provide complete release of all claims for labor and material arising out of the Contract.

f. Provide a certified statement signed by the subcontractors, indicating actual amounts paid to the Disadvantaged Business Enterprise (DBE) subcontractors and/or suppliers associated with the project.

g. When applicable per state requirements, return copies of sales tax completion forms.

h. Manufacturer's certifications for all items incorporated in the work.

i. All required record drawings, as-built drawings or as-constructed drawings.

j. Project Operation and Maintenance (O&M) Manual.

k. Security for Construction Warranty.

l. Equipment commissioning documentation submitted, if required.

END OF SECTION 90

Section 100 Contractor Quality Control Program

100-01 General. When the specification requires a Contractor Quality Control Program, the Contractor shall establish, provide, and maintain an effective Quality Control Program that details the methods and procedures that will be taken to assure that all materials and completed construction required by this contract conform to contract plans, technical specifications and other requirements, whether manufactured by the Contractor, or procured from subcontractors or vendors. Although guidelines are established and certain minimum requirements are specified here and elsewhere in the contract technical specifications, the Contractor shall assume full responsibility for accomplishing the stated purpose.

The intent of this section is to enable the Contractor to establish a necessary level of control that will:

a. Adequately provide for the production of acceptable quality materials.

b. Provide sufficient information to assure both the Contractor and the Engineer that the specification requirements can be met.

c. Allow the Contractor as much latitude as possible to develop his or her own standard of control.

The Contractor shall be prepared to discuss and present, at the preconstruction conference, their understanding of the quality control requirements. The Contractor shall not begin any construction or production of materials to be incorporated into the completed work until the Quality Control Program has been reviewed and accepted by the Engineer. No partial payment will be made for materials subject to specific quality control requirements until the Quality Control Program has been reviewed ***and accepted***.

The quality control requirements contained in this section and elsewhere in the contract technical specifications are in addition to and separate from the acceptance testing requirements. Acceptance testing requirements are the responsibility of the Engineer.

Paving projects over $500,000 shall have a Quality Control (QC)/Quality Assurance (QA) workshop with the Engineer, Contractor, subcontractors, testing laboratories, and Owner's representative at start of construction. The workshop shall address QC and QA requirements of the project specifications. The Contractor shall coordinate with the Airport and the Engineer on time and location of the QC/QA workshop.

100-02 Description of program.

a. General description. The Contractor shall establish a Quality Control Program to perform quality control inspection and testing of all items of work required by the technical specifications, including those performed by subcontractors. This Quality Control Program shall ensure conformance to applicable specifications and plans with respect to materials, workmanship, construction, finish, and functional performance. The Quality Control Program shall be effective for control of all construction work performed under this Contract and shall specifically include surveillance and tests required by the technical specifications, in addition to other requirements of this section and any other activities deemed necessary by the Contractor to establish an effective level of quality control.

b. Quality Control Program. The Contractor shall describe the Quality Control Program in a written document that shall be reviewed and approved by the Engineer prior to the start of any production, construction, or off-site fabrication. The written Quality Control Program shall be submitted to the Engineer for review and approval at least 5 calendar days before the Preconstruction Conference. The Contractor's Quality Control Plan and Quality Control testing laboratory must be approved in writing by the Engineer prior to the Notice to Proceed (NTP).

The Quality Control Program shall be organized to address, as a minimum, the following items:

a. Quality control organization

b. Project progress schedule

c. Submittals schedule

d. Inspection requirements

e. Quality control testing plan

f. Documentation of quality control activities

g. Requirements for corrective action when quality control and/or acceptance criteria are not met

The Contractor is encouraged to add any additional elements to the Quality Control Program that is deemed necessary to adequately control all production and/or construction processes required by this contract.

The cost of development, administration and/or performance of the Contractor Quality Control Program shall not be paid for separately but shall be incidental to the various bid items.

100-03 Quality control organization. The Contractor Quality Control Program shall be implemented by the establishment of a separate quality control organization. An organizational chart shall be developed to show all quality control personnel and how these personnel integrate with other management/production and construction functions and personnel.

The organizational chart shall identify all quality control staff by name and function, and shall indicate the total staff required to implement all elements of the Quality Control Program, including inspection and testing for each item of work. If necessary, different technicians can be used for specific inspection and testing functions for different items of work. If an outside organization or independent testing laboratory is used for implementation of all or part of the Quality Control Program, the personnel assigned shall be subject to the qualification requirements of paragraph 100-03a and 100-03b. The organizational chart shall indicate which personnel are Contractor employees and which are provided by an outside organization.

The quality control organization shall, as a minimum, consist of the following personnel:

a. Program Administrator. The Program Administrator shall be a full-time **[** on-site **]** employee of the Contractor, or a consultant engaged by the Contractor. The Program Administrator shall have a minimum of five (5) years of experience in airport and/or highway construction and shall have had prior quality control experience on a project of comparable size and scope as the contract.

Additional qualifications for the Program Administrator shall include at least one of the following requirements:

(1) Professional Engineer with one (1) year of airport paving experience.

(2) Engineer-in-training with two (2) years of airport paving experience.

(3) An individual with three (3) years of highway and/or airport paving experience, with a Bachelor of Science Degree in Civil Engineering, Civil Engineering Technology or Construction.

(4) Construction materials technician certified at Level III by the National Institute for Certification in Engineering Technologies (NICET).

(5) Highway materials technician certified at Level III by NICET.

(6) Highway construction technician certified at Level III by NICET.

(7) A NICET certified engineering technician in Civil Engineering Technology with five (5) years of highway and/or airport paving experience.

The Program Administrator shall have full authority to institute any and all actions necessary for the successful implementation of the Quality Control Program to ensure compliance with the contract plans and technical specifications. The Program Administrator shall report directly to a responsible officer of the construction firm. The Program Administrator may supervise the Quality Control Program on more than one project provided that person can be at the job site within two (2) hours after being notified of a problem.

b. Quality control technicians. A sufficient number of quality control technicians necessary to adequately implement the Quality Control Program shall be provided. These personnel shall be either Engineers, engineering technicians, or experienced craftsman with qualifications in the appropriate field equivalent to NICET Level II or higher construction materials technician or highway construction technician and shall have a minimum of two (2) years of experience in their area of expertise.

The quality control technicians shall report directly to the Program Administrator and shall perform the following functions:

(1) Inspection of all materials, construction, plant, and equipment for conformance to the technical specifications, and as required by subsection 100-06.

(2) Performance of all quality control tests as required by the technical specifications and subsection 100-07.

(3) Performance of density tests for the Engineer when required by the technical specifications.

Certification at an equivalent level, by a state or nationally recognized organization will be acceptable in lieu of NICET certification.

c. Staffing levels. The Contractor shall provide sufficient qualified quality control personnel to monitor each work activity at all times. Where material is being produced in a plant for incorporation into the work, separate plant and field technicians shall be provided at each plant and field placement location. The scheduling and coordinating of all inspection and testing must match the type and pace of work activity. The Quality Control Program shall state where different technicians will be required for different work elements.

100-04 Project progress schedule. The Contractor shall submit a coordinated construction schedule for all work activities. The schedule shall be prepared as a network diagram in Critical Path Method (CPM), Program Evaluation and Review Technique (PERT), or other format, or as otherwise specified in the contract. As a minimum, it shall provide information on the sequence of work activities, milestone dates, and activity duration.

The Contractor shall maintain the work schedule and provide an update and analysis of the progress schedule on a twice monthly basis, or as otherwise specified in the contract. Submission of the work schedule shall not relieve the Contractor of overall responsibility for scheduling, sequencing, and coordinating all work to comply with the requirements of the contract.

100-05 Submittals schedule. The Contractor shall submit a detailed listing of all submittals (for example, mix designs, material certifications) and shop drawings required by the technical specifications. The listing can be developed in a spreadsheet format and shall include:

a. Specification item number

b. Item description

c. Description of submittal

d. Specification paragraph requiring submittal

e. Scheduled date of submittal

100-06 Inspection requirements. Quality control inspection functions shall be organized to provide inspections for all definable features of work, as detailed below. All inspections shall be documented by the Contractor as specified by subsection 100-07.

Inspections shall be performed daily to ensure continuing compliance with contract requirements until completion of the particular feature of work. These shall include the following minimum requirements:

a. During plant operation for material production, quality control test results and periodic inspections shall be used to ensure the quality of aggregates and other mix components, and to adjust and control mix proportioning to meet the approved mix design and other requirements of the technical specifications. All equipment used in proportioning and mixing shall be inspected to ensure its proper operating condition. The Quality Control Program shall detail how these and other quality control functions will be accomplished and used.

b. During field operations, quality control test results and periodic inspections shall be used to ensure the quality of all materials and workmanship. All equipment used in placing, finishing, and compacting shall be inspected to ensure its proper operating condition and to ensure that all such operations are in conformance to the technical specifications and are within the plan dimensions, lines, grades, and tolerances specified. The Program shall document how these and other quality control functions will be accomplished and used.

100-07 Quality control testing plan. As a part of the overall Quality Control Program, the Contractor shall implement a quality control testing plan, as required by the technical specifications. The testing plan shall include the minimum tests and test frequencies required by each technical specification Item, as well as any additional quality control tests that the Contractor deems necessary to adequately control production and/or construction processes.

The testing plan can be developed in a spreadsheet fashion and shall, as a minimum, include the following:

a. Specification item number (for example, P-401)

b. Item description (for example, Plant Mix Bituminous Pavements)

c. Test type (for example, gradation, grade, asphalt content)

d. Test standard (for example, ASTM or American Association of State Highway and Transportation Officials (AASHTO) test number, as applicable)

e. Test frequency (for example, as required by technical specifications or minimum frequency when requirements are not stated)

f. Responsibility (for example, plant technician)

g. Control requirements (for example, target, permissible deviations)

The testing plan shall contain a statistically-based procedure of random sampling for acquiring test samples in accordance with ASTM D3665. The Engineer shall be provided the opportunity to witness quality control sampling and testing.

All quality control test results shall be documented by the Contractor as required by subsection 100-08.

100-08 Documentation. The Contractor shall maintain current quality control records of all inspections and tests performed. These records shall include factual evidence that the required inspections or tests have been performed, including type and number of inspections or tests involved; results of inspections or tests; nature of defects, deviations, causes for rejection, etc.; proposed remedial action; and corrective actions taken.

These records must cover both conforming and defective or deficient features, and must include a statement that all supplies and materials incorporated in the work are in full compliance with the terms of the contract. Legible copies of these records shall be furnished to the Engineer daily. The records shall cover all work placed subsequent to the previously furnished records and shall be verified and signed by the Contractor's Program Administrator.

Specific Contractor quality control records required for the contract shall include, but are not necessarily limited to, the following records:

a. Daily inspection reports. Each Contractor quality control technician shall maintain a daily log of all inspections performed for both Contractor and subcontractor operations. These technician's daily reports shall provide factual evidence that continuous quality control inspections have been performed and shall, as a minimum, include the following:

(1) Technical specification item number and description

(2) Compliance with approved submittals

(3) Proper storage of materials and equipment

(4) Proper operation of all equipment

(5) Adherence to plans and technical specifications

(6) Review of quality control tests

(7) Safety inspection.

The daily inspection reports shall identify inspections conducted, results of inspections, location and nature of defects found, causes for rejection, and remedial or corrective actions taken or proposed.

The daily inspection reports shall be signed by the responsible quality control technician and the Program Administrator. The Engineer shall be provided at least one copy of each daily inspection report on the work day following the day of record.

b. Daily test reports. The Contractor shall be responsible for establishing a system that will record all quality control test results. Daily test reports shall document the following information:

(1) Technical specification item number and description

(2) Test designation

(3) Location

(4) Date of test

(5) Control requirements

(6) Test results

(7) Causes for rejection

(8) Recommended remedial actions

(9) Retests

Test results from each day's work period shall be submitted to the Engineer prior to the start of the next day's work period. When required by the technical specifications, the Contractor shall maintain statistical quality control charts. The daily test reports shall be signed by the responsible quality control technician and the Program Administrator.

100-09 Corrective action requirements. The Quality Control Program shall indicate the appropriate action to be taken when a process is deemed, or believed, to be out of control (out of tolerance) and detail what action will be taken to bring the process into control. The requirements for corrective action shall include both general requirements for operation of the Quality Control Program as a whole, and for individual items of work contained in the technical specifications.

The Quality Control Program shall detail how the results of quality control inspections and tests will be used for determining the need for corrective action and shall contain clear sets of rules to gauge when a process is out of control and the type of correction to be taken to regain process control.

When applicable or required by the technical specifications, the Contractor shall establish and use statistical quality control charts for individual quality control tests. The requirements for corrective action shall be linked to the control charts.

100-10 Surveillance by the Engineer. All items of material and equipment shall be subject to surveillance by the Engineer at the point of production, manufacture or shipment to determine if the Contractor, producer, manufacturer or shipper maintains an adequate quality control system in conformance with the requirements detailed here and the applicable technical specifications and plans. In addition, all items of materials, equipment and work in place shall be subject to surveillance by the Engineer at the site for the same purpose.

Surveillance by the Engineer does not relieve the Contractor of performing quality control inspections of either on-site or off-site Contractor's or subcontractor's work.

100-11 Noncompliance.

a. The Engineer will notify the Contractor of any noncompliance with any of the foregoing requirements. The Contractor shall, after receipt of such notice, immediately take corrective action. Any notice, when delivered by the Engineer or his or her authorized representative to the Contractor or his or her authorized representative at the site of the work, shall be considered sufficient notice.

b. In cases where quality control activities do not comply with either the Contractor Quality Control Program or the contract provisions, or where the Contractor fails to properly operate and maintain an effective Quality Control Program, as determined by the Engineer, the Engineer may:

(1) Order the Contractor to replace ineffective or unqualified quality control personnel or subcontractors.

(2) Order the Contractor to stop operations until appropriate corrective actions are taken.

END OF SECTION 100

Section 105 Mobilization

105-1 Description. This item shall consist of work and operations, but is not limited to, work and operations necessary for the movement of personnel, equipment, material and supplies to and from the project site for work on the project except as provided in the contract as separate pay items.

105-1.1 Posted notices. Prior to commencement of construction activities the Contractor must post the following documents in a prominent and accessible place where they may be easily viewed by all employees of the prime Contractor and by all employees of subcontractors engaged by the prime Contractor: Equal Employment Opportunity (EEO) Poster "Equal Employment Opportunity is the Law" in accordance with the Office of Federal Contract Compliance Programs Executive Order 11246, as amended; Davis Bacon Wage Poster (WH 1321) - DOL "Notice to All Employees" Poster; and Applicable Davis-Bacon Wage Rate Determination. These notices must remain posted until final acceptance of the work by the Owner.

105-2 Basis of measurement and payment. Based upon the contract lump sum price for "Mobilization" partial payments will be allowed as follows:

a. With first pay request, 25%.

b. When 25% or more of the original contract is earned, an additional 25%.

c. When 50% or more of the original contract is earned, an additional 40%.

d. After Final Inspection, Staging area clean-up and delivery of all Project Closeout materials as required by 90-11, the final 10%.

END OF SECTION 105

Section 110 Method of Estimating Percentage of Material Within Specification Limits (PWL)

110-01 General. When the specifications provide for acceptance of material based on the method of estimating percentage of material within specification limits (PWL), the PWL will be determined in accordance with this section. All test results for a lot will be analyzed statistically to determine the total estimated percent of the lot that is within specification limits. The PWL is computed using the sample average (X) and sample standard deviation (S_n) of the specified number (n) of sublots for the lot and the specification tolerance limits, L for lower and U for upper, for the particular acceptance parameter. From these values, the respective Quality index, Q_L for Lower Quality Index and/or Q_U for Upper Quality Index, is computed and the PWL for the lot for the specified n is determined from Table 1. All specification limits specified in the technical sections shall be absolute values. Test results used in the calculations shall be to the significant figure given in the test procedure.

There is some degree of uncertainty (risk) in the measurement for acceptance because only a small fraction of production material (the population) is sampled and tested. This uncertainty exists because all portions of the production material have the same probability to be randomly sampled. The Contractor's risk is the probability that material produced at the acceptable quality level is rejected or subjected to a pay adjustment. The Owner's risk is the probability that material produced at the rejectable quality level is accepted.

It is the intent of this section to inform the Contractor that, in order to consistently offset the Contractor's risk for material evaluated, production quality (using population average and population standard deviation) must be maintained at the acceptable quality specified or higher. In all cases, it is the responsibility of the Contractor to produce at quality levels that will meet the specified acceptance criteria when sampled and tested at the frequencies specified.

110-02 Method for computing PWL. The computational sequence for computing PWL is as follows:

a. Divide the lot into n sublots in accordance with the acceptance requirements of the specification.

b. Locate the random sampling position within the sublot in accordance with the requirements of the specification.

c. Make a measurement at each location, or take a test portion and make the measurement on the test portion in accordance with the testing requirements of the specification.

d. Find the sample average (X) for all sublot values within the lot by using the following formula:

$$\mathbf{X = (x_1 + x_2 + x_3 + \ldots x_n) / n}$$

Where: X = Sample average of all sublot values within a lot

x_1, x_2 = Individual sublot values

n = Number of sublots

e. Find the sample standard deviation (S_n) by use of the following formula:

$$\mathbf{S_n = [(d_1^2 + d_2^2 + d_3^2 + \ldots d_n^2)/(n-1)]^{1/2}}$$

Where: S_n = Sample standard deviation of the number of sublot values in the set

d_1, d_2 = Deviations of the individual sublot values x_1, x_2, … from the average value X

that is: $d_1 = (x_1 - X)$, $d_2 = (x_2 - X)$ … $d_n = (x_n - X)$

n = Number of sublots

f. For single sided specification limits (that is, L only), compute the Lower Quality Index Q_L by use of the following formula:

$$\mathbf{Q_L = (X - L) / S_n}$$

Where: L = specification lower tolerance limit

Estimate the percentage of material within limits (PWL) by entering Table 1 with Q_L, using the column appropriate to the total number (n) of measurements. If the value of Q_L falls between values shown on the table, use the next higher value of PWL.

g. For double-sided specification limits (that is, L and U), compute the Quality Indexes Q_L and Q_U by use of the following formulas:

$$\mathbf{Q_L = (X - L) / S_n}$$
and
$$\mathbf{Q_U = (U - X) / S_n}$$

Where: L and U = specification lower and upper tolerance limits

Estimate the percentage of material between the lower (L) and upper (U) tolerance limits (PWL) by entering Table 1 separately with Q_L and Q_U, using the column appropriate to the total number (n) of measurements, and determining the percent of material above P_L and percent of material below P_U for each tolerance limit. If the values of Q_L fall between values shown on the table, use the next higher value of P_L or P_U. Determine the PWL by use of the following formula:

$$\mathbf{PWL = (P_U + P_L) - 100}$$

Where: P_L = percent within lower specification limit

P_U = percent within upper specification limit

EXAMPLE OF PWL CALCULATION

Project: Example Project

Test Item: Item P-401, Lot A.

A. PWL Determination for Mat Density.

1. Density of four random cores taken from Lot A.

A-1 = 96.60

A-2 = 97.55

A-3 = 99.30

A-4 = 98.35

n = 4

2. Calculate average density for the lot.

$X = (x_1 + x_2 + x_3 + . . . x_n) / n$

$X = (96.60 + 97.55 + 99.30 + 98.35) / 4$

X = 97.95% density

3. Calculate the standard deviation for the lot.

$S_n = [((96.60 - 97.95)^2 + (97.55 - 97.95)^2 + (99.30 - 97.95)^2 + (98.35 - 97.95)^2)) / (4 - 1)]^{1/2}$

$S_n = [(1.82 + 0.16 + 1.82 + 0.16) / 3]^{1/2}$

$S_n = 1.15$

4. Calculate the Lower Quality Index Q_L for the lot. (L=96.3)

$Q_L = (X - L) / S_n$

$Q_L = (97.95 - 96.30) / 1.15$

$Q_L = 1.4348$

5. Determine PWL by entering Table 1 with Q_L= 1.44 and n= 4.

PWL = 98

B. PWL Determination for Air Voids.

1. Air Voids of four random samples taken from Lot A.

A-1 = 5.00
A-2 = 3.74
A-3 = 2.30
A-4 = 3.25

2. Calculate the average air voids for the lot.

$X = (x_1 + x_2 + x_3 \ldots n) / n$

$X = (5.00 + 3.74 + 2.30 + 3.25) / 4$

X = 3.57%

3. Calculate the standard deviation S_n for the lot.

$S_n = [((3.57 - 5.00)^2 + (3.57 - 3.74)^2 + (3.57 - 2.30)^2 + (3.57 - 3.25)^2) / (4 - 1)]^{1/2}$

$S_n = [(2.04 + 0.03 + 1.62 + 0.10) / 3]^{1/2}$

$S_n = 1.12$

4. Calculate the Lower Quality Index Q_L for the lot. (L= 2.0)

$Q_L = (X - L) / S_n$

$Q_L = (3.57 - 2.00) / 1.12$

$Q_L = 1.3992$

5. Determine P_L by entering Table 1 with Q_L = 1.41 and n = 4.

$P_L = 97$

6. Calculate the Upper Quality Index Q_U for the lot. (U= 5.0)

$Q_U = (U - X) / S_n$

$Q_U = (5.00 - 3.57) / 1.12$

$Q_U = 1.2702$

7. Determine P_U by entering Table 1 with Q_U = 1.29 and n = 4.

$P_U = 93$

8. Calculate Air Voids PWL

$PWL = (P_L + P_U) - 100$

$PWL = (97 + 93) - 100 = 90$

EXAMPLE OF OUTLIER CALCULATION (REFERENCE ASTM E178)

Project: Example Project

Test Item: Item P-401, Lot A.

A. Outlier Determination for Mat Density.

1. Density of four random cores taken from Lot A arranged in descending order.

A-3 = 99.30
A-4 = 98.35
A-2 = 97.55
A-1 = 96.60

2. Use n=4 and upper 5% significance level of to find the critical value for test criterion = 1.463.

3. Use average density, standard deviation, and test criterion value to evaluate density measurements.

a. For measurements greater than the average:

If (measurement - average)/(standard deviation) is less than test criterion, then the measurement is not considered an outlier

For A-3, check if (99.30 - 97.95) / 1.15 is greater than 1.463.

Since 1.174 is less than 1.463, the value is not an outlier.

b. For measurements less than the average:

If (average - measurement)/(standard deviation) is less than test criterion, then the measurement is not considered an outlier.

For A-1, check if (97.95 - 96.60) / 1.15 is greater than 1.463.

Since 1.435 is less than 1.463, the value is not an outlier.

Note: In this example, a measurement would be considered an outlier if the density were:

Greater than (97.95 + 1.463 × 1.15) = 99.63%

OR

less than (97.95 - 1.463 × 1.15) = 96.27%.

Table 1. Table for Estimating Percent of Lot Within Limits (PWL)

Percent Within Limits (P_L and P_U)	Positive Values of Q (Q_L and Q_U)							
	n=3	n=4	n=5	n=6	n=7	n=8	n=9	n=10
99	1.1541	1.4700	1.6714	1.8008	1.8888	1.9520	1.9994	2.0362
98	1.1524	1.4400	1.6016	1.6982	1.7612	1.8053	1.8379	1.8630
97	1.1496	1.4100	1.5427	1.6181	1.6661	1.6993	1.7235	1.7420
96	1.1456	1.3800	1.4897	1.5497	1.5871	1.6127	1.6313	1.6454
95	1.1405	1.3500	1.4407	1.4887	1.5181	1.5381	1.5525	1.5635
94	1.1342	1.3200	1.3946	1.4329	1.4561	1.4717	1.4829	1.4914
93	1.1269	1.2900	1.3508	1.3810	1.3991	1.4112	1.4199	1.4265
92	1.1184	1.2600	1.3088	1.3323	1.3461	1.3554	1.3620	1.3670
91	1.1089	1.2300	1.2683	1.2860	1.2964	1.3032	1.3081	1.3118
90	1.0982	1.2000	1.2290	1.2419	1.2492	1.2541	1.2576	1.2602
89	1.0864	1.1700	1.1909	1.1995	1.2043	1.2075	1.2098	1.2115
88	1.0736	1.1400	1.1537	1.1587	1.1613	1.1630	1.1643	1.1653
87	1.0597	1.1100	1.1173	1.1192	1.1199	1.1204	1.1208	1.1212
86	1.0448	1.0800	1.0817	1.0808	1.0800	1.0794	1.0791	1.0789
85	1.0288	1.0500	1.0467	1.0435	1.0413	1.0399	1.0389	1.0382
84	1.0119	1.0200	1.0124	1.0071	1.0037	1.0015	1.0000	0.9990
83	0.9939	0.9900	0.9785	0.9715	0.9671	0.9643	0.9624	0.9610
82	0.9749	0.9600	0.9452	0.9367	0.9315	0.9281	0.9258	0.9241
81	0.9550	0.9300	0.9123	0.9025	0.8966	0.8928	0.8901	0.8882
80	0.9342	0.9000	0.8799	0.8690	0.8625	0.8583	0.8554	0.8533
79	0.9124	0.8700	0.8478	0.8360	0.8291	0.8245	0.8214	0.8192
78	0.8897	0.8400	0.8160	0.8036	0.7962	0.7915	0.7882	0.7858
77	0.8662	0.8100	0.7846	0.7716	0.7640	0.7590	0.7556	0.7531
76	0.8417	0.7800	0.7535	0.7401	0.7322	0.7271	0.7236	0.7211
75	0.8165	0.7500	0.7226	0.7089	0.7009	0.6958	0.6922	0.6896
74	0.7904	0.7200	0.6921	0.6781	0.6701	0.6649	0.6613	0.6587
73	0.7636	0.6900	0.6617	0.6477	0.6396	0.6344	0.6308	0.6282
72	0.7360	0.6600	0.6316	0.6176	0.6095	0.6044	0.6008	0.5982
71	0.7077	0.6300	0.6016	0.5878	0.5798	0.5747	0.5712	0.5686
70	0.6787	0.6000	0.5719	0.5582	0.5504	0.5454	0.5419	0.5394
69	0.6490	0.5700	0.5423	0.5290	0.5213	0.5164	0.5130	0.5105
68	0.6187	0.5400	0.5129	0.4999	0.4924	0.4877	0.4844	0.4820
67	0.5878	0.5100	0.4836	0.4710	0.4638	0.4592	0.4560	0.4537
66	0.5563	0.4800	0.4545	0.4424	0.4355	0.4310	0.4280	0.4257
65	0.5242	0.4500	0.4255	0.4139	0.4073	0.4030	0.4001	0.3980
64	0.4916	0.4200	0.3967	0.3856	0.3793	0.3753	0.3725	0.3705
63	0.4586	0.3900	0.3679	0.3575	0.3515	0.3477	0.3451	0.3432
62	0.4251	0.3600	0.3392	0.3295	0.3239	0.3203	0.3179	0.3161
61	0.3911	0.3300	0.3107	0.3016	0.2964	0.2931	0.2908	0.2892
60	0.3568	0.3000	0.2822	0.2738	0.2691	0.2660	0.2639	0.2624
59	0.3222	0.2700	0.2537	0.2461	0.2418	0.2391	0.2372	0.2358
58	0.2872	0.2400	0.2254	0.2186	0.2147	0.2122	0.2105	0.2093
57	0.2519	0.2100	0.1971	0.1911	0.1877	0.1855	0.1840	0.1829
56	0.2164	0.1800	0.1688	0.1636	0.1607	0.1588	0.1575	0.1566
55	0.1806	0.1500	0.1406	0.1363	0.1338	0.1322	0.1312	0.1304
54	0.1447	0.1200	0.1125	0.1090	0.1070	0.1057	0.1049	0.1042
53	0.1087	0.0900	0.0843	0.0817	0.0802	0.0793	0.0786	0.0781
52	0.0725	0.0600	0.0562	0.0544	0.0534	0.0528	0.0524	0.0521
51	0.0363	0.0300	0.0281	0.0272	0.0267	0.0264	0.0262	0.0260
50	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Percent Within Limits (P_L and P_U)	Negative Values of Q (Q_L and Q_U)							
	n=3	n=4	n=5	n=6	n=7	n=8	n=9	n=10
49	-0.0363	-0.0300	-0.0281	-0.0272	-0.0267	-0.0264	-0.0262	-0.0260
48	-0.0725	-0.0600	-0.0562	-0.0544	-0.0534	-0.0528	-0.0524	-0.0521
47	-0.1087	-0.0900	-0.0843	-0.0817	-0.0802	-0.0793	-0.0786	-0.0781
46	-0.1447	-0.1200	-0.1125	-0.1090	-0.1070	-0.1057	-0.1049	-0.1042
45	-0.1806	-0.1500	-0.1406	-0.1363	-0.1338	-0.1322	-0.1312	-0.1304
44	-0.2164	-0.1800	-0.1688	-0.1636	-0.1607	-0.1588	-0.1575	-0.1566
43	-0.2519	-0.2100	-0.1971	-0.1911	-0.1877	-0.1855	-0.1840	-0.1829
42	-0.2872	-0.2400	-0.2254	-0.2186	-0.2147	-0.2122	-0.2105	-0.2093
41	-0.3222	-0.2700	-0.2537	-0.2461	-0.2418	-0.2391	-0.2372	-0.2358
40	-0.3568	-0.3000	-0.2822	-0.2738	-0.2691	-0.2660	-0.2639	-0.2624
39	-0.3911	-0.3300	-0.3107	-0.3016	-0.2964	-0.2931	-0.2908	-0.2892
38	-0.4251	-0.3600	-0.3392	-0.3295	-0.3239	-0.3203	-0.3179	-0.3161
37	-0.4586	-0.3900	-0.3679	-0.3575	-0.3515	-0.3477	-0.3451	-0.3432
36	-0.4916	-0.4200	-0.3967	-0.3856	-0.3793	-0.3753	-0.3725	-0.3705
35	-0.5242	-0.4500	-0.4255	-0.4139	-0.4073	-0.4030	-0.4001	-0.3980
34	-0.5563	-0.4800	-0.4545	-0.4424	-0.4355	-0.4310	-0.4280	-0.4257
33	-0.5878	-0.5100	-0.4836	-0.4710	-0.4638	-0.4592	-0.4560	-0.4537
32	-0.6187	-0.5400	-0.5129	-0.4999	-0.4924	-0.4877	-0.4844	-0.4820
31	-0.6490	-0.5700	-0.5423	-0.5290	-0.5213	-0.5164	-0.5130	-0.5105
30	-0.6787	-0.6000	-0.5719	-0.5582	-0.5504	-0.5454	-0.5419	-0.5394
29	-0.7077	-0.6300	-0.6016	-0.5878	-0.5798	-0.5747	-0.5712	-0.5686
28	-0.7360	-0.6600	-0.6316	-0.6176	-0.6095	-0.6044	-0.6008	-0.5982
27	-0.7636	-0.6900	-0.6617	-0.6477	-0.6396	-0.6344	-0.6308	-0.6282
26	-0.7904	-0.7200	-0.6921	-0.6781	-0.6701	-0.6649	-0.6613	-0.6587
25	-0.8165	-0.7500	-0.7226	-0.7089	-0.7009	-0.6958	-0.6922	-0.6896
24	-0.8417	-0.7800	-0.7535	-0.7401	-0.7322	-0.7271	-0.7236	-0.7211
23	-0.8662	-0.8100	-0.7846	-0.7716	-0.7640	-0.7590	-0.7556	-0.7531
22	-0.8897	-0.8400	-0.8160	-0.8036	-0.7962	-0.7915	-0.7882	-0.7858
21	-0.9124	-0.8700	-0.8478	-0.8360	-0.8291	-0.8245	-0.8214	-0.8192
20	-0.9342	-0.9000	-0.8799	-0.8690	-0.8625	-0.8583	-0.8554	-0.8533
19	-0.9550	-0.9300	-0.9123	-0.9025	-0.8966	-0.8928	-0.8901	-0.8882
18	-0.9749	-0.9600	-0.9452	-0.9367	-0.9315	-0.9281	-0.9258	-0.9241
17	-0.9939	-0.9900	-0.9785	-0.9715	-0.9671	-0.9643	-0.9624	-0.9610
16	-1.0119	-1.0200	-1.0124	-1.0071	-1.0037	-1.0015	-1.0000	-0.9990
15	-1.0288	-1.0500	-1.0467	-1.0435	-1.0413	-1.0399	-1.0389	-1.0382
14	-1.0448	-1.0800	-1.0817	-1.0808	-1.0800	-1.0794	-1.0791	-1.0789
13	-1.0597	-1.1100	-1.1173	-1.1192	-1.1199	-1.1204	-1.1208	-1.1212
12	-1.0736	-1.1400	-1.1537	-1.1587	-1.1613	-1.1630	-1.1643	-1.1653
11	-1.0864	-1.1700	-1.1909	-1.1995	-1.2043	-1.2075	-1.2098	-1.2115
10	-1.0982	-1.2000	-1.2290	-1.2419	-1.2492	-1.2541	-1.2576	-1.2602
9	-1.1089	-1.2300	-1.2683	-1.2860	-1.2964	-1.3032	-1.3081	-1.3118
8	-1.1184	-1.2600	-1.3088	-1.3323	-1.3461	-1.3554	-1.3620	-1.3670
7	-1.1269	-1.2900	-1.3508	-1.3810	-1.3991	-1.4112	-1.4199	-1.4265
6	-1.1342	-1.3200	-1.3946	-1.4329	-1.4561	-1.4717	-1.4829	-1.4914
5	-1.1405	-1.3500	-1.4407	-1.4887	-1.5181	-1.5381	-1.5525	-1.5635
4	-1.1456	-1.3800	-1.4897	-1.5497	-1.5871	-1.6127	-1.6313	-1.6454
3	-1.1496	-1.4100	-1.5427	-1.6181	-1.6661	-1.6993	-1.7235	-1.7420
2	-1.1524	-1.4400	-1.6016	-1.6982	-1.7612	-1.8053	-1.8379	-1.8630
1	-1.1541	-1.4700	-1.6714	-1.8008	-1.8888	-1.9520	-1.9994	-2.0362

END OF SECTION 110

SECTION 011000 - SUMMARY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including Form of Agreement between Owner and Contractor and Division 1 Specification Sections, apply to this Section.

B. In FAA standard specifications, where portions of text have been struck out (~~example~~), this text has been deleted and does not apply to this project. Where portions of text are bold and italic (***example***), this text has been added and is binding to this project. This process is utilized throughout the specifications and contract documents (excluding the plans).

1.2 PROJECT DESCRIPTION

A. Project Identification:

1. Name of the Project: Air Traffic Control Tower

2. Owner: City of Lynchburg, Virginia.

3. Architect/Engineer: RS&H, Inc., Alexandria, Virginia.

B. The project and the work of the Contract can be described in summary as follows:

1. The project consists of providing all labor, materials, and other means of construction necessary for a new air traffic control tower. Construction includes grading, drainage improvements, utility installation, roadway construction, and construction of a new air traffic control tower building.

C. The Work will be constructed under the construction management at risk delivery method with multiple phase subcontract packages.

D. Summary by Reference: The work can be summarized by reference to the requirements of the various Contract Documents. These references can be summarized but are not necessarily limited to the following:

1. The Executed Form of Agreement between the Owner and Contractor (not bound herewith).

2. The Drawings, which are listed on the cover sheet "Index of Drawings" (not bound herewith).

3. Volume 1 – Contract and Bid Documents (not bound herewith) and Technical specifications (bound herewith and are listed in the Table of Contents) in this Contract Document Manual.

4. The Contract Document Revisions to the Contract Documents, which have been either bound herewith (in this Contract Document Manual) or distributed by transmittal subsequent to the binding hereof.

5. Work by the Owner, which is in connection with the project.

6. Governing regulations, which have a bearing on the performance of the work; copies can be obtained from or reviewed at the local, state or federal agency responsible for the regulation in each case.

7. Submittals (of any kind), copies of which are retained by the Contractor at the site.

8. Miscellaneous element of information having a bearing on the performance of the work, such as weather forecasts and reports of general trade union negotiations; copies must be obtained by the Contractor through normal information channels.

1.3 NOT-FOR-PROFIT OWNER STATUS

A. It is the not-for-profit Owner's potential intent to directly purchase some components for tax savings purposes. The Contractor, however, shall include all items in the bid along with appropriate tax amounts. The Contractor shall have full responsibility, including scheduling, warranties, coordination, etc., for all components of the project including those purchased by the Owner as in a traditional manner. The Contractor shall be responsible for proper accounting procedures required to substantiate credits back to the Owner for Owner purchased components and tax savings. The Contractor shall be responsible for coordinating this procedure with the Owner.

1.4 WORK UNDER OTHER CONTRACTS

A. The project is to be constructed under a number of contract packages in addition to this package. The work under this contract shall be scheduled and performed in such a manner as to support the coordination with and progress of all other subcontracts. The subcontractor's responsibility in this regard includes, but is not limited to, the following:

1. Familiarity with the documents and required work of the other subcontracts.

2. Timely completion of work at interfaces with the other contracts.

3. Providing access for the work of the other subcontracts.

4. Cooperation with the other subcontractors including staging and storage areas and maintenance of traffic.

B. The work of the other contract packages is proximate to, adjacent to, or within the work areas of this contract. For the contracts for which documents are not available, the extent of the work shall be inferred from the indications in the documents for this contract.

C. The successful completion of the Project is dependent upon close and active cooperation of all those engaged in the execution of the work of this project. Therefore, it is expressly understood and agreed that the subcontractors shall schedule, layout, and install their work in such time and in such a manner so as not to delay or interfere with, but to compliment the execution of the work of other subcontractors, utility companies, and the operation of the Airport.

D. It is imperative that the subcontractors accommodate their work with the operations of the Airport that serves the public daily. The subcontractors shall take all necessary means to schedule and execute the work to safeguard the occupants and operation of the Airport. This may require off-hour work to accomplish the scope of the Contracts within the allotted time and, if so, the subcontractors shall have already accounted for this cost in their bids.

1.5 WORK SEQUENCE

A. In addition to the general requirement for the subcontractors to properly sequence the various elements of the work in order to achieve the intended results and fulfill the requirements of the Contract, the Work will be conducted in phases.

B. The work shall be performed in phases to provide the least possible interference with the operation of the existing airport and the maintenance of traffic and to permit an orderly incorporation of operations in the new facility. Specific phasing requirements are indicated on the Drawings.

1.6 CONTRACTOR USE OF PREMISES

A. Limitation of Access, Work Areas and Disruption: This project is constructed on the premises of an operational public airport. Priority is given to the facility operation, not the construction operation. The construction must be performed to functionally maintain all airport operations, provide the least disruption possible to normal operations, maintain all areas visible to the public free from dirt debris and views of construction operations and prevent access of the construction crews to public areas whenever possible. This shall be accomplished as follows:

1. Maintain all areas visible to the public clean and free of dirt and debris at all times.

2. Provide temporary enclosures, temporary partitions and temporary interior barricades as required by Section G-105 to isolate all construction.

3. Wherever construction is permitted near, adjacent to, within or in view of public spaces restore the area to a clean condition at the end of each shift or each intermediate time when construction is not in active progress. Included is the removal all construction materials, temporary barricades, tools and debris. Thoroughly clean the area to at least the degree of cleanliness of the surrounding JIA maintained space not affected by construction.

4. Construction employees shall access sites of construction through non-public access ways wherever possible. When access through the public space is requested it shall not be utilized until specific Owner approval is provided. Provide facilities for employee use within the isolated construction areas for breaks, restrooms storage, plan tables, etc.

B. Use of the Site: Limit use of the premises to work in areas indicated. Confine operations to areas within contract limits indicated. Do not disturb portions of the site beyond the areas in which the Work is indicated.

1. Owner Occupancy: Allow for Owner occupancy and use by the public.

2. Driveways and Entrances: Keep roadways, driveways and entrances serving the premises clear and available to the Public, Owner, the Owner's employees, and emergency vehicles at all times. Do not use these areas for parking or storage of materials. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.

C. Site Use Plan: Requirements for the Contractor’s site use plan are contained in Division 1, Section 012001 - COORDINATION.

1.7 OCCUPANCY REQUIREMENTS

A. Full Owner Occupancy: The Owner will occupy the site and existing buildings during the entire construction period. Cooperate with the Owner during construction operations to

minimize conflicts and facilitate Owner usage. Perform the Work so as not to interfere with the Owner's operations.

B. Partial Owner Occupancy: The Owner reserves the right to occupy and to place and install equipment in completed areas of the building and parking lots prior to Substantial Completion, provided such occupancy does not interfere with completion of the Work. Such placing of equipment and partial occupancy shall not constitute acceptance of the total Work.

1. The Architect will prepare a Certificate of Substantial Completion for each specific portion of the Work to be occupied prior to Owner occupancy.

2. Obtain a Certificate of Occupancy from local building officials prior to Owner occupancy.

3. Prior to partial Owner occupancy, mechanical and electrical systems shall be fully operational. Required inspections and tests shall have been successfully completed. Upon occupancy, the Owner will operate and maintain mechanical and electrical systems serving occupied portions of the building.

4. Upon occupancy, the Owner will assume responsibility for maintenance and custodial service for occupied portions of the building.

1.8 OWNER-FURNISHED, CONTRACTOR-INSTALLED PRODUCTS

A. The Work includes providing support systems to receive Owner's equipment, and any mechanical and electrical connections required.

1. The Owner will arrange for and deliver necessary shop drawings, product data, and samples to the Contractor.

2. The Owner will arrange and pay for delivery of Owner-furnished items according to the Contractor's Construction Schedule.

3. Following delivery, the Owner will inspect items delivered for damage.

4. If Owner-furnished items are damaged, defective, or missing, the Owner will arrange for replacement.

5. The Owner will arrange for manufacturer's field services and for the delivery of manufacturer's warranties to the appropriate Contractor.

6. The Contractor shall designate delivery dates of Owner-furnished items in the Contractor's Construction Schedule.

7. The Contractor shall review shop drawings, product data, and samples and return them to the Architect noting discrepancies or problems anticipated in use of the product.

8. The Contractor is responsible for receiving, unloading, and handling Owner-furnished items at the site.

9. The Contractor is responsible for protecting Owner-furnished items from damage, including damage from exposure to the elements. The Contractor shall repair or replace items damaged as a result of his operations.

PART 2 - PRODUCTS
NOT USED

PART 3 - EXECUTION
NOT USED

END OF SECTION 011000

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SECTION 012000 – PROJECT MEETINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this section.

1.2 SUMMARY

A. This section specifies administrative and procedural requirements for project meetings, including, but not limited to, the following:
1. Preconstruction conferences.
2. Preinstallation conferences.
3. Progress meetings.

B. Contractor's Construction Schedule requirements are specified in another Division 1 section.

C. Refer to individual sections for the portions of the project requiring preinstallation conferences.

1.3 PRECONSTRUCTION CONFERENCE

A. The Owner and / or Architect will schedule a preconstruction conference and organizational meeting prior to the start of construction, but no later than 15 days after the execution of the Owner-Contractor Agreement. The preconstruction conference will be held at the project site, or an otherwise convenient location. The meeting shall be conducted to review responsibilities and personnel assignments.

B. Attendees: Authorized representatives of the Owner, Architect and their consultants, the Contractor and its superintendent, major subcontractors, manufacturers, suppliers, and other concerned parties shall attend the conference. All participants at the conference shall be familiar with the Project and authorized to conclude matters relating to the work.

C. Agenda: Discuss items of significance that could affect progress, including the following:
1. Tentative construction schedule.
2. Critical work sequencing.
3. Designation of responsible personnel.
4. Procedures for processing field decisions and Change Orders.
5. Procedures for processing Applications for Payment.
6. Distribution of Contract Documents, if not previously distributed.
7. Submittal of Shop Drawings, Product Data, and Samples.
8. Preparation of record documents.
9. Use of the premises.
10. Parking availability.
11. Office, work, storage areas and temporary facilities.
12. Equipment deliveries and priorities.
13. Safety procedures.
14. First aid.
15. Security.
16. Housekeeping.
17. Working hours.
18. Coordination with work of concurrent and subsequent contracts under other Contractors.
19. Other appropriate topics.

D. Schedule of Values: The Contractor shall provide an outline or draft copy of the Schedule of Values, in accordance with the requirements of Section 012900 - PAYMENT PROCEDURES and Volume 1 – Contract and Bid Documents, for initial review. The intent of this submittal is to review the Schedule of Values for organization and content with respect to the construction progress and work requirements, such that the review time of the formal submittal may be minimized. No dollar values or other monetary breakdowns are required with this outline. The formal submittal of the Schedule of Values with all monetary breakdowns and other requirements shall be in accordance with Volume 1 – Contract and Bid Documents and Section 012900 - PAYMENT PROCEDURES.

E. The Architect shall record the results of the meeting and distribute copies to attendees and other interested parties.

1.4 PREINSTALLATION CONFERENCES

A. The Contractor shall conduct a preinstallation conference at the Project Site before each construction activity that requires coordination with other construction.

B. Attendees: The Installer and representatives of manufacturers and fabricators involved in or affected by the installation, and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise the Architect at least ten (10) working days in advance of scheduled meeting dates.

C. Do not schedule conferences until the submittals required by the Contract Documents for work associated with the construction activity requiring the conference have been approved and returned to the Contractor.

D. Review the progress of other construction activities and preparations for the particular activity under consideration at each preinstallation conference, including requirements for the following:
1. Contract Documents.
2. Options.
3. Related Change Orders.
4. Purchases.
5. Deliveries.
6. Shop Drawings, Product Data, and quality-control samples.
7. Review of mockups.
8. Possible conflicts.
9. Compatibility problems.
10. Time schedules.
11. Weather limitations.
12. Manufacturer's recommendations.
13. Warranty requirements.
14. Compatibility of materials.
15. Acceptability of substrates.
16. Temporary facilities.
17. Space and access limitations.
18. Governing regulations.
19. Safety.
20. Inspecting and testing requirements.
21. Required performance results.
22. Recording requirements.
23. Protection.

E. The Contractor shall record the results of the meeting and distribute copies to attendees and other interested parties.

F. Do not proceed with the installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of work and reconvene the conference at the earliest feasible date.

1.5 PROGRESS MEETINGS

A. The Contractor shall conduct progress meetings at the Project Site at regularly scheduled times on a weekly interval. Notify the Owner and the Architect of scheduled meeting dates. Coordinate dates of meetings with preparation of the payment request and in conjunction with any coordination meetings.

B. Attendees: In addition to representatives of the Owner and the Architect, each subcontractor, supplier, or other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the conference shall be familiar with the Project and authorized to conclude matters relating to progress.

C. Agenda: Review and correct or approve minutes of the previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to the status of the Project.
   1. Contractor's Construction Schedule: Review progress since the last meeting. Determine where each activity is in relation to the Contractor's Construction Schedule, whether on time or ahead or behind schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to insure that current and subsequent activities will be completed within the Contract Time.
   2. Review the present and future needs of each entity present, including the following:
      a. Interface requirements.
      b. Time.
      c. Sequences.
      d. Status of submittals.
      e. Deliveries.
      f. Off-site fabrication problems.
      g. Access.
      h. Site utilization.
      i. Temporary facilities and services.
      j. Hours of work.
      k. Hazards and risks.
      l. Housekeeping.
      m. Quality and work standards.
      n. Change Orders.
      o. Documentation of information for payment requests.

D. Reporting: Contractor shall record minutes of the meeting and distribute to each party present and to parties who should have been present. Contractor shall revise the construction schedule after each progress meeting where revisions to the schedule have been made or recognized. Contractor shall issue the revised schedule to attendees and others who should have been present no later than 3 days after the meeting.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 012000

SECTION 012001 – COORDINATION

PART 1 - GENERAL

1.1 SUMMARY

A. This section specifies administrative and supervisory requirements necessary for Project coordination.

1.2 COORDINATION

A. Coordination: Coordinate construction activities included under various sections of these Specifications to assure efficient and orderly installation of each part of the work. Coordinate construction operations included under different sections of the Specifications that are dependent upon each other for proper installation, connection, and operation.

1. Where installation of one part of the work is dependent on installation of other components, either before or after its own installation, schedule construction activities in the sequence required to obtain the best results.

2. Where availability of space is limited, coordinate installation of different components to assure maximum accessibility for required maintenance, service and repair.

3. Make adequate provisions to accommodate items scheduled for later installation.

B. Where necessary, prepare memoranda for distribution to each party involved outlining special procedures required for coordination. Include such items as required notices, reports, and attendance at meetings.

1. Prepare similar memoranda for the Owner and separate Subcontractors where coordination of their work is required.

C. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities to avoid conflicts and ensure orderly progress of the work. Such administrative activities include, but are not limited to, the following:

1. Preparation of schedules.

2. Installation and removal of temporary facilities.

3. Delivery and processing of submittals.

4. Progress meetings.

5. Project Close-out activities.

1.3 ADMINISTRATIVE/SUPERVISORY PERSONNEL

A. General: In addition to a General Superintendent and other administrative and supervisory personnel required for performance of the work, provide specific coordinating personnel as specified herein.

B. Submittal of Staff Names, Duties: Within 10 working days of Contract date, submit a listing of Contractor's principal staff assignments and consultants, naming persons and listing their addresses and telephone numbers.

1.4 SUBCONTRACTOR/SUPPLIER LIST

A. Within 10 working days of Contract date, submit a listing of Contractor's principal subcontractors and suppliers, naming persons and listing their addresses and telephone numbers.

1.5 SURVEYS AND RECORDS/REPORTS

A. Surveyor: Engage a land surveyor or professional engineer experienced and specializing in land survey work, who is registered in the State of Virginia, to perform services specified in other specification sections including project and building controls and as-built drawings.

1.6 LIMITATIONS FOR USE OF SITE

A. General: In addition to site utilization limitations and requirements shown on drawings, and indicated by other Contract documents, administer allocation of available space equitably among entities needing access and space, so as to produce best overall efficiency in performance of total work of project. Schedule deliveries so as to minimize space and time requirements for storage of materials and equipment on site. Refer to ~~Division 1, Section 011000 - SUMMARY OF WORK for additional requirements~~ ***Volume 1 – Contract and Bid Documents for additional requirements.***

B. Within 10 working days of Contract award, the Contrator shall develop and submit for Owner's approval a site use plan. This plan shall clearly describe the proposed temporary facilities, staging areas, ramps and major traffic ways, hazardous material storage, provisions for site services, safety and security. Changes to the site plan shall be submitted for review and approval 5 working days prior to effecting the changes.

1.7 TRADESPERSONS AND WORKMANSHIP STANDARDS

A. General: Instigate and maintain procedures to ensure that persons performing work at site are skilled and knowledgeable in methods and craftsmanship needed to produce required quality levels for workmanship in completed work. Remove and replace work which does not comply with workmanship standards as specified and as recognized in the construction industry for applications indicated. Remove and replace other work damaged or deteriorated by faulty workmanship or its replacement.

B. Availability of Tradespersons: At each progress or coordination meeting, review availability of tradespersons and projected needs to accomplish work as scheduled. Require each entity employing personnel to report on events which might affect progress of work. Where possible, consider alternatives and take actions to avoid disputes and delays.

1.8 INSPECTIONS, TESTS AND REPORTS

A. General: Required inspection and testing services are intended to assist in determination of probable compliances of work with requirements, but do not relieve the Contractor of responsibility for those compliances, or for general fulfillment of requirements of Contract documents. Specified inspections and tests are not intended to limit Contractor's quality control program. Afford reasonable access to agencies performing tests and inspections.

1. Conduct all tests or inspections required to fulfill requirements of the Contract under Contractor's Quality Control Program. Provide testing by a licensed testing firm approved by the Owner.

B. Qualification of Testing Agencies: Except as otherwise indicated and except where manufacturer's testing facilities are indicated as acceptable, engage independent testing laboratories specializing in required services and acceptable to the Architect-Engineer and Owner ***as required by the contract specifications***. ~~Refer to Section 014000 - QUALITY CONTROL SERVICES/TESTING LABORATORY.~~

C. Reports: ***As required by the contract specifications.*** ~~Refer to Section 013000 - SUBMITTALS.~~

PART 2 - PRODUCTS

NOT USED.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION PROVISIONS

A. Inspection of Conditions: Require the installer of each major component to inspect both the substrate and conditions under which work is to be performed, and to report (in writing to the Contractor) unsatisfactory conditions. Do not proceed until unsatisfactory conditions have been corrected in a manner acceptable to installer.

B. Manufacturer's Instructions: Comply with manufacturer's installation instructions and recommendations, to the extent that those instructions and recommendations are more explicit or stringent than requirements contained in Contract Documents.

C. Inspect materials or equipment immediately upon delivery and again prior to installation. Reject damaged and defective items.

D. Provide attachment and connection devices and methods necessary for securing work. Secure work true to line and level. Allow for expansion and building movement.

E. Visual Effects: Provide uniform joint widths in exposed work. Arrange joints in exposed work to obtain the best visual effect. Refer questionable choices to the Architect-Engineer for final decision.

F. Recheck measurements and dimensions, before starting each installation.

G. Install each component during conditions of temperature, humidity, exposure, forecasted weather and status of project completion that will ensure the best possible results, in coordination with entire work. Isolate each part of the completed construction from incompatible material as necessary to prevent deterioration.

H. Coordinate temporary and permanent enclosures with required inspections and tests, to minimize the necessity of uncovering completed construction for that purpose.

I. Mounting Heights: Where mounting heights are not indicated, install individual components at standard mounting heights recognized within the industry for the particular application indicated. Refer questionable mounting height decisions to the Architect-Engineer for final decision.

3.2 CLEANING AND PROTECTION

A. During handling and installation, clean and protect construction in progress and adjoining materials in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.

B. Clean and maintain completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.

C. Limiting Exposures: Supervise construction activities to ensure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period. Where applicable, such exposures include, but are not limited to, the following:

1. Excessive static or dynamic loading.
2. Excessive internal or external pressures.
3. Excessively high or low temperatures.
4. Thermal shock.
5. Excessively high or low humidity.
6. Air contamination or pollution.
7. Water or ice.
8. Solvents.
9. Chemicals.
10. Light.
11. Radiation.
12. Puncture.
13. Abrasion.
14. Heavy traffic.
15. Soiling, staining and corrosion.
16. Bacteria.
17. Rodent and insect infestation.
18. Combustion.
19. Electrical current.
20. High speed operation,

21. Improper lubrication,

22. Unusual wear or other misuse.

23. Contact between incompatible materials.

24. Destructive testing.

25. Misalignment.

26. Excessive weathering.

27. Unprotected storage.

28. Improper shipping or handling.

29. Theft.

30. Vandalism.

31. Installation of exfiltration piping and drainage system.

3.3 ENVIRONMENTAL PROTECTION

A. Soil Disposal and/or Borrow: Conduct all soil disposal and/or borrow work in accordance with requirements of local regulatory authorities. Dispose of all excess soil in a legal manner off site.

B. Solid, Liquid and Gaseous Contaminants: Contractor shall be responsible for the proper disposal of all solid, liquid and gaseous contaminants in accordance with all local codes and regulations, together with the following requirements.

1. Discharge gaseous contaminants so that they will be sufficiently diluted with fresh air to reduce the toxicity to an acceptable level.

2. Liquid contaminants may, subject to local utility standards, be diluted with water to a level of quality acceptable in the local sewer system or shall be contained in approved vessels for disposal at approved sites.

C. Disposal of Refuse: Remove refuse resulting from construction operations from the site. Burning on the site is not permissible.

D. Hazardous Waste: All hazardous waste generated by the Contractor and the Contractor's subcontractors during the course of construction shall be stored, transported and disposed of in accordance with 40 CFR 260. The Contractor and his subcontractors shall be responsible for all documentation related to hazardous waste generated as a result of this Contract and that documentation shall be in accordance with 40 CFR 260.

E. Construction Site Maintenance:

1. Store all supplies and equipment on project site so as to preclude mechanical and climatic damage. Maintain site in a neat and orderly manner.

2. Contractor shall be responsible for maintaining the temporary structures and construction enclosure (fence) in good repair and visually pleasant. Contractor shall further provide adequate security, supplementing the existing fencing as

necessary, to prevent the presence of unauthorized persons on the site and to keep gates secured when not in actual use to ensure the integrity of the barrier as well as for property security.

F. Noise Control: Comply with all applicable state and local laws, ordinances and regulations relative to noise control.

END OF SECTION 012001

SECTION 012100 – ALLOWANCES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes administrative and procedural requirements governing allowances.
   1. Certain items are specified in the Contract Documents by allowances. Allowances have been established in lieu of additional requirements and to defer selection of actual materials and equipment to a later date when additional information is available for evaluation. If necessary, additional requirements will be issued by Change Order.

B. Types of allowances include the following:
   1. Lump-sum allowances.
   2. Unit-cost allowances.
   3. Quantity allowances.
   4. Contingency allowances.
   5. Testing and inspecting allowances.

C. Related Sections include the following:
   1. Division 1 Section "Contract Modification Procedures" for procedures for submitting and handling Change Orders for allowances.
   2. Division 1 Section "Quality Requirements" for procedures governing the use of allowances for testing and inspecting.
   3. Divisions 2 through 32 Sections for items of Work covered by allowances.

1.3 SELECTION AND PURCHASE

A. At the earliest practical date after award of the Contract, advice Architect of the date when final selection and purchase of each product or system described by an allowance must be completed to avoid delaying the Work.

B. At Architect's request, obtain proposals for each allowance for use in making final selections. Include recommendations that are relevant to performing the Work.

C. Purchase products and systems selected by Architect from the designated supplier.

1.4 SUBMITTALS

A. Submit proposals for purchase of products or systems included in allowances, in the form specified for Change Orders.

B. Submit invoices or delivery slips to show actual quantities of materials delivered to the site for use in fulfillment of each allowance.

C. Coordinate and process submittals for allowance items in same manner as for other portions of the Work.

1.5 COORDINATION

A. Coordinate allowance items with other portions of the Work. Furnish templates as required to coordinate installation.

1.6 LUMP-SUM / UNIT-COST AND QUANTITY ALLOWANCES

A. Allowance shall include cost to Contractor of specific products and materials ordered by Owner under allowance and shall include taxes, freight, and delivery to Project site.

B. Contractor's costs for receiving and handling at Project site, labor, installation, overhead and profit, and similar costs related to products and materials ordered by Owner under allowance shall be included as part of the Contract Sum and not part of the allowance.

1.7 UNUSED MATERIALS

A. Return unused materials purchased under an allowance to manufacturer or supplier for credit to Owner, after installation has been completed and accepted.
   1. If requested by Architect, prepare unused material for storage by Owner when it is not economically practical to return the material for credit. If directed by Architect, deliver unused material to Owner's storage space. Otherwise, disposal of unused material is Contractor's responsibility.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine products covered by an allowance promptly on delivery for damage or defects. Return damaged or defective products to manufacturer for replacement.

3.2 PREPARATION

A. Coordinate materials and their installation for each allowance with related materials and installations to ensure that each allowance item is completely integrated and interfaced with related work.

3.3 SCHEDULE OF ALLOWANCES

Item 012100-1 – Utility Allowance - $25,000.

1. The Utility Allowance provides for payment to local utility companies for permanent electrical power and telecommunications connections to the new air traffic control tower building. Exact work scope to be determined during construction but anticipated to include providing and installing cable and making final connections.

Item 012100-2 – Communication and Technology Package (CTP) $50,000

1. The CTP includes equipment and its installation for Access Controls System (ACS), CCTV system and ATCT voice communication switching system. The base bid shall include all conduit and cabling for CCTV cameras as shown on the drawing (2-CAT6 Cables), communications outlets shall be provided with 3-CAT6 cables for the communication outlets as shown on the drawings and ACS shall include complete raceway system for access controls system.

2. Under the scope of this allowance, the contractor shall provide a new access controls system including but not limited to card readers, door position switch, electronic locks, cabling, intelligent field panels, computer work station/server, card stock and badge printer. The CCTV system will include mega pixel cameras, CCTV work station/server and storage and retrieval system. The ATCT voice communication system shall be included in Item No 275000-1 Air Traffic Control (ATC) Equipment.
3. Design information will be developed during the construction phase of the project for contractor to provide a detail cost estimate to use the allowance.

Grand Total Allowance Accounts: $75,000

END OF SECTION 012100

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SECTION 012300 – ALTERNATES

PART 1 - GENERAL

1.1 SUMMARY

This Section includes administrative and procedural requirements governing Alternates.

A. Related Work Described Elsewhere:

1. Materials and methods to be used in the Base Bid and in the alternates have been described on the drawings and in the specifications.
2. Method for stating the proposed Contract Sum is described in the Bid Form.

1.2 DEFINITIONS

A. Definition: An alternate is an amount proposed by bidders and stated on the Bid Form for certain work defined in the Bidding Requirements that may be added to or deducted from the Base Bid amount if the Owner decides to accept a corresponding change in either the amount of construction to be completed, or in the products, materials, equipment, systems, or installation methods described in the Contract Documents.

1. The cost or credit for each alternate is the net addition to or deduction from the Contract Sum to incorporate the Alternate into the Work. No other adjustments are made to the Contract Sum.
2. The description of each alternate is abbreviated; however, the work of each alternate shall be complete for the scope of work affected. Refer to applicable specification sections and the drawings for specific requirements of the work of each alternate regardless of whether references are specified in the description of each alternate or not.

1.3 SUBMITTALS

A. Alternates described in this section are required to be included on the bid form as submitted by bidders. Do not submit alternates other than as described in this section, except as provided for "substitutions" under other Division 1 sections.

1.4 PROCEDURES

A. Coordination: Coordinate related work and modify or adjust affected adjacent work as necessary to ensure that work affected by each accepted alternate is complete and fully integrated into the Project.

1. Include as part of each alternate, miscellaneous devices, accessory objects, and similar items incidental to or required for a complete installation whether or not mentioned as part of the Alternate.

B. Notification: Immediately following the award of the Contract, or as soon thereafter as the Owner has made decision on which, if any, alternates will be selected, notify each party involved, in writing, of the status of each alternate. Indicate whether alternates have been accepted, rejected, or deferred for later consideration. Include a complete description of negotiated modifications to alternates.

C. Execute accepted alternates under the same conditions as other work of this Contract.

D. Schedule: A "Schedule of Alternates" is included at the end of this Section. Other Specification Sections contain requirements for materials necessary to achieve the Work described under each alternate.

E. The contractor shall provide separate bid numbers of each of the items listed under alternates.

PART 2 - PRODUCTS

NOT APPLICABLE

PART 3 - EXECUTION

3.1 SCHEDULE OF ALTERNATES

A. Alternate No. 1 – ATCT Split Face Thin Block Finish

1. For the areas indicated to be a High-Performance Coating (Exterior Stucco System), contractor shall provide a Split Face Think Block Unit inlay system. Contractor shall be responsible for providing all required work to install and complete the split face think block inlay system, including but not limited to, modifying details and sections.

END OF SECTION 012300

SECTION 012500 – PRODUCTS AND SUBSTITUTIONS

PART 1 - GENERAL

1.1 SUMMARY

A. General: Unless otherwise specifically provided in this Contract, reference to any equipment, material, article or patented process by trade name, make or catalog number, shall be regarded as establishing a standard of quality and shall not be construed as limiting competition. Subject to compliance with specified requirements, the Contractor may, at his option, use any equipment, material, article or process which, in the sole judgment of the Architect-Engineer, is equal to that named.

1.2 DEFINITIONS

A. Definitions used in this article are not intended to change or modify the meaning of other terms used in the Contract Documents.

B. "Products": Include purchased items for incorporation into the work, regardless of whether specifically purchased for project.

C. "Materials": Products which must be substantially cut, shaped, worked, mixed, finished, refined or otherwise fabricated, processed, installed or applied to form units of work.

D. "Equipment": Products with operational parts, regardless of whether motorized or manually operated and particularly including products with service connections (wiring, piping, etc.).

E. Substitutions: Requests for changes in products, materials, equipment, and methods of construction required by Contract Documents proposed by the Contractor after award of the Contract are considered requests for "substitutions." The following are not considered substitutions:

1. Substitutions requested by bidders during the bidding period, and accepted prior to award of Contract, are considered as included in the Contract Documents and are not subject to requirements specified in this section for substitutions.

a. Substitutions requested by bidders, in order to obtain approval to use unspecified manufacturers and/or products, must be submitted to the Architect-Engineer at least 14 days prior to the bid date, and are subject to the requirements listed in the subparagraphs below. Requests received after this date shall not be considered. Requests shall clearly describe the manufacturer and/or product for which approval is requested, including all data necessary to demonstrate acceptability. If the substitution is acceptable, the Architect-Engineer shall approve the manufacturer and/or product. The Architect-Engineer reserves the right to withhold the decision regarding the acceptance of any proposed substitution if, in his opinion, insufficient data has been provided by the Proposer to properly evaluate the proposed substitution or if the time necessary for evaluation of subsequent data would negatively impact the Project.

b. Requested substitutions for unspecified manufacturers and/or products shall only be evaluated where the specifications list two (2) or fewer acceptable manufacturers and/or products, or approved

equal, for the item in question. Where the specifications list three (3) or greater acceptable manufacturers and/or products, evaluation of the proposed substitution shall be deferred and shall be subject to the requirements specified in this section.

2. Revisions to Contract Documents requested by the Owner or the Architect-Engineer.

3. Specified options of products and construction methods included in Contract Documents.

4. The Contractor's determination of and compliance with governing regulations and orders issued by governing authorities.

5. Any use of a material, equipment or system other than that specified, unless such material, equipment or system has been approved by the Architect-Engineer, will be made at Contractor's risk. No substitution shall be made without authority in writing from the Architect-Engineer.

F. Standards: Refer to Division 1, Section 014200 - REFERENCES for applicability of industry standards to products of project and for acronyms used in text of specification sections.

1.3 SUBMITTALS

A. Materials, products, equipment and systems are specified in the Contract Documents by manufacturer, trade name or distributor to establish a standard of the required criteria, including function, performance, dimension, appearance and quality to be met by any proposed substitution. Unless otherwise specified, application for substitutions will be considered by the Owner and the Architect-Engineer after execution of the agreement. The burden of proof of merit of proposed substitute is upon the Contractor. Substitute items shall not be incorporated in the work without prior written approval of the item by the Architect-Engineer.

B. Where an item is specified by one or more manufacturer's model number or specific item identification and "or approved equal" is included, only the item(s) that is specified by manufacturer's model number or specific identification is approved and any other item must be submitted for approval as a substitution.

C. Where an item is specified by a referenced standard, the item must be submitted for approval same as a substitute.

D. Submit 3 copies of each request for substitution for consideration. Submit requests in the form and in accordance with procedures required for change order proposals.

E. Identify the product, or the fabrication or installation method to be replaced in each request. Include related specification section and Drawing numbers. Provide complete documentation showing compliance with the requirements for substitutions, and the following information, as appropriate:

1. Product Data, including Drawings and descriptions of products, fabrication and installation procedures.

2. Samples, where applicable or requested.

3. A detailed comparison of significant qualities of the proposed substitution with those of the work specified. Significant qualities may include elements such as size, weight, durability, performance and visual effect.

4. Coordination information, including a list of changes or modifications needed to other parts of the work and to construction performed by the Owner and separate Contractors, that will become necessary to accommodate the proposed substitution.

5. A statement indicating the substitution's effect on the Contractor's construction schedule compared to the schedule without approval of the substitution. Indicate the effect of the proposed substitution on overall Contract time.

6. Cost information, including a proposal of the net change, if any in the Contract Sum.

7. Certification by the Contractor that the substitution proposed is equal-to or better in every significant respect to that required by the Contract Documents, and that it will perform adequately in the application indicated. Include the Contractor's waiver of rights to additional payment or time, that may subsequently become necessary because of the failure of the substitution to perform adequately.

F. Labels and Listings: Where equipment or materials are specified to conform to requirements of the standards of organizations such as American Society of Mechanical Engineers (ASME), Underwriters Laboratories, Inc. (UL), American Refrigeration Institute (ARI), Air Diffusion Council (ADC), Sheet Metal and Air-Conditioning Contractors National Association, Inc. (SMACNA) and Air Moving and Conditioning Association (AMCA) or other organizations that use a label or listing as a method of indicating compliance, submit proof of such conformance to the Architect-Engineer for approval. The label or listing of the specified organization will be acceptable evidence. In lieu of the label or listing, the Contractor may submit a notarized certificate from a nationally recognized testing organization, adequately equipped and competent to perform such services and approved by the Architect-Engineer, stating that the item has been tested in accordance with the specified organization’s test methods and that the item conforms to the specified organization’s standard or code. For materials whose compliance with organizational standards or specifications is not regulated by an organization using its own listing or label as proof of compliance, furnish a notarized certificate from the manufacturer stating that the material complies with the applicable referenced standard or specification.

G. Work Related Submittals: Contractor’s submittal of (and the Architect-Engineer’s acceptance of) shop drawings, product data or samples which relate to work not complying with requirements of Contract documents, does not constitute an acceptable or valid request for substitution, nor approval thereof.

1.4 QUALITY ASSURANCE

A. Source Limitations: To the greatest extent possible for each unit of work and subject to the restrictions of the Buy America Act, provide products, materials or equipment of a singular generic kind from a single source.

B. Compatibility of Options: Where more than one choice is available as options for Contractor’s selection of a product or material, select an option which is compatible with other products and materials already selected (which may have been from among options for those other products and materials). Total compatibility among options is not assured

by limitations within Contract documents, but must be provided by Contractor. Compatibility is a basic general requirement of product/material selections.

1.5 PRODUCT DELIVERY-STORAGE HANDLING

A. General: Deliver, handle and store products in accordance with manufacturer's recommendations and by methods and means which will prevent damage, deterioration and loss including theft and protect against damage from climactic conditions. Control delivery schedules to minimize long-term storage of products at site and overcrowding of construction spaces. In particular, provide delivery/installation coordination to ensure minimum holding or storage times for products recognized to be flammable, hazardous, easily damaged or sensitive to deterioration, theft and other sources of loss. Damaged or defective items, in the option of the Architect-Engineer shall be replaced at no cost to the Owner.

PART 2 - PRODUCTS

2.1 GENERAL PRODUCT COMPLIANCES

A. General: The compliance requirements for individual products, as indicated in Contract documents, are multiple in nature and may include generic, descriptive, performance, prescriptive, compliance with standards, conformance with graphic details and other similar forms and methods of indicating requirements, all of which must be complied with.

B. Procedures for Selecting Products: Contractor's option for selecting products are limited by Contract document requirements, and governing regulations and are not controlled by industry traditions or procedures experienced by Contractor on previous construction projects. Required procedures include, but are not necessarily limited to, the following for various indicated methods of specifying.

1. Standards, Codes and Regulations: Where only compliance with an imposed standard, code or regulation is required, selection from among products which comply with requirements including those standards, codes and regulations, is Contractor's option.

2. Performance Requirements: Provide products which comply with specific performances indicated and which are recommended by manufacturer in published product literature or by individual certification for application indicated. Overall performance of a product is implied where product is specified with only certain specific performance requirements.

3. Prescriptive Requirements: Provide products which have been produced in accordance with prescriptive requirements, using specified ingredients and components and complying with specified requirements for mixing, fabricating, curing, finishing, testing and similar operations in manufacturing process.

4. Visual Matching: Where matching with an established sample is required, the Architect-Engineer has final judgement of whether a product proposed by Contractor matches sample satisfactorily.

5. Visual Selection: Except as otherwise indicated, where specified, product requirements include "...as selected from manufacturer's standard colors, patterns, textures..." or words of similar effect, the selection of manufacturer and basic product (complying with requirements) is Contractor's option and subsequent selection of color, pattern and texture is the Architect-Engineer's selection.

2.2 GENERAL PRODUCT REQUIREMENTS

A. General: Provide products which comply with the requirements herein and which are undamaged and unused at time of installation and which are complete with accessories, trim, finish, safety guards and other devices and details needed for complete installation and for intended use and effect.

1. Standard Products: Products shall be essentially the standard catalogued products of manufacturer's regularly engaged in production of such products and shall be the manufacturer's latest standard design that complies with the specification requirements. Equipment shall essentially duplicate items that have been in satisfactory commercial and industrial use at least 2 years or more if otherwise specified, prior to bid opening; or in lieu thereof, shall have been used and operated in a test installation which, in the opinion of the Architect-Engineer, duplicate its field performance for the same period of time. The Architect-Engineer reserves the right to require the Contractor to submit evidence to this effect for his approval. When 2 units of the same class of equipment are required, these units shall be the product of a single manufacturer; however, the component parts of the system need not be the products of the same manufacturer.

2. Continued Availability: Products which, by nature of their application, are likely to be needed at a later date for maintenance and repair or replacement of work, shall be current models for which replacement parts are available.

2.3 SUBSTITUTIONS

A. Conditions: The Contractor's substitution request will be received and considered by the Architect-Engineer when one or more of the following conditions are satisfied, as determined by the Architect-Engineer otherwise requests will be returned without action except to record noncompliance with these requirements.

1. Extensive revisions to Contract Documents are not required.

2. Proposed changes are in keeping with the general intent of Contract Documents.

3. The request is timely, fully documented and properly submitted.

4. The request is directly related to an "or equal" clause or similar language in the Contract Documents.

5. The specified product or method of construction cannot be provided within the Contract time. The request will not be considered if the product or method cannot be provided as a result of failure to pursue the work promptly or coordinate activities properly.

6. The specified product or method of construction cannot receive necessary approval by a governing authority, and the requested substitution can be approved.

7. A substantial advantage is offered the Owner, in terms of cost, time, energy conservation or other considerations of merit, after deducting offsetting responsibilities the Owner may be required to bear. Additional responsibilities for the Owner may include additional compensation to the Architect-Engineer

for redesign and evaluation services, increased cost of other construction by the Owner or separate Contractors, and similar considerations.

8. The specified product or method of construction cannot be provided in a manner that is compatible with other materials, and where the Contractor certifies that the substitution will overcome the incompatibility.

9. The specified product or method of construction cannot be coordinated with other materials, and where the Contractor certifies that the proposed substitution can be coordinated.

10. The specified product or method of construction cannot provide a warranty required by the Contract Documents and where the Contractor certifies that the proposed substitution provide the required warranty.

B. The Contractor's submittal and the Architect-Engineer's acceptance of shop drawings, product data or samples that relate to construction activities not complying with the Contract Documents does not constitute an acceptable or valid request for substitution, nor does it constitute approval.

C. The Architect-Engineer's decision of approval or disapproval of a proposed substitution shall be final.

D. All costs that may be incurred associated with a substitution proposed by the Contractor shall be borne by the Contractor. This shall apply to all interfacing components recognized prior to or after approval of the substitution by the Architect-Engineer.

PART 3 - EXECUTION

NOT USED.

END OF SECTION 012500

SECTION 012600 – CONTRACT MODIFICATION PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. This section specifies administrative and procedural requirements for handling and processing supplements and modifications to the drawings and specifications.

1.2 CONTRACT DOCUMENT SUPPLEMENTS

A. Clarification / Supplemental Instructions (C): Shall provide further detail to requirements inferred in the Contract Documents or authorize minor changes in the work, not involving an adjustment to the Contract Sum or Contract Time, and will be issued by the Architect with supplemental or revised drawings and specifications, if necessary. Clarifications / Supplemental Instructions issued by the Architect-Engineer shall become binding and a part of the Contract as minor changes in the work unless the Contractor notifies the Architect-Engineer within 10 days that the instructions result in changes that affect the Contract Cost or Contract Time.

C. Request for Information/Supplemental Instructions (RFI): Shall be initiated by the Contractor when necessary for performance of the work. It shall include the Contractor's proposed interpretation or action. The Architect-Engineer's reply will constitute further detail to requirements if inferred in the contract documents or authorization for minor changes in the work, not involving an adjustment to the contract sum or contract time. The Contractor shall maintain a sequentially numbered log of all such requests.

D. Construction Deficiency / Corrective Action (CCA): Shall be initiated by the Contractor when deviations from the contract requirements have been constructed. In the absence of timely initiation by the Contractor, the Architect-Engineer may initiate the form with the description of the deficiency. The Contractor shall provide a fully detailed proposal for his corrective or remedial work. The Architect-Engineer's reply will indicate approval of the proposed action as detailed, approval with certain modifications, or rejection of the proposal. Use forms provided by the Architect-Engineer. The Contractor shall maintain a sequentially numbered log of all such proposals initiated by the Contractor. The number shall be suffixed with "C" (CCA-001C). The Architect-Engineer will maintain a sequential log of the forms initiated by the AE with the number suffixed by "AE" (CCA-001AE).

1.3 REQUEST FOR PROPOSAL/CONTRACT CHANGE REQUESTS

A. Request for Proposal (RFP): Proposed changes in the work that will require adjustment to the Contract in either time or cost will be issued by the Architect-Engineer, with a detailed description of the proposed change, supplemental or revised Drawings and Specifications, if necessary, and a specific period of time during which the requested price will be considered valid.

1. Proposal requests issued by the Architect-Engineer are for information only. Do not consider them a directive either to stop work in progress, or to execute the proposed change.

2. Unless otherwise indicated in the proposal request, within 21 days from the date of the proposal request, submit to the Architect-Engineer for the Owner's review an estimate of cost necessary to execute the proposed change.

a. Include a list of quantities of products to be purchased and unit costs, along with the total amount of purchases to be made. Where requested, furnish survey data to substantiate quantities.

b. Itemize labor charges by time and category.

c. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.

d. Indicate overhead and profit charges.

d. Include a statement indicating the effect the proposed change in the work will have on the Contract Time.

B. Contractor-Initiated Contract Change Requests (CCR): When CSI changes, latent or other unforeseen conditions require a change to the Contract in either time or cost, the Contractor may propose changes by submitting a written request for a change to the Architect-Engineer.

1. Include a statement outlining the reasons for the change and the effect of the change on the work. Provide a complete description of the proposed change. Indicate the effect of the proposed change on the Subcontract Sum and Subcontract Time, as well as any effect on the work of other Subcontractors.

2. Include a list of quantities of products to be purchased and unit costs along with the total amount of purchases to be made. Where requested, furnish survey data to substantiate quantities.

3. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.

4. Comply with requirements in Section 012500 - PRODUCTS AND SUBSTITUTIONS if the proposed change in the work requires the substitution of one product or system for a product or system specified.

1.4 CONSTRUCTION CHANGE DIRECTIVE

A. Construction Change Directive (CCD): When the Owner and Contractor are not in total agreement on the terms of a Contract Change Request, the Architect-Engineer may issue a Construction Change Directive instructing the Contractor to proceed with a change in the work, for subsequent inclusion in a Subcontract Change Order.

1. The Construction Change Directive will contain a complete description of the change in the work and designate the method to be followed to determine change in the Contract Sum or Contract Time.

B. Documentation: Maintain detailed records on a time and material basis of work required by the Construction Change Directive.

1. After completion of the change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.

1.5 CONTRACT CHANGE PROCEDURES

A. Upon the Architect-Engineer's and Owner's approval of a Subcontract Change Order, the Architect-Engineer will issue a Change Order for signature, as provided in the Conditions of the Contract.

PART 2 - PRODUCTS

NOT USED.

PART 3 - EXECUTION

NOT USED.

END OF SECTION 012600

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SECTION 012900 –PAYMENT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Volume 1 Contract and Bid Documents, Drawings, Form of Agreement between Owner and Contractor, and other Division 01 Specification Sections, apply to this section.

1.2 SUMMARY

A. This section specifies administrative and procedural requirements governing the Contractor's Applications for Payment.

1.3 SCHEDULE OF VALUES

A. Coordination: Coordinate preparation of the Schedule of Values with preparation of the Construction PROJECT MANAGEMENT INFORMATION SYSTEM (PMIS).

1. Submit 3 copies of the Schedule of Values to the Architect-Engineer at the earliest possible date but no later than 7 days before the date scheduled for submittal of the initial Applications for Payment.

B. Format and Content: Use the Project Manual table of contents as a guide to establish the format for the Schedule of Values. Provide at least one line item for each Specification Section.

1. Identification: Include the following project identification on the Schedule of Values:

a. Project name and location.

b. Name of the Architect-Engineer.

c. Project number.

d. Contractor's name and address.

e. Date of submittal.

2. Arrange the Schedule of Values in tabular form with separate columns to indicate the following for each item listed:

a. Related Specification section or Division.

b. Description of work/generic name of this item.

c. Name of subcontractor.

d. Name of manufacturer or fabricator.

e. Name of supplier.

f. Change Orders (numbers) that affect value.

g. Dollar value.

1) Percentage of Contract Sum to nearest one-hundredth percent, adjusted to total 100 percent.

3. Provide a breakdown of the Contract Sum in sufficient detail to facilitate continued evaluation of Applications for Payment and progress reports. Coordinate with the Project Manual table of contents. Break principal subcontract amounts down into several line items.

4. Round amounts to nearest whole dollar; the total shall equal the Contract Sum.

5. Provide a separate line item in the Schedule of Values for each part of the work where Applications for Payment may include materials or equipment, purchased or fabricated and stored, but not yet installed.

   a. Differentiate between items stored on-site and items stored off-site. Include requirements for insurance and bonded warehousing, if required.

6. Provide separate line items on the Schedule of Values for initial cost of the materials, for each subsequent stage of completion, and for total installed value of that part of the work.

7. Unit-Cost Allowances: Show the line-item value of unit-cost allowances, as a product of the unit cost, multiplied by the measured quantity. Estimate quantities from the best indication in the Contract Documents.

8. Margins of Cost: Show line items for indirect costs and margins on actual costs only when such items are listed individually in Applications for Payment. Each item in the Schedule of Values and Applications for Payment shall be complete. Include the total cost and proportionate share of general overhead and profit margin for each item.

   a. Temporary facilities and other major cost items that are not direct cost of actual work-in-place may be shown either as separate line items in the Schedule of Values or distributed as general overhead expense, at the Contractor's option.

9. Schedule Updating: Update and resubmit the Schedule of Values prior to the next Applications for Payment when Change Orders or Construction Change Directives result in a change in the Contract Sum.

1.4 APPLICATIONS FOR PAYMENT

A. Each Application for Payment shall be consistent with previous applications and payments as certified by the Architect-Engineer and paid for by the Owner.

   1. The initial Application for Payment, the Application for Payment at time of Substantial Completion, and the final Application for Payment involve additional requirements.

B. Payment-Application Forms: Use AIA Document G702 and Continuation Sheets G703 as the form for Applications for Payment.

C. Application Preparation: Complete every entry on the form. Include notarization and execution by a person authorized to sign legal documents on behalf of the Contractor. The Architect-Engineer will return incomplete applications without action.

1. Entries shall match data on the Schedule of Values and the Contractor's Construction Schedule. Use updated schedules if revisions were made.

2. Include amounts of Change Orders and Construction Change Directives issued prior to the last day of the construction period covered by the application.

D. Transmittal: Submit 3 signed and notarized original copies of each Application for Payment to the Architect-Engineer by a method ensuring receipt within 24 hours. One copy shall be complete, including waivers of lien and similar attachments, when required.

1. Transmit each copy with a transmittal form listing attachments and recording appropriate information related to the application, in a manner acceptable to the Architect-Engineer.

E. Initial Application for Payment: Administrative actions and submittals, that must precede or coincide with submittal of the first Application for Payment, include the following:

1. List of subcontractors.

2. List of principal suppliers and fabricators.

3. Schedule of Values.

4. Contractor's Construction Schedule (preliminary if not final).

5. Schedule of principal products.

6. Schedule of unit prices.

7. Submittal Schedule (preliminary if not final).

8. List of Contractor's staff assignments.

9. List of Contractor's principal consultants.

10. Copies of building permits.

11. Copies of authorizations and licenses from governing authorities for performance of the work.

12. Initial progress report.

13. Report of preconstruction meeting.

F. Application for Payment at Substantial Completion: Following issuance of the Certificate of Substantial Completion, submit an Application for Payment.

1. This application shall reflect Certificates of Partial Substantial Completion issued previously for Owner occupancy of designated portions of the work.

2. Administrative actions and submittals that shall precede or coincide with this application include:

a. Occupancy permits and similar approvals or certifications by governing authorities, assuring Owner's full access and use of the completed work.

b. Warranties (guarantees) and maintenance agreements.

c. Test/adjust/balance records.

d. Maintenance instructions.

e. Meter readings.

f. Startup performance reports.

g. Changeover information related to Owner's occupancy, use, operation, and maintenance.

h. Final cleaning.

i. Application for reduction of retainage and consent of surety.

j. Advice on shifting insurance coverages, including proof of extended coverages as required.

k. Final progress photographs.

l. List of incomplete work recognized to be completed by the Contractor, as exceptions to Architect-Engineer's Certificate of Substantial Completion.

G. Final Payment Application: Administrative actions and submittals that must precede or coincide with submittal of the final Application for Payment include the following:

1. Completion of project closeout requirements.

2. Completion of items specified for payment application at time of Substantial Completion (regardless of whether such application was made).

3. Assurance, satisfactory to Owner, that unsettled claims will be settled and that work not actually completed or accepted will be completed without undue delay.

4. Transmittal of required project construction records to the Owner.

5. Certified property survey.

6. Proof, satisfactory to Owner, that taxes, fees, and similar obligations of the Contractor have been paid.

7. Removal of temporary facilities and services.

8. Removal of surplus materials, rubbish, and similar elements.

9. Change of door locks and other Contractor access to Owner's property.

10. Consent of Surety for Final Payment.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 012900

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SECTION 01300 – SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. This section specifies administrative and procedural requirements for submittals required for performance of the work, including;

1. Submittal schedule.

2. Shop drawings.

3. Coordination drawings.

4. Product data.

5. Samples.

B. Administrative Submittals: Refer to other Division 1 sections and other Contract Documents for requirements for administrative submittals

C. Inspection and test reports are included in Section 014000 - QUALITY REQUIREMENTS.

D. The Schedule of Values submittal is included in Section 012900 – PAYMENT PROCEDURES.

1.2 QUALITY ASSURANCE

A. Compatibility of Options: When the Contractor is given the option of selecting between 2 or more products for use on the Project, the product selected shall be compatible with products previously selected, even if previously selected products were also options.

1.3 GENERAL SUBMITTAL REQUIREMENTS

A. General:

1. All submittals shall be made to the Architect-Engineer. Only the Architect-Engineer can approve or disapprove submittals. Submittals shall be e-mailed to the Resident Project Representative. Samples shall be delivered to:

Reynolds, Smith and Hills, Inc.
10748 Deerwood Park Blvd. So.
Jacksonville, Florida 32256
Attn: Aviation Shop Drawing Section

2. Failure on the part of the Contractor to indicate approval on submittals prior to submission to the Architect will result in their being returned to the Contractor without being acted upon.

3. No delays in construction occasioned by the Contractor's failure to submit material for approval in accordance with the approved schedule will be excused or be allowed as a basis for any claim by the Contractor for an extension of Contract time or additional cost.

B. Preparation of Submittals: Provide permanent marking on each submittal to identify project, date, Contractor, subcontractor, submittal name and similar information to distinguish it from other submittals.

C. Show Contractor's executed review and approval marking and provide space for the Architect-Engineer's action marking. Package each submittal appropriately for transmittal and handling. Submittals which are received from sources other than through Contractor's office will be returned without action.

D. Transmittal Form: A standard project transmittal form, to be used by the Contractor for all project transmittals, shall be supplied by Architect-Engineer.

E. Record relevant information and requests for data on the transmittal form. On a separate sheet attached to the transmittal form, record deviations from the requirements of the Contract documents, if any, including minor variations and limitations.

F. Include on each transmittal form a complete list and description of each item in submittal. Record drawing numbers and title/description of each individual drawing in submittal.

G. The Contractor is responsible to pay all submittal production and distribution costs.

1.4 SUBMITTAL PROCEDURES

A. Coordination: Coordinate preparation and processing of submittals with performance of construction activities. Transmit each submittal sufficiently in advance of performance of related construction activities to avoid delay.

1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals and related activities that require sequential activity.

2. Submittals of major components and systems shall be separated into multiple reasonably sized packages in accordance with fabrication and construction sequences. Submittals shall be staggered to allow completion of review of one package before receipt of the next.

3. Multiple submittals for the same discipline shall be staggered to allow completion of review of one submittal before receipt of the next.

4. Coordinate transmittal of different types of submittals for related elements of the work so processing will not be delayed by the need to review submittals concurrently for coordination.

a. The Architect-Engineer reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.

2. Processing: Allow sufficient review time so that installation will not be delayed as a result of the time required to process submittals, including time for resubmittals.

a. Allow two weeks plus time in transit for initial review. Allow additional time if processing must be delayed to permit coordination with subsequent submittals. The Architect-Engineer will advise the Contractor when a submittal being processed must be delayed for coordination. The review time allowed commences upon completion of review of the prior package or single discipline group of submittals if the timing is not staggered as required in the subparagraphs above.

b. If an intermediate submittal is necessary, process the same as the initial submittal.

c. Allow two weeks plus time in transit for reprocessing each submittal.

d. No extension of Contract Time will be authorized because of failure to transmit submittals to the Architect-Engineer sufficiently in advance of the work to permit processing.

3. The Architect-Engineer will review up to 2 submissions (original and one resubmission) of shop drawings and other data submitted by the Contractor. Thereafter, additional reviews will be at the expense of the Contractor. These two referenced submissions shall be the only two whose associated review costs shall be borne by the Owner, regardless of whether a different product is submitted in subsequent submittals and regardless of whether a product is submitted as an equal product or substitution. The Architect-Engineer will record the time expended in reviewing and approving submittals in excess of the original and one (1) resubmission and notify the Contractor of the charges. The Owner shall deduct any such compensation due the Architect-Engineer from the Contractor's monthly periodic pay requests in accordance with the compensation terms for cost, overhead and profit in the Owner/Architect-Engineer agreement.

B. Contractor's Action: Each shop drawing sheet and the cover sheet of bound packets of product data shall bear a stamp indicating the Contractor's disposition following his review and checking. The disposition shall be indicated as "approved," "approved as noted," or similar as applicable. The stamp shall include the Contractor's name, the signature of the reviewer and the date checked. The notated sample shall be construed as evidence the Contractor has performed the review, check, verification and coordination as required by the Form of Agreement.

1.5 SUBMITTAL SCHEDULE

A. Contractor shall prepare a complete schedule of submittals. Schedule shall be submitted to Architect-Engineer within thirty (30) consecutive calendar days of the Notice to Proceed.

1. The submittal schedule shall include all product data, shop drawings, samples, inspection reports, test reports and similar items as called out in the individual specification sections, to be submitted by the Contractor during the course of the project.

2. Coordinate submittal schedule with the list of Subcontracts, schedule of values and the list of products as well as the Contractor's construction schedule.

3. Prepare the schedule in chronological order; include submittals required during the first 90 days of construction. Provide the following information:

a. Scheduled date for the first submittal.

b. Related section number.

c. Submittal category.

d. Name of Subcontractor.

e. Description of the part of the work covered.

f. Scheduled date for resubmittal.

g. Scheduled date of the Architect-Engineer's final release or approval.

B. Distribution: Following response to initial submittal, print and distribute copies to the Architect-Engineer, Owner, Subcontractors, and other parties required to comply with submittal dates indicated. Post copies in the project meeting room and field office.

1. When revisions are made, distribute to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the work and are no longer involved in construction activities.

C. Schedule Updating: Revise the schedule after each meeting or activity, where revisions have been recognized or made. Issue the updated schedule concurrently with report of each meeting.

1.6 SHOP DRAWINGS

A. Submit newly prepared information, drawn to accurate scale. Highlight, encircle, or otherwise indicate deviations from the Contract Documents. Do not reproduce Contract Documents or copy standard information as the basis of shop drawings. Standard information prepared without specific reference to the project is not considered shop drawings.

B. Shop drawings include fabrication and installation drawings, setting diagrams, schedules, patterns, templates and similar drawings. Include the following information:

1. Dimensions.

2. Identification of products and materials included.

3. Compliance with specified standards.

4. Notation of coordination requirements.

5. Notation of dimensions established by field measurement.

6. Sheet Size: Except for templates, patterns and similar full- size drawings, submit shop drawings on sheets at least 8-1/2 by 11 inches but no larger than 30 by 42 inches.

7. Submittal Quantity and Type: Submit 4 plots for the Architect-Engineer's review. One notated copy will be returned for reproduction as needed by the Contractor.

8. Do not use shop drawings without an appropriate final stamp indicating action taken in connection with construction.

1.7 COORDINATION DRAWINGS

A. Provide coordination drawings where required for the integration of the work including work first shown in detail on shop drawings or product data. Show sequencing and relationship of separate units of work which must interface in a restricted manner to fit in the space provided, or function as indicated. Coordination drawings are considered shop drawings and must be definitive in nature.

B. Prepare and submit coordinated composite layouts of the mechanical, plumbing, electrical, fire protection and security systems and equipment for all areas, drawn at a scale not less than 1/8 inch = 1 foot showing on both plan and elevation, including, but not limited to, all equipment, ducts, pipe sleeves, piping including plumbing and sprinkler system, lighting, special supports and other items contained within the space. Show mechanical and electrical services as well as architectural and structural features drawn to scale. Provide composite drawings for all areas such as corridors, specialty spaces, mechanical rooms, shafts, tunnels and all congested areas. Copies of composite drawings shall be distributed to all trades to assure a complete, coordinated installation of work within the space available.

C. Show the interrelationship of components shown on separate shop drawings.

D. Indicate required installation sequences.

E. Comply with all applicable requirements contained in this section.

F. Refer to Division 26, Section 260510 - ELECTRICAL BASIC REQUIREMENTS for specific additional coordination drawing requirements for electrical installations.

G. Submittal and review of composite coordination drawings is required before work can start in any given area of the project.

1.8 PRODUCT DATA

A. Collect product data into a single submittal for each element of construction or system. Product data includes printed information such as manufacturer's installation instructions, catalog cuts, standard color charts, roughing-in diagrams and templates, standard wiring diagrams and performance curves. Where product data must be specially prepared because standard printed data is not suitable for use, submit as "shop drawings."

1. Mark each copy to show applicable choices and options. Where printed product data includes information on several products, some of which are not required, mark copies to indicate the applicable information. Include the following information:

a. Manufacturer's printed recommendations.

b. Compliance with recognized trade association standards.

c. Compliance with recognized testing agency standards.

d. Application of testing agency labels and seals.

e. Notation of dimensions verified by field measurement.

f. Notation of coordination requirements.

2. Do not submit product data until compliance with requirements of the Contract Documents has been confirmed.

3. Submittals: Submit 4 copies of each required submittal. The Architect-Engineer will retain one, and will return the other marked with action taken and corrections or modifications required.

4. Distribution: Furnish copies of final submittal to installers, subcontractors, suppliers, manufacturers, fabricators, and others required for performance of construction activities. Show distribution on transmittal forms.

a. Do not proceed with installation until a copy of applicable product data is in the installer's possession.

b. Do not permit use of unmarked copies of product data in connection with construction.

1.9 SAMPLES

A. Submit full-size, fully fabricated samples cured and finished as specified and physically identical with the material or product proposed. Samples include partial sections of manufactured or fabricated components, cuts or containers of materials, color range sets, and swatches showing color, texture and pattern.

1. Mount, display, or package samples in the manner specified to facilitate review of qualities indicated. Prepare samples to match the Architect-Engineer's sample. Include the following:

a. Generic description of the sample.

b. Sample source.

c. Product name or name of manufacturer.

d. Compliance with recognized standards.

e. Availability and delivery time.

2. Submit samples for review of kind, color, pattern, and texture, for a final check of these characteristics with other elements, and for a comparison of these characteristics between the final submittal and the actual component as delivered and installed.

a. Where variation in color, pattern, texture or other characteristics are inherent in the material or product represented, submit multiple units (not less than 3), that show approximate limits of the variations.

b. Refer to other specification sections for requirements for samples that illustrate workmanship, fabrication techniques, and details of assembly, connections, operation and similar construction characteristics.

3. Preliminary submittals: Where samples are for selection of color, pattern, texture or similar characteristics from a range of standard choices, submit a full set of choices for the material or product.

a. Preliminary submittals will be reviewed and returned with the Architect-Engineer's notations indicating selection and other action.

4. Submittals: Except for samples illustrating assembly details, workmanship, fabrication techniques, connections, operation and similar characteristics, submit 3 sets; one will be returned marked with the action taken.

5. Maintain sets of samples, as returned, at the project site, for quality comparisons throughout the course of construction.

a. Unless noncompliance with Contract Document provisions is observed, the submittal may serve as the final submittal.

b. Sample sets may be used to obtain final acceptance of the construction associated with each set.

B. Distribution of Samples: Prepare and distribute additional sets to subcontractors, manufacturers, fabricators, suppliers, installers, and others as required for performance of the work. Show distribution on transmittal forms.

1. Field samples specified in individual sections are special types of samples. Field samples are full-size examples erected on site to illustrate finishes, coatings, or finish materials and to establish the standard by which the work will be judged.

a. Comply with submittal requirements to the fullest extent possible. Process transmittal forms to provide a record of activity.

1.10 ACTION ON SUBMITTALS

A. Except for submittals for record, information or similar purposes, where action and return is required or requested, the Architect-Engineer will review each submittal, mark to indicate action taken, and return in accordance with the "Processing" portion of Paragraph 1.3 - SUBMITTAL PROCEDURES.

8

1. Compliance with specified characteristics is the Contractor's responsibility.

B. Action Stamp: The Architect-Engineer will stamp each submittal with a uniform, self-explanatory action stamp. The stamp will be appropriately marked, as follows, to indicate the action taken:

1. Final Unrestricted Release: Where submittals are marked "Approved," that part of the work covered by the submittal may proceed provided it complies with requirements of the Contract Documents; final acceptance of the work will depend upon that compliance.

2. Final-But-Restricted Release: When submittals are marked "Approved as Noted," that part of the work covered by the submittal may proceed provided it complies with both the notations or corrections on the submittal and with the requirements of the Contract Documents; final acceptance of the work will depend on that compliance.

3. Returned or Resubmittal: When submittal is marked "Not Approved" or "Returned for Correction," do not proceed with that part of the work covered by the submittal, including purchasing, fabrication, delivery, or other activity. Revise or prepare a new submittal in accordance with the notations; resubmit without delay. Repeat if necessary to obtain a different action mark. Do not permit submittals so marked to be used at the project site, or elsewhere where work is in progress.

4. Other Action: Where a submittal is primarily for information or record purposes, special processing or other activity, the submittal will be returned, marked "Returned without Action." Unsolicited submittals may also be returned with this disposition.

C. Except for verification of finishes, colors and other aesthetic matters left to the Architect-Engineer’s discretion by the Contract documents, Architect-Engineer’s review of shop drawings is only for the convenience of the Owner in following the work and shall not relieve the Contractor from responsibility for any deviations from the requirements of the Contract documents. The Architect-Engineer’s review shall not be construed as a

complete check nor shall it relieve the Contractor from responsibility for errors of any sort in shop drawings or schedules or from the necessity of furnishing any work required by the Contract documents which may have been omitted on the shop drawings. The Architect-Engineer's review of a separate item shall not indicate review of the complete assembly in which it functions.

PART 2 - PRODUCTS

NOT USED.

PART 3 - EXECUTION

NOT USED.

END OF SECTION 013000

SECTION 014000 – QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. This section specifies administrative and procedural requirements for quality control services.

B. Quality control services include inspections and tests and related actions including reports, performed by independent testing laboratories, governing authorities, and the Contractor. They do not include Contract enforcement activities performed by the Architect-Engineer.

C. Inspection and testing services are required to verify compliance with requirements specified or indicated. These services do not relieve the Contractor of responsibility for compliance with Contract Document requirements.

D. Requirements of this section relate to customized fabrication and installation procedures, not production of standard products.

1. Specific quality control requirements for individual construction activities are specified in the sections that specify those activities. Those requirements, including inspections and tests, cover production of standard products as well as customized fabrication and installation procedures.

2. Inspections, test and related actions specified are not intended to limit the Contractor's quality control procedures that facilitate compliance with Contract Document requirements.

3. Requirements for the Contractor to provide quality control services required by the Architect-Engineer, Owner, or authorities having jurisdiction are not limited by provisions of this section.

1.2 RESPONSIBILITIES

A. Independent Testing Laboratory Responsibilities: The Contractor shall employ and pay an independent testing laboratory to perform on site geotechnical, concrete and steel construction testing.

B. Contractor Responsibilities: The Contractor shall provide inspections, tests and similar quality control services required in each specification section or by governing authorities except where indicated to be provided by Architect-Engineer or Owner. The Contractor shall provide management, coordination and timely notification for all testing entities regardless of the party employing them.

1. The Contractor shall provide quality control and testing services for concrete and steel in accordance with PCI MNL 116. Quality control inspection records and test reports required herein or in PCI MNL 116 shall be submitted to the Architect-Engineer.

2. Contractor’s Convenience Testing: Inspecting and testing performed exclusively for the Contractor’s convenience shall be the sole responsibility of the Contractor.

3. Retesting: The Contractor is responsible for retesting where results of required inspections, tests or similar services prove unsatisfactory and indicate

noncompliance with Contract Document requirements, regardless of whether the original test was the Contractor's responsibility.

a. Cost of retesting construction revised or replaced by the Contractor is the Contractor's responsibility, where required tests were performed on original construction.

4. Associated Services: The Contractor shall cooperate with agencies performing required inspections, tests and similar services and provide reasonable auxiliary services as requested. Notify the agency sufficiently in advance of operations to permit assignment of personnel. Auxiliary services required include but are not limited to:

a. Providing access to the work and furnishing incidental labor and facilities necessary to facilitate inspections and tests.

b. Taking adequate quantities of representative samples of materials that require testing or assisting the agency in taking samples.

c. Providing facilities for storage and curing of test samples, and delivery of samples to testing laboratories.

d. Providing the agency with a preliminary design mix proposed for use for materials mixes that require control by the testing agency.

e. Providing security and protection of samples and test equipment at the Project site.

C. Duties of the Testing Laboratory: The independent testing laboratory engaged to perform inspections, sampling and testing of materials and construction specified in individual specification sections shall cooperate with the Architect-Engineer and Contractor in performance of its duties, and shall provide qualified personnel to perform required inspections and tests.

1. The testing laboratory shall notify the Architect-Engineer and Contractor promptly of irregularities or deficiencies observed in the work during performance of its services.

2. The testing laboratory is not authorized to release, revoke, alter or enlarge requirements of the Contract Documents, or approve or accept any portion of the work.

3. The testing laboratory shall not perform any duties of the Contractor.

D. Coordination: The Contractor shall coordinate the sequence of activities of the testing laboratory and each agency engaged to perform inspections, tests and similar services to accommodate required services with a minimum of delay. In addition, the Contractor shall coordinate activities of the testing laboratory and each agency to avoid the necessity of removing and replacing construction to accommodate inspections and tests.

1. The Contractor is responsible for scheduling times for inspections, tests, taking samples and similar activities.

1.3 SUBMITTALS

A. The independent testing laboratory shall submit a certified written report of each inspection, test or similar service, to the Architect-Engineer and the Contractor, in duplicate.

1. Submit additional copies of each written report directly to the governing authority, when the authority so directs.

2. Report Data: Written reports of each inspection, test or similar service shall include, but not be limited to:

a. Date of issue.

b. Project title and number.

c. Name, address and telephone number of testing laboratory.

d. Dates and locations of samples and tests or inspections.

e. Names of individuals making the inspection or test.

f. Designation of the work and test method.

g. Identification of product and specification section.

h. Complete inspection or test data.

i. Test results and an interpretation of test results.

j. Ambient conditions at the time of sample-taking and testing.

k. Comments or professional opinion as to whether inspected or tested work complies with Contract Document requirements.

l. Name and signature of laboratory inspector.

m. Recommendations on retesting.

1.4 QUALITY ASSURANCE

A. General: Qualifications paragraphs in this article establish the minimum qualification levels required; individual Specification Sections specify additional requirements

B. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

C. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

D. Installer Qualifications: A firm or individual experienced in installing, erecting, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance

E. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that are similar in material, design, and extent to those indicated for this Project.

F. Qualification for Service Agencies: Inspection and testing service agencies, including independent testing laboratories, shall be prequalified as complying with "Recommended Requirements for Independent Laboratory Qualification" by the American Council of Independent Laboratories, and which specialize in the types of inspections and tests to be performed.

1. Each independent inspection and testing agency engaged on the Project shall be authorized by authorities having jurisdiction to operate in the State of Virginia.

PART 2 - PRODUCTS

NOT USED.

PART 3 - EXECUTION

3.1 REPAIR AND PROTECTION

A. General: Upon completion of inspection, testing, sample-taking and similar services, repair damaged construction and restore substrates and finishes to eliminate deficiencies, including deficiencies in visual qualities of exposed finishes. Comply with Contract Document requirements for "Cutting and Patching."

B. Protect construction exposed by or for quality control service activities, and protect repaired construction.

C. Repair and protection is the Contractor's responsibility, regardless of the assignment of responsibility for inspection, testing or similar services.

END OF SECTION 014000

SECTION 014200 – REFERENCES

PART 1 - GENERAL

1.1 DEFINITIONS

A. General Explanation: A substantial amount of specification language consists of definitions of terms found in other Contract documents, including drawings. (Drawings are recognized as being diagrammatic in nature and not completely descriptive of requirements indicated thereon.) Certain terms used in Contract documents are defined in this article. Definitions and explanations contained in this section are not necessarily either complete or exclusive, but are general for the work to the extent that they are not stated more explicitly in another element of Contract documents.

B. Special Conditions: Wherever the term "Special Conditions" or "Section, Special Conditions" is used in the specifications, it refers collectively to all of the sections in Division 1, General Requirements and Form of Agreement between Owner and Contractor.

C. Indicated: The term "indicated" refers to graphic representations, notes or schedules on the Drawings, or other Paragraphs or Schedules in the Specifications, and similar requirements in the Contract Documents. Where terms such as "shown," "noted," "scheduled," and "specified" are used, it is to help the reader locate the reference; no limitation on location is intended.

D. Regulation: The term "Regulations" includes laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, as well as rules, conventions, and agreements within the construction industry that control performance of the work.

E. Furnish: The term "furnish" is used to mean "supply and deliver to the Project site, ready for unloading, unpacking, assembly, installation, and similar operations."

F. Install: The term "install" is used to describe operations at project site including the actual unloading, temporary storage, unpacking, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations.

G. Provide: The term "provide" means "to furnish and install, complete and ready for the intended use."

H. Testing Agencies, Laboratories or Service: All terms interchangeably refer to an independent entity engaged by the Contractor to perform specific inspections or tests, either at the Project Site or elsewhere, and to report on and, if required, to interpret results of those inspections or tests.

I. Directed, Requested, etc.: Where not otherwise explained, terms such as "directed," "requested," "authorized," "selected," "approved," "required," "accepted," and "permitted" mean "directed by the Architect-Engineer, "requested by the Architect-Engineer, and similar phrases. However, no such implied meaning will be interpreted to extend the Architect-Engineer's responsibility into Contractor's area of construction supervision.

J. Approve: Only the Owner can approve or disapprove contract actions. Even if the specifications indicate that an individual other than the Owner (such as the "Architect-Engineer") will approve or disapprove an action, it is understood that only the Owner has this authority unless the individual is so designated by him in writing. Even when an individual is so designated, the Contractor may appeal the action to the Owner's and the

Owner's decision shall be final. In no case will "approval" by the Owner's be interpreted as a release of the Contractor from responsibility to fulfill requirements of Contract documents.

K. Project Site: The space available to Contractor for performance of the work, either exclusively or in conjunction with others performing other work as part of the project. The extent of project site is shown on drawings and may or may not be identical with description of land upon which project is to be built.

L. Installer: The term "Installer" is defined as the entity (person or firm) engaged by the Contractor or its subcontractor or sub-subcontractor for performance of a particular unit of work at the project site, including installation, erection, application and similar required operations. Installers shall be skilled in the work they are to perform.

M. Specialist: The term "Specialist" means an individual or firm of established reputation (or, if newly organized, whose personnel have previously established a reputation in the same field), which is regularly engaged in, and which maintains a regular force of workmen skilled in either (as applicable) manufacturing or fabricating items required by the Contract, installing items required by the Contract, or otherwise performing work required by the Contract. Where the Contract specification requires installation by a specialist, the term shall also be deemed to mean either the manufacturer of the item, an individual or firm licensed by the manufacturer, or an individual or firm who will perform the work under the manufacturer's direct supervision.

N. Nationally Recognized Testing Laboratories: The term "nationally recognized testing laboratory (NRTL)" shall mean a firm or organization which is recognized by OSHA in accordance with 29 CFR Part 1910.7 to test and approve (i.e., certify, label or list) equipment or materials as being safe for the intended use. Labeling and/or listing of products by NRTL is acceptable wherever a reference to the UL or FMRC label is made in the specifications.

O. Label: The label must be provided by a nationally recognized testing laboratory. The Contractor shall provide a statement from the testing laboratory attesting that the laboratory has been approved by OSHA to certify the category of product(s) being submitted for approval.

1.2 SPECIFICATION CONTENT EXPLANATION

A. Specification Content: This Specification uses certain conventions in the use of language and the intended meaning of certain terms, words, and phrases when used in particular situations or circumstances. These conventions are explained as follows:

1. Abbreviated Language: Language used in Specifications and other Contract Documents is the abbreviated type. Words and meanings shall be interpreted as appropriate. Words that are implied, but not stated shall be interpretated as the sense requires. Singular words will be interpreted as plural and plural words interpreted as singular where applicable and the context of the Contract Documents so indicates.

2. Imperative mood and streamlined language is used generally in the Specifications. Requirements expressed in the imperative mood are to be performed by the Contractor. At certain locations in the text, for clarity, subjective language is used to describe responsibilities that must be fulfilled indirectly by the Contractor, or by others when so noted.

a. The words □shall, □shall comply with or □shall be" shall be included by inference wherever a colon (:) is used within a sentence or phrase.

1.3 OVERLAPPING AND CONFLICTING ASSIGNMENTS

A. Contract Documents: The Contract documents are complementary. What is required by one shall be as binding as if required by all. Where there appear to be overlapping or conflicting requirements in the Contract documents, the Contractor is responsible to seek clarification from the Architect-Engineer. No claims will be accepted for work performed where overlapping or conflicting requirements could have been resolved by requests for clarification.

B. Industry Standards: Where compliance with 2 or more industry standards or sets of requirements are specified, and overlapping of those different standards or requirements establishes different or conflicting minimums or levels of quality, most stringent requirement shall govern.

C. Contractor's Option: Except for overlapping or conflicting requirements, where more than one set of requirements are specified for a particular unit of work, option is intended to be Contractor's regardless of whether or not it is specifically indicated as such.

1.4 MINIMUM QUALITY/QUANTITY

A. In every instance, the quality level or quantity shown or specified is intended to be the minimum for the work to be performed or provided. Except as otherwise specifically indicated, the actual work may either comply exactly with that minimum (within specified tolerances), or may exceed that minimum within reasonable limits. In complying with requirements, indicated numeric values are either minimums or maximums as noted or as appropriate for context of requirements. Refer instances of uncertainty to the Architect-Engineer for decision before proceeding.

1. The Architect-Engineer is the sole interpreter of what constitutes "minimum requirements" in any given situation. Exceeding minimum requirements in one or more aspects of any given specification does not cancel or replace the need to meet minimum requirements of any other aspect of that same specification.

1.5 ASSIGNMENT OF SPECIALISTS

A. In certain instances, specification text requires that specific work is to be assigned to specialists who must be engaged for performance of that work. Such assignments are special requirements over which the Contractor has no choice or option. These requirements should not be interpreted so as to conflict with applicable regulations, union jurisdiction settlements and similar conventions. Such assignments are intended to establish which party or entity involved in a specific unit of work is recognized as "expert" for the indicated construction processes or operations. Nevertheless, the final responsibility for fulfillment of the entire set of requirements remains with the Contractor.

1.6 INDUSTRY STANDARDS

A. Applicability of Standards: Except where the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference.

B. Publication Dates: Refer to clause "Standard References" of General Conditions. Except as otherwise indicated, where compliance with an industry standard is required, comply with standard in effect as of Invitation for Bids.

1. Updated Standards: Submit a change order proposal where an applicable industry standard has been revised and reissued after the date of Contract documents and before the performance of the work affected. The Architect-Engineer will decide whether to issue a change order to proceed with the updated standard.

C. Copies of Standards: Each entity engaged in construction on the Project is required to be familiar with industry standards applicable to that entity's construction activity. Copies of applicable standards are not bound with the Contract Documents.

1. Where copies of standards are needed for performance of a required construction activity, the Contractor shall obtain copies directly from the publication source.

2. Maintain copy of referenced standards, including those referenced in the referenced standards and where required manufacturer’s instructions, where work is being performed and make available to the Architect-Engineer on request.

D. Abbreviations and Names: Trade association names and titles of general standards are frequently abbreviated. The abbreviations and acronyms, as referenced in the Contract Documents, mean the associated names. The trade associations and general standards are commonly known in the industry. Any such acronyms not known by the Contractor shall be requested of the Architect-Engineer who shall provide names and addresses. Names and addresses are subject to change and are believed, but are not assured, to be accurate and up-to-date as of the date of the Contract Documents.

PART 2 - PRODUCTS

NOT USED.

PART 3 - EXECUTION

NOT USED.

END OF SECTION 014200

SECTION 014500 – STATEMENT OF SPECIAL INSPECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provision of the Contract, including Form of Agreement between Owner and Contractor and Division 1 Specification Sections, apply to this Section.

1.2 DESCRIPTION

A. In compliance with the Chapter 17 of the 2012 Virginia Construction Code, the Owner shall employ a Special Inspector (hereinafter Inspector) to provide inspections during construction of the structural components of the Project identified in this Section.

B. The Special Inspector shall provide written documentation to the building official, satisfactory to the building official, demonstrating competence and relevant experience or training related in complexity to the same type of special inspection activities for projects of similar complexity and material qualities.

1.3 RESPONSIBILITIES

A. The Inspector will be responsible to keep records of inspections. All inspection reports shall be submitted to the building official and engineer of record (EOR). Reports and final report shall meet requirements of Section 1704.2.4 of the 2012 Virginia Construction Code (VCC). Work completed not in accordance with the construction documents (ie discrepancies) shall be brought to the attention of the contractor, and if not correct, shall be brought to the attention of the building official and EOR prior to completion of that phase of work. The final report by the special inspector must certify that the entire structural system complies with the approved plans and specifications. The final report shall be submitted to the EOR and building official an agreed time prior to stat or work by the contractor.

B. The Contractor shall furnish, and keep current, a schedule of construction so the Inspector can be present to provide inspection of structural work. Contractor shall make all areas available and safe for inspection and all work to be inspected accessible and exposed until completion of the inspection.

C. The acceptance of any structural component by the Inspector in no way relieves the Contractor of responsibility for complying with the requirements of the Contract Documents.

D. All inspections shall be performed by the special inspections, job site visits by the structural engineer or building official do not constitute, and are not a substitute, for inspection to be completed by the special inspector.

E. Specified tests, inspections, and related actions do not limit the Contractor's other quality-assurance and control procedures that facilitate compliance with the Contract Document requirements.

F. Requirements for the Contractor to provide quality-assurance and control services required by the Architect-Engineer, Owner or authorities having jurisdiction are not limited by the provisions of this Section.

G. The Contractor shall submit a written statement meeting the requirements of Section 1704.4 of the 2012 Virginia Construction Code to the building official and owner prior to

commencement of work on the seismic or wind resisting system or any component of the seismic or wind resisting system.

1. Main wind-/seismic-force resisting system: Reinforced Concrete Wall Panels

1.4 SPECIAL INSPECTION PLAN

A. As required by Section 1704 of the Virginia Construction Code, the Inspector shall be present and observe the installation and construction of each type structural component.

B. Following are representative examples of the above (shall not be construed as all-inclusive):

1. Structural Steel: Inspections and verifications of steel construction shall be as required by Virginia Construction Code, Section 1705.2. Special inspection shall be in accordance with the quality assurance inspection requirements of AISC 360-10 Chapter N.

Welding

a. Inspections Tasks Prior to Welding (Table 1)

1.	Welding procedure specifications (WPS's) have been submitted to EOR and are available on-site	P
2.	Manufacturer certifications for welding consumables submitted to EOR and are available on-site	P
3	Material identification (type/grade)	O
4	Welder identification system (system shall be by fabricator or erector)	O
5	Fit-up groove welds (including joint geometry) • Joint preparation • Dimensions (alignment, root opening, root face, bevel) • Cleanliness (condition of steel surfaces) • Tacking (tack weld quality and location) • Backing type and fit (if applicable)	O
6	Configuration and finish of access holes	O
7	Fit up of fillet welds • Dimensions (alignment, gaps at roof) • Cleanliness (condition of steel surfaces) • Tacking (tack weld quality and location)	O

P- Denotes tasks shall be performed for each welded joint or member
O- Denotes items shall be observed on a random basis and operations need to be delayed pending these inspections

b. Inspections Tasks During Welding (Table 2)

1.	Use of qualified welders	O
2.	Control and handling of welding consumables • Packaging • Exposure Control	O
3	No welding over cracked tack welds	O
4	Environmental Conditions • Wind speed within limits • Precipitation and temperature	O
5	WPS followed	O

	• Settings on welding equipment • Travel Speed • Sleeted welding materials • Shielding gas type/ flow rate • Preheat applied • Interpass temperature maintained (min/max) • Proper position (F, V, H, OH)	
6	Welding techniques • Interpass and final cleaning • Each pass within profile limitations • Each pass meets quality requirements	O

P- Denotes tasks shall be performed for each welded joint or member

O- Denotes items shall be observed on a random basis and operations need to be delayed pending these inspections

c. Inspections Tasks After Welding (Table 3)

1.	Welds cleaned	O
2.	Size, length, and location of welds	P
3	Weld meet visual acceptance criteria • Crack prohibition • Weld/base-metal fusion • Crater cross section • Weld profiles • Weld size • Undercut • Porosity	P
4	Arc strikes	P
5	k-area • When welding of doubler plates, continuity places or stiffeners have been performed in the k-area, visually inspect the web k-area for cracks within 3 inches of the weld	P
6	Backing removed and weld tabs removed (if required)	P
7	Repair activities	P
8	Document acceptance or rejection of welded joint or member	P

P- Denotes tasks shall be performed for each welded joint or member
O- Denotes items shall be observed on a random basis and operations need to be delayed pending these inspections

Bolting

a. Inspections Tasks Prior to Bolting (Table 4)

1.	Manufacturer's certifications submitted to EOR and available on-site for fastener materials	P
2.	Fasteners marked in accordance with ASTM requirements	O
3	Proper fasteners selected for joint detail (grade, type, bolt length if threads are to be excluded form shear plane)	O
4	Proper bolting procedure selected for joint detail.	O
5	Connecting elements, including the appropriate faying surface condition and hole preparation, if specified, meet applicable requirements	O
6	Pre-installation verification testing by installation personnel observed and documented for fastener assemblies and methods used (See Note #1)	O
7	Proper storage provided for bolts, nuts, washers and other fastener components.	O

P- Denotes tasks shall be performed for each welded joint or member
O- Denotes items shall be observed on a random basis and operations need to be delayed pending these inspections

b. Inspections Tasks During Bolting (Table 5)

1.	Fastener assemblies, of suitable condition, placed in all holes and washers (if required) are positioned as required	O
2.	Joint brought to the snug-tight condition prior to the pretensioning operation	O
3	Fastener component non turned by wrench prevented from rotating	O
4	Fasteners are pretensioned in accordance with RCSC Specification, progressing systematically from the most rigid point toward the free edges	O

P- Denotes tasks shall be performed for each welded joint or member
O- Denotes items shall be observed on a random basis and operations need to be delayed pending these inspections

c. Inspections Tasks After Bolting (Table 6)

1.	Document acceptance or rejection of bolted connections	P

P- Denotes tasks shall be performed for each welded joint or member
O- Denotes items shall be observed on a random basis and operations need to be delayed pending these inspections

Notes:
1. For snug-tight joints, pre-installation verification testing as specified in Table 4 and monitoring of the installation procedures as specified in Table 5 are not applicable. The special inspector need not be present during the installation of fasteners in snug-tight joints.
2. For pretensioned joints and slip-critical joints, when the installer is using the turn-of the nut method with matchmarking techniques, the direct-tension-indicator method, or the twist-off type tension control bolt method, monitoring of the bolt pretensioning procedures shall be as specified in Table 5. The special inspector need not be present during the installation of fasteners when these methods are used by the installer. Contractor shall notify special inspector of installation method.
3. For pretensioned joints and slip-critical joints, when the installer is using the calibrated wrench method or turn of the nut method without matchmarking, monitoring of bolt pretensioning procedures shall be as specified in Table 5. The special inspector shall be engaged in their assigned inspections duties during installation of fasteners when these methods are used by the installer.

d. Nondestructive Testing:
   1) CJP: Ultrasonic Testing (UT) shall be performed on all Complete Joint Penetration Groove Welds on joints, in material 5/16” thick or greater. UT shall be in accordance with AWS D1.1; acceptance criteria shall be in accordance with AWS D1.1
   2) Access Hole: Thermally cut surfaces of access holes shall be tested using MT or PT when the flange thickness exceeds 2” for rolled shapes, or when the web thickness exceeds 2” for built-up shapes. Any crack shall be deemed unacceptable regardless of size or location.
   3) Documentation: All NDT performed shall be documented. For shop fabrication, the NDT report shall identify the tested weld piece mark and location in the piece. For field work, the NDT report shall identify the tested weld by location in the structure, piece mark, and

location in the piece. When a weld is rejected on the basis of NDT, the NDT record shall indicate the location of the defect and basis of rejection.

e. The special inspector shall be on the premise for inspections during placement of embedments including embed plates. Location of embed plates shall be verified prior to placement of concrete.

f. Special Inspector shall submit to the fabricator and erector all inspection reports and nondestructive testing reports.

g. Inspection of steel fabricators shall be in performed in compliance with Section 1704.2.5 of the Virginia Construction Code, (VCC), unless the steel fabricator meets one of the following criteria:

4) Fabricator can demonstrate certification in compliance with Section 1704.2.5.2 of the VCC: Approval by the Building Official shall be based upon review of the fabricator's written procedural and quality control manuals and periodic auditing of fabrication practices by an special inspection agency.

a) Fabricator shall submit a certificate of compliance to the building official stating that the work was performed in accordance with the approved construction documents at the completion of fabrication.

5) Fabricator does not perform any welding, thermal cutting or heating operation of any kind as part of the fabrication process.

a) Fabricator shall submit detailed procedure for material control that demonstrates the fabricator's ability to maintain suitable records and procedures such that, at any time during the fabrication process, the material specification, and grade for the main stress-carrying elements are capable of being determined. Mill test reports shall be identifiable to the main stress-carrying elements (ie cab floor and roof steel framing.)

2. Steel Deck: Inspections and verifications of steel deck construction shall be as required by Virginia Construction Code, Table 1705.2.2.

Verification and Inspection	Continuous	Periodic	Reference Standard
1 Material verification of cold-formed steel deck:			
a. Identification markings to confirm to ASTM standards	-	X	Applicable ASTM Standards
b. Manufacturer's certified test reports	-	X	
2 Inspection of Welding			
a. Cold-formed Steel Deck			
1. Floor and Roof Deck Welds	-	X	AWS D1.3

Notes:
1. Continuous special inspection shall be defined as special inspection by the *special inspector* who is continuously present when and where the work to be inspected is being performed.

2. Periodic inspection shall be defined as special inspection by the *special inspector* who is intermittently present where the work to be inspected has been or is being performed

3. Steel Reinforcement: Not permitted per Specification 033000.

4. Concrete: Inspections and verifications of concrete construction shall be as required by Virginia Construction Code, Section 1705.3:

	Verification and Inspection	Continuous	Periodic
1	Inspection of reinforcing steel and placement	-	X
2	Inspection of anchors cast in concrete	-	X
3	Inspection of post-installed anchors in concrete	-	X
4	Inspection of Welding (See Note #1)	-	X
5	Verify use of required design mix	-	X
6	At the time of fresh concrete is sampled to fabricate specimens for strength tests, perform slump and air content tests, and determine the temperature of the concrete	X	-
7	Inspection of concrete placement for proper application techniques	X	-
8	Inspection for maintenance of specified curing temperature and techniques. Verify compliance with ACI 318-11 Section 5.11 thru 5.13	-	X
9	Erection of Reinforced Concrete Wall Panels	-	X
10	Inspect formwork for shape, location, and dimensions of the concrete member being formed	-	X

Notes:
1. For post-installed anchors, verify that anchor was installed in accordance with manufacturer's recommendations. Contractor shall submit written documentation that anchor was installed in accordance with manufacturer's requirements. Contractor shall confirm with building official prior to commencement that written documentation will meet requirements of 2012 VCC Table 1705.2.2 footnote b.
2. Continuous special inspection shall be defined as special inspection by the *special inspector* who is continuously present when and where the work to be inspected is being performed.
3. Periodic inspection shall be defined as special inspection by the *special inspector* who is intermittently present where the work to be inspected has been or is being performed

5. Earthwork: Inspections and verifications of earthwork shall be as required by Virginia Construction Code, Section 1705.6. Special inspections for existing site soil conditions, fill placement, and load-bearing requirements shall be as shown in table below. The geotechnical report, and the construction documents shall be used to determine compliance. The special inspector shall determine that proper material and procedures are use in accordance with the provisions of the geotechnical report and Section 024100 and 312000 during fill placement.

Verification and Inspection Task	Continuous During	Periodic During Task

		Task Listed	Listed
1	Verify materials below foundations are adequate the achieve the design bearing capacity	-	X
2	Verify excavations are extended to proper depth and have reached proper material.	-	X
3	Perform classification and testing of compacted fill materials	-	X
4	Verify use of proper materials, densities and lift thickness during placement and compaction of compacted fill.	X	-
5	Prior to placement of compacted fill, observe subgrade and verify that site has been prepared properly.	-	X

6. Masonry: Inspections and verifications of masonry construction shall be as required by Virginia Construction Code, Section 1705.4. Special inspection shall be in accordance with the quality assurance inspection requirements of TMS 402/ACI 530/ASCE 5 & TMS 602/ACI 530.1/ASCE 6.

Verification of Tests			
1	Verification of Slump flow and VSI as delivered to the site in accordance with TMS 402/ACI 530/ASCE 5 Article 1.5 B.1.b.3 for self-consolidating grout		
2	Verification of f'm and f'aac prior to construction		
Verification and Inspection		**Continuous**	**Periodic**
1	Verify compliance with approved submittals	-	X
2	As masonry construction begins, verify that the following are in compliance:		
	a. Proportions of site-prepared mortar	-	X
	b. Construction of mortar joints	-	X
	c. Location of reinforcement, connectors, and anchorages		X
3	Prior to grouting, verify that the following are in compliance:		
	a. Grout space	-	X
	b. Grade, type, and size of reinforcement and anchor bolts, and anchorages	-	X
	c. Placement of reinforcement, connectors, and anchorages	-	X
	d. Proportions of site-prepared grout	-	X
	e. Construction of mortar joints	-	X
4	Verify during construction:	-	X
	a. Size and location of structural elements	-	X
	b. Type, size, and location of anchors, including other details	-	X

	of anchorage of masonry to structural members, frames, or other construction.		
	c. Preparation, construction, and protection of masonry during cold weather (below 40 degrees Fahrenheit or above 90 degrees Fahrenheit	-	X
	d. Placement of grout is in compliance	X	-
5	Observe preparation of grout specimens, mortar specimens, and or prisms	-	X

1.4 INSPECTION REPORTS

A. General: Reports of special inspection shall be in conformance with Section 1704.1.3 of the Virginia Construction Code.

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION (NOT APPLICABLE)

END OF SECTION 014500

SECTION 015000 – TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 SUMMARY

A. This section specifies requirements for temporary services and facilities, including utilities, construction and support facilities, security and protection.

B. Temporary utilities required include but are not limited to:

1. Water service and distribution.

2. Temporary electric power and light.

3. Telephone service.

4. Storm and sanitary sewer.

C. Temporary construction and support facilities required include but are not limited to:

1. Temporary heat.

2. Field offices and storage sheds.

3. Temporary roads and paving.

4. Sanitary facilities, including drinking water.

5. Dewatering facilities and drains.

6. Temporary enclosures.

7. Temporary partitions.

8. Temporary interior barricades.

9. Project signs.

10. Temporary exterior lighting.

D. Security and protection facilities required include but are not limited to:

1. Temporary fire protection.

2. Barricades, warning signs, lights.

3. Sidewalk bridge or enclosure fence for the site.

4. Environmental protection.

1.2 QUALITY ASSURANCE

A. Regulations: Comply with industry standards and applicable laws and regulations of authorities having jurisdiction, including but not limited to:

1. Building Code requirements.

2. Health and safety regulations.

3. Utility company regulations.

4. Police, Fire Department and Rescue Squad rules.

5. Environmental protection regulations.

B. Inspections: Arrange for authorities having jurisdiction to inspect each temporary utility before use. Obtain required certifications and permits.

1.3 PROJECT CONDITIONS

A. Conditions of Use: Keep temporary services and facilities clean and neat in appearance. Operate in a safe and efficient manner. Take necessary fire prevention measures. Do not overload facilities, or permit them to interfere with progress. Do not allow hazardous, dangerous or unsanitary conditions, or public nuisances to develop or persist on the site.

PART 2 - PRODUCTS

NOT USED.

PART 3 - EXECUTION

3.1 TEMPORARY UTILITY INSTALLATION

A. General: Engage the appropriate local utility company to install temporary service or connect to existing service. Where the company provides only part of the service, provide the remainder with matching, compatible materials and equipment; comply with the company's recommendations.

1. Arrange with the company and existing users for a time when service can be interrupted, where necessary, to make connections for temporary services.

2. Provide adequate capacity at each stage of construction. Prior to temporary utility availability, provide trucked-in services.

3. Obtain easements to bring temporary utilities to the site, where the Owner's easements cannot be used for that purpose.

4. Use Charges: Cost or use charges for temporary facilities are not chargeable to the Owner or Architect-Engineer, and will not be accepted as a basis of claims for a Change Order.

B. Water Service: Install water service and distribution piping of sizes and pressures adequate for construction until permanent water service is in use.

1. Sterilization: Sterilize temporary water piping prior to use.

2. When nonpotable water is used, mark each outlet with hazardous warning signs.

C. Temporary Electric Power Service: Provide weatherproof, grounded electric power service and distribution system of sufficient size, capacity, and power characteristics during construction period. Include meters, transformers, overload protected disconnects, automatic ground-fault interrupters and main service panelboard or fired switches.

1. Power Distribution System: Install wiring overhead, and rise vertically where least exposed to damage. Where permitted, wiring circuits not exceeding 125 Volts, AC 20 ampere rating, and lighting circuits may be nonmetallic sheathed cable where overhead and exposed for surveillance.

D. Temporary Lighting: Whenever overhead floor or roof deck has been installed, provide temporary lighting with local switching.

1. Install and operate temporary lighting that will fulfill security and protection requirements, without operating the entire system, and will provide adequate illumination for construction operations and traffic conditions.

E. Sewers and Drainage: If sewers are available, provide temporary connections to remove effluent that can be discharged lawfully. If sewers are not available or cannot be used, provide drainage ditches, dry wells, stabilization ponds and similar facilities. If neither sewers nor drainage facilities can be lawfully used for discharge of effluent, provide containers to remove and dispose of effluent off the site in a lawful manner.

1. Filter out excessive amounts of soil, construction debris, chemicals, oils and similar contaminants that might clog sewers or pollute waterways before discharge.

2. Connect temporary sewers to the municipal system as directed by the sewer department officials.

3. Maintain temporary sewers and drainage facilities in a clean, sanitary condition. Following heavy use, restore normal conditions promptly.

F. Provide earthen embankments and similar barriers in and around excavations and subgrade construction, sufficient to prevent flooding by runoff of storm water from heavy rains.

G. Telephone: Provide all telephone lines, telephone systems and equipment necessary for Contractor’s use from point of connection with the local telephone company.

H. Provide service connections for water and sanitary sewer to Contractor's office. Provide temporary pole and electric and telephone service. See other Sections of the Specification for additional requirements.

3.2 TEMPORARY CONSTRUCTION AND SUPPORT FACILITIES INSTALLATION

A. Locate field offices, storage sheds, sanitary facilities and other temporary construction and support facilities for easy access.

1. Maintain temporary construction and support facilities until near Substantial Completion. Remove prior to Substantial Completion. Personnel remaining after Substantial Completion will be permitted to use permanent facilities, under conditions acceptable to the Owner.

B. Temporary Heat: Provide temporary heat required by construction activities, for curing or drying of completed installations or protection of installed construction from adverse effects of low temperatures or high humidity.

C. Sanitary facilities include temporary toilets, wash facilities and drinking water fixtures. Comply with regulations and health codes for the type, number, location, operation and maintenance of fixtures and facilities. Install where facilities will best serve the project's needs.

D. Dewatering Facilities and Drains: For temporary drainage and dewatering facilities and operations not directly associated with construction activities included under individual sections, comply with dewatering requirements of applicable Division 32 sections. Where feasible, utilize the same facilities. Maintain the site, excavations and construction free of water.

E. Project Signs: There will be two Contractor-furnished project identification signs. Contractor shall add his name and license numbers to each sign, in the same font and type size used for the Architect-Engineer's identification. Contractor shall relocate signs as required for construction operations. Contractor shall remove signs at end of project at Architect-Engineer's direction and turn them over to the Owner. No other Contractor, subcontractor or supplier-provided signs shall be allowed.

F. Temporary Exterior Lighting: Install exterior yard and sign lights so that signs are visible when work is being performed.

3.3 SECURITY AND PROTECTION FACILITIES INSTALLATION

A. Except for use of permanent fire protection as soon as available, do not change over from use of temporary security and protection facilities to permanent facilities until Substantial Completion, or longer as requested by the Owner.

B. Temporary Fire Protection: Until fire protection needs are supplied by permanent facilities, install and maintain temporary fire protection facilities of the types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 10 "Standard for Portable Fire Extinguishers," and NFPA 241 "Standard for Safeguarding Construction, Alterations and Demolition Operations."

1. Locate fire extinguishers where convenient and effective for their intended purpose, but not less than one extinguisher at each floor at or near each usable stairwell.

2. Store combustible materials in containers in fire-safe locations.

3. Maintain unobstructed access to fire extinguishers, fire hydrants, temporary fire protection facilities, stairways and other access routes for fighting fires. Prohibit smoking in hazardous fire exposure areas.

4. Provide supervision of welding operations, combustion type temporary heating units, and similar sources of fire ignition.

C. Permanent Fire Protection: At the earliest feasible date in each area of the project, complete installation of the permanent fire protection facility, including connected services, and place into operation and use. Instruct key personnel on use of facilities.

D. Barricades, Warning Signs and Lights: Comply with standards and code requirements for erection of structurally adequate barricades. Paint with appropriate colors, graphics and warning signs to inform personnel and the public of the hazard being protected against. Where appropriate and needed provide lighting, including flashing red or amber lights.

E. Enclosure Fence: Contractor shall provide open-mesh, chain-link enclosure fence with lockable entrance gates as required along the site perimeter to completely enclose the site for construction operations. Contractor shall maintain integrity of entire enclosure. Contractor shall assure full responsibility for the entire enclosure fence. Contractor shall remove all enclosure fence, at the end of the project.

F. Security Enclosure and Lockup: Install substantial temporary enclosure of partially completed areas of construction. Provide locking entrances to prevent unauthorized entrance, vandalism, theft and similar violations of security.

G. Environmental Protection: Provide protection, operate temporary facilities and conduct construction in ways and by methods that comply with environmental regulations, and minimize the possibility that air, waterways and subsoil might be contaminated or polluted, or that other undesirable effects might result. Avoid use of tools and equipment which produce harmful noise. Restrict use of noise making tools and equipment to hours that will minimize complaints from persons or firms near the site.

3.4 OPERATION, TERMINATION AND REMOVAL

A. Supervision: Enforce strict discipline in use of temporary facilities. Limit availability of temporary facilities to essential and intended uses to minimize waste and abuse.

B. Maintenance: Maintain facilities in good operating condition until removal. Protect from damage by freezing temperatures and similar elements.

1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation and similar facilities on a 24-hour day basis where required to achieve indicated results and to avoid possibility of damage.

2. Protection: Prevent water filled piping from freezing. Maintain markers for underground lines. Protect from damage during excavation operations.

C. Termination and Removal: Unless the Architect-Engineer requests that it be maintained longer, remove each temporary facility when the need has ended, or when replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of

interference with the temporary facility. Repair damaged work, clean exposed surfaces and replace construction that cannot be satisfactorily repaired.

1. Materials and facilities that constitute temporary facilities are property of the Contractor.

2. Remove temporary paving that is not intended for or acceptable for integration into permanent paving. Where the area is intended for landscape development, remove soil and aggregate fill that does not comply with requirements for fill or subsoil in the area. Remove materials contaminated with road oil, asphalt and other petrochemical compounds, and other substances which might impair growth of plant materials or lawns. Repair or replace street paving, curbs and sidewalks at the temporary entrances, as required by the governing authority.

3. At Substantial Completion, clean and renovate permanent facilities that have been used during the construction period, including but not limited to:

    a. Replace significantly worn parts and parts that have been subject to unusual operating conditions.

    b. Replace lamps that are burned out or noticeably dimmed by substantial hours of use.

END OF SECTION 015000

SECTION 017300 - EXECUTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes general administrative and procedural requirements governing execution of the Work including, but not limited to, the following:

1. Construction layout.
2. Field engineering and surveying.
3. Installation of the Work.
4. Coordination of Owner-installed products.
5. Progress cleaning.
6. Starting and adjusting.
7. Protection of installed construction.

B. Related Requirements:

1. Section 011000 "Summary" for limits on use of Project site.
2. Section 013300 "Submittal Procedures" for submitting surveys.
3. Section 017700 "Closeout Procedures" for submitting final property survey with Project Record Documents, recording of Owner-accepted deviations from indicated lines and levels, and final cleaning.
4. Section 024119 "Selective Demolition" for demolition and removal of selected portions of the building.
5. Section 024120 "Cutting and Patching" for cutting and patching.
6. Section 078413 "Penetration Firestopping" for patching penetrations in fire-rated construction.
7. G-104 “Project Survey & Stakeout”

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For **land surveyor**.

B. Certificates: Submit certificate signed by **land surveyor** certifying that location and elevation of improvements comply with requirements.

C. Landfill Receipts: Submit copy of receipts issued by a landfill facility, licensed to accept hazardous materials, for hazardous waste disposal.

D. Certified Surveys: Submit **two** copies signed by land surveyor.

E. Final Property Survey: Submit **10** copies showing the Work performed and record survey data.

1.4 QUALITY ASSURANCE

A. Land Surveyor Qualifications: A professional land surveyor who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing land-surveying services of the kind indicated.

B. Manufacturer's Installation Instructions: Obtain and maintain on-site manufacturer's written recommendations and instructions for installation of products and equipment.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General: Comply with requirements specified in other Sections.

1. For projects requiring compliance with sustainable design and construction practices and procedures, use products for patching that comply with sustainable design requirements.

B. In-Place Materials: Use materials for patching identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.

1. If identical materials are unavailable or cannot be used, use materials that, when installed, will provide a match acceptable to Architect for the visual and functional performance of in-place materials.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Existing Conditions: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify the existence and location of underground utilities, **mechanical and electrical systems,** and other construction affecting the Work.

1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, and water-service piping; underground electrical services, and other utilities.
2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.

B. Examination and Acceptance of Conditions: Before proceeding with each component of the Work, examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.

1. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.

2. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
3. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.

C. Written Report: Where a written report listing conditions detrimental to performance of the Work is required by other Sections, include the following:

1. Description of the Work.
2. List of detrimental conditions, including substrates.
3. List of unacceptable installation tolerances.
4. Recommended corrections.

D. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Existing Utility Information: Furnish information to **local utility and Owner** that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.

B. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

C. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.

D. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents caused by differing field conditions outside the control of Contractor, submit a request for information to Architect according to requirements in Section 012001 "Coordination."

3.3 CONSTRUCTION LAYOUT

A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks. If discrepancies are discovered, notify Architect promptly.

B. General: Engage a **land surveyor** to lay out the Work using accepted surveying practices.

1. Establish benchmarks and control points to set lines and levels at each story of construction and elsewhere as needed to locate each element of Project.
2. Establish limits on use of Project site.
3. Establish dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.
4. Inform installers of lines and levels to which they must comply.

5. Check the location, level and plumb, of every major element as the Work progresses.
6. Notify Architect when deviations from required lines and levels exceed allowable tolerances.
7. Close site surveys with an error of closure equal to or less than the standard established by authorities having jurisdiction.

C. Site Improvements: Locate and lay out site improvements, including pavements, grading, fill and topsoil placement, utility slopes, and rim and invert elevations.

D. Building Lines and Levels: Locate and lay out control lines and levels for structures, building foundations, column grids, and floor levels, including those required for mechanical and electrical work. Transfer survey markings and elevations for use with control lines and levels. Level foundations and piers from two or more locations.

E. Record Log: Maintain a log of layout control work. Record deviations from required lines and levels. Include beginning and ending dates and times of surveys, weather conditions, name and duty of each survey party member, and types of instruments and tapes used. Make the log available for reference by Architect.

3.4 FIELD ENGINEERING

A. Identification: Identify existing benchmarks, control points, and property corners.

B. Reference Points: Locate existing permanent benchmarks, control points, and similar reference points before beginning the Work. Preserve and protect permanent benchmarks and control points during construction operations.

1. Do not change or relocate existing benchmarks or control points without prior written approval of Architect. Report lost or destroyed permanent benchmarks or control points promptly. Report the need to relocate permanent benchmarks or control points to Architect before proceeding.
2. Replace lost or destroyed permanent benchmarks and control points promptly. Base replacements on the original survey control points.

C. Benchmarks: Establish and maintain a minimum of **two** permanent benchmarks on Project site, referenced to data established by survey control points. Comply with authorities having jurisdiction for type and size of benchmark.

1. Record benchmark locations, with horizontal and vertical data, on Project Record Documents.
2. Where the actual location or elevation of layout points cannot be marked, provide temporary reference points sufficient to locate the Work.
3. Remove temporary reference points when no longer needed. Restore marked construction to its original condition.

D. Certified Survey: On completion of foundation walls, major site improvements, and other work requiring field-engineering services, prepare a certified survey showing dimensions, locations, angles, and elevations of construction and sitework.

E. Final Property Survey: Engage a **land surveyor** to prepare a final property survey showing significant features (real property) for Project. Include on the survey a certification, signed by

land surveyor, that principal metes, bounds, lines, and levels of Project are accurately positioned as shown on the survey.

1. Show boundary lines, monuments, streets, site improvements and utilities, existing improvements and significant vegetation, adjoining properties, acreage, grade contours, and the distance and bearing from a site corner to a legal point.
2. Recording: At Substantial Completion, have the final property survey recorded by or with authorities having jurisdiction as the official "property survey."

3.5 INSTALLATION

A. General: Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.

1. Make vertical work plumb and make horizontal work level.
2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
3. Conceal pipes, ducts, and wiring in finished areas unless otherwise indicated.
4. Maintain minimum headroom clearance of **96 inches (2440 mm)** in occupied spaces and **90 inches (2300 mm)** in unoccupied spaces.

B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.

C. Install products at the time and under conditions that will ensure the best possible results. Maintain conditions required for product performance until Substantial Completion.

D. Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy.

E. Sequence the Work and allow adequate clearances to accommodate movement of construction items on site and placement in permanent locations.

F. Tools and Equipment: Do not use tools or equipment that produce harmful noise levels.

G. Templates: Obtain and distribute to the parties involved templates for work specified to be factory prepared and field installed. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.

H. Attachment: Provide blocking and attachment plates and anchors and fasteners of adequate size and number to securely anchor each component in place, accurately located and aligned with other portions of the Work. Where size and type of attachments are not indicated, verify size and type required for load conditions.

1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Architect.
2. Allow for building movement, including thermal expansion and contraction.
3. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

I. Joints: Make joints of uniform width. Where joint locations in exposed work are not indicated, arrange joints for the best visual effect. Fit exposed connections together to form hairline joints.

J. Hazardous Materials: Use products, cleaners, and installation materials that are not considered hazardous.

3.6 OWNER-INSTALLED PRODUCTS

A. Site Access: Provide access to Project site for Owner's construction personnel.

B. Coordination: Coordinate construction and operations of the Work with work performed by Owner's construction personnel.

1. Construction Schedule: Inform Owner of Contractor's preferred construction schedule for Owner's portion of the Work. Adjust construction schedule based on a mutually agreeable timetable. Notify Owner if changes to schedule are required due to differences in actual construction progress.
2. Preinstallation Conferences: Include Owner's construction personnel at preinstallation conferences covering portions of the Work that are to receive Owner's work. Attend preinstallation conferences conducted by Owner's construction personnel if portions of the Work depend on Owner's construction.

3.7 PROGRESS CLEANING

A. General: Clean Project site and work areas daily, including common areas. Enforce requirements strictly. Dispose of materials lawfully.

1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
2. Do not hold waste materials more than seven days during normal weather or three days if the temperature is expected to rise above 80 deg F (27 deg C).
3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.

   a. Use containers intended for holding waste materials of type to be stored.

4. Coordinate progress cleaning for joint-use areas where Contractor and other contractors are working concurrently.

B. Site: Maintain Project site free of waste materials and debris.

C. Work Areas: Clean areas where work is in progress to the level of cleanliness necessary for proper execution of the Work.

1. Remove liquid spills promptly.
2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.

D. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning

materials that are not hazardous to health or property and that will not damage exposed surfaces.

E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.

F. Exposed Surfaces in Finished Areas: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.

G. Waste Disposal: Do not bury or burn waste materials on-site. Do not wash waste materials down sewers or into waterways. Comply with waste disposal requirements in **Section 015000 "Temporary Facilities and Controls"**

H. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.

I. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.

J. Limiting Exposures: Supervise construction operations to assure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

3.8 STARTING AND ADJUSTING

A. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.

B. Adjust equipment for proper operation. Adjust operating components for proper operation without binding.

C. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Manufacturer's Field Service: Comply with qualification requirements in Section 014000 "Quality Requirements."

3.9 PROTECTION OF INSTALLED CONSTRUCTION

A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.

B. Comply with manufacturer's written instructions for temperature and relative humidity.

END OF SECTION 017300

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SECTION 017400 – WARRANTIES AND BONDS

PART 1 - GENERAL

1.1 SUMMARY

A. This section specifies general administrative and procedural requirements for warranties and bonds required by the Contract Documents, including manufacturers standard warranties on products and special warranties.

1. Refer to the Form of Agreement between the Owner and Contractor for terms of the Contractor's special warranty of workmanship and materials.

2. Specific requirements for warranties for the work and products and installations that are specified to be warranted, are included in the individual sections of Divisions 2 through 32.

3. Certifications and other commitments and agreements for continuing services to Owner are specified elsewhere in the Contract Documents.

B. Disclaimers and Limitations: Manufacturer's disclaimers and limitations on product warranties do not relieve the Contractor of the warranty on the work that incorporates the products, nor does it relieve suppliers, manufacturers, and subcontractors required to countersign special warranties with the Contractor.

1.2 WARRANTY REQUIREMENTS

A. Related Damages and Losses: When correcting warranted work that has failed, remove and replace other work that has been damaged as a result of such failure or that must be removed and replaced to provide access for correction of warranted work.

B. Reinstatement of Warranty: When work covered by a warranty has failed and been corrected by replacement or rebuilding, reinstate the warranty by written endorsement. The reinstated warranty shall be equal to the original warranty with an equitable adjustment for depreciation.

C. Replacement Cost: Upon determination that work covered by a warranty has failed, replace or rebuild the work to an acceptable condition complying with requirements of Contract Documents. The Contractor is responsible for the cost of replacing or rebuilding defective work regardless of whether the Owner has benefited from use of the work through a portion of its anticipated useful service life.

D. Owner's Recourse: Written warranties made to the Owner are in addition to implied warranties, and shall not limit the duties, obligations, rights and remedies otherwise available under the law, nor shall warranty periods be interpreted as limitations on time in which the Owner can enforce such other duties, obligations, rights, or remedies.

1. Rejection of Warranties: The Owner reserves the right to reject warranties and to limit selections to products with warranties not in conflict with requirements of the Contract Documents.

E. The Owner reserves the right to refuse to accept work for the project where a special warranty, certification, or similar commitment is required on such work or part of the work, until evidence is presented that entities required to countersign such commitments are willing to do so.

1.3 SUBMITTALS

A. Submit written warranties to the Architect-Engineer prior to the date certified for substantial completion. If the Certificate of Substantial Completion designates a commencement date for warranties other than the date of substantial completion for the work, or a designated portion of the work, submit written warranties upon request of the Architect-Engineer.

1. When a designated portion of the work is completed and occupied or used by the Owner, by separate agreement with the Contractor during the construction period, submit properly executed warranties to the Architect-Engineer within 15 days of completion of that designated portion of the work.

B. When a special warranty is required to be executed by the Contractor, or the Contractor and a subcontractor, supplier or manufacturer, prepare a written document that contains appropriate terms and identification, ready for execution by the required parties. Submit a draft to the Owner through the Architect-Engineer for approval prior to final execution.

1. Refer to individual sections of Divisions 2 through 32 for specific content requirements, and particular requirements for submittal of special warranties.

C. Form of Submittal: At final completion compile two copies of each required warranty and bond properly executed by the Contractor, subcontractor, supplier, or manufacturer. Organize the warranty documents into an orderly sequence based on the table of contents of the Project Manual.

D. Bind warranties and bonds in heavy-duty, commercial quality, durable 3-ring vinyl covered loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2-inch by 11-inch paper.

1. Provide heavy paper dividers with celluloid covered tabs for each separate warranty. Mark the tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product, and the name, address and telephone number of the installer.

2. Identify each binder on the front and the spine with the typed or printed title "WARRANTIES AND BONDS", the project title or name, and the name of the Contractor.

3. When operating and maintenance manuals are required for warranted construction, provide additional copies of each required warranty, as necessary, for inclusion in each required manual.

PART 2 - PRODUCTS

NOT USED.

PART 3 - EXECUTION

NOT USED.

END OF SECTION 017400

SECTION 017700 –CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. This section specifies administrative and procedural requirements for project closeout, including but not limited to:

1. Inspection procedures.

2. Project record document submittal.

3. Operating and maintenance manual submittal.

4. Submittal of warranties.

5. Final cleaning.

B. Closeout requirements for specific construction activities are included in the appropriate sections in Divisions 2 through 32.

1.2 SUBSTANTIAL COMPLETION

A. Preliminary Procedures: Before requesting inspection for certification of substantial completion, complete the following. List exceptions in the request.

1. In the Application for Payment that coincides with, or first follows, the date substantial completion is claimed, show 100 percent completion for the portion of the work claimed as substantially complete. Include supporting documentation for completion as indicated in these Contract Documents and a statement showing an accounting of changes to the Contract Sum.

a. If 100 percent completion cannot be shown, include a list of incomplete items, the value of incomplete construction, and reasons the work is not complete.

2. Advise the Owner of pending insurance changeover requirements.

3. Submit specific warranties, workmanship bonds, maintenance agreements, final certifications and similar documents.

4. Obtain and submit releases enabling the Owner unrestricted use of the work and access to services and utilities; include occupancy permits, operating certificates and similar releases.

5. Deliver tools, spare parts, extra stock, and similar items.

6. Make final change-over of permanent locks and transmit keys to the Owner. Advise the Owner's personnel of change-over in security provisions.

7. Complete start-up testing of systems, and instruction of the Owner's operating and maintenance personnel. Discontinue or change over and remove temporary facilities from the site, along with construction tools, mock-ups, and similar elements.

8. Complete final clean up requirements, including touch-up painting. Touch-up and otherwise repair and restore marred exposed finishes.

B. Inspection Procedures: Upon receipt of a request for inspection, the Architect-Engineer will either proceed with inspection or advise the Construction Manager of unfilled requirements. The Architect-Engineer will prepare the Certificate of Substantial Completion following inspection, or advise the Construction Manager of construction that must be completed or corrected before the certificate will be issued.

1. The Architect-Engineer will repeat inspection when requested and assured that the work has been substantially completed.

2. Results of the completed inspection will form the basis of requirements for final acceptance.

1.3 FINAL ACCEPTANCE

A. Preliminary Procedures: Before requesting final inspection for certification of final acceptance and final payment, complete the following. List exceptions in the request.

1. Submit the final payment request with releases and supporting documentation not previously submitted and accepted. Include certificates of insurance for products and completed operations where required.

2. Submit an updated final statement, accounting for final additional changes to the Contract Sum.

3. Submit a certified copy of the Architect-Engineer's final inspection list of items to be completed or corrected, stating that each item has been completed or otherwise resolved for acceptance, and the list has been endorsed and dated by the Architect-Engineer.

4. Submit final meter readings for utilities, a measured record of stored fuel, and similar data as of the date of Substantial Completion, or when the Owner took possession of and responsibility for corresponding elements of the work.

5. Submit consent of surety to final payment.

6. Submit a final liquidated damages settlement statement.

7. Submit evidence of final, continuing insurance coverage complying with insurance requirements.

8. Submit record as-built drawings, final project photographs, property survey and similar final record information.

B. Reinspection Procedure: The Architect-Engineer will reinspect the work upon receipt of notice that the work, including inspection list items from earlier inspections, has been completed, except items whose completion has been delayed because of circumstances acceptable to the Architect-Engineer.

1. Upon completion of reinspection, the Architect-Engineer will prepare a Certificate of Final Acceptance, or advise the Construction Manager of work that is incomplete or of obligations that have not been fulfilled but are required for final acceptance.

2. If necessary, reinspection will be repeated. The Construction Manager shall pay for any and all costs of the Architect-Engineer's additional reinspections.

1.4 RECORD DOCUMENT SUBMITTALS

A. General: As work progresses, prepare and maintain record documents as specified herein. Do not use record documents for construction purposes; protect from deterioration and loss in a secure, fire-resistive location; provide access to record documents for the Architect-Engineer's reference during normal working hours. Upon completion of the project, certify that record documents are complete and turn over record documents to Architect-Engineer.

B. Record Drawings: Maintain a clean, undamaged set of blue or black line white-prints of Contract drawings, including amendment and change order drawings, and shop drawings. Mark the set to show the actual installation where the installation varies substantially from the work as originally shown. Mark whichever drawing is most capable of showing conditions fully and accurately; where Shop Drawings are used, record a cross-reference at the corresponding location on the Contract drawings. Give particular attention to concealed elements that would be difficult to measure and record at a later date.

1. Mark record sets with red erasable pencil; use other colors to distinguish between variations in separate categories of the work.

2. Mark new information that is recognized to be important to the Owner, but was not shown on Contract drawings or shop drawings.

3. Note related change order numbers where applicable.

4. Organize record drawing sheets into manageable sets, bind with durable paper cover sheets, and print suitable titles, dates and other identification on the cover of each set.

5. Preparation of Transparencies: In preparation for certification of substantial completion on last major portion of the work, review completed mark-up of record drawings with Architect-Engineer. Incorporate changes and additional information previously marked up on print sets by erasing and redrawing where applicable, and by adding details and notations where applicable; refer instances of uncertainty to the Architect-Engineer for determination. Identify and date each updated drawing.

6. Copies, Distribution: At the completion of the work the Construction Manager shall forward one (1) copy of marked-up drawings to the Architect-Engineer. Organize drawings into a set matching print sets, place set in a durable tube-type drawing container (with end caps), and mark end cap with suitable identification.

C. Record Specifications: Maintain one (1) complete copy of the project manual, including addenda, and one (1) copy of other written construction documents such as change orders and modifications issued in printed form during construction. Mark these documents to show substantial variations in actual work performed in comparison with the text of the specifications and modifications. Give particular attention to substitutions, selection of options and similar information on elements that are concealed or cannot otherwise be readily discerned later by direct observation. Note related record drawing information and product data.

1. Upon completion of the work, submit record specifications to the Architect-Engineer.

D. Record Sample Submitted: Immediately prior to the date or dates of Substantial Completion, the Contractor will meet at the site with the Architect-Engineer to determine which of the submitted samples that have been maintained during progress of the work are to be transmitted to the Owner. Comply with Architect-Engineer's instructions for packaging, identification marking and delivery.

E. Record Shop Drawing, Product Data, Certifications and Laboratory Test Reports: Maintain one copy of each approved shop drawing and product data submittal, product certification and laboratory test report and mark up significant variations in actual work in comparison with submitted information. Include both variations in product as delivered to site and variations from manufacturer's instructions and recommendations for installation. Give particular attention to concealed products and portions of the work which cannot otherwise be readily discerned at a later date by direct observation. Note related change orders and mark up of record drawings and specifications.

F. Survey of Outside Utility Lines: Upon completion of the structural and service relocation furnish to the Architect-Engineer an acceptable and accurately dimensioned survey showing location and elevation of all utility lines (water, gas, electric, sewer, steam, etc.) including valves, connections and changes in direction, as installed under the Contract, within construction limits. Points where utility lines emerge from the vaults shall be located on wall elevations. Points where utility lines leave the property shall be located from lot monuments. Finished drawings shall be the same size as the Contract drawings.

G. Progress and Final Photographs: For each structure under contract, provide the following:

1. Three copies each of 4 separate views each month of progress photographs, in color, in sharp focus approximately 8 inches by 10 inches mounted on 9-inch by 12-inch hardboard. Take on the first working day of each month (whether or not any work was done during the proceeding month). Take from points selected by the Architect-Engineer and deliver 3 sets plus the negatives to the Architect-Engineer. Label each photograph with description (of what and from where taken), name and location of building,Construction Manager's name, type of photograph (progress, special, final) and date taken.

H. Miscellaneous Record Submittals: Refer to other specification sections for requirements of miscellaneous record-keeping and submittals in connection with actual performance of the work. Immediately prior to the date or dates of substantial completion, complete miscellaneous records and place in good order, properly identified and bound or filed, ready for continued use and reference. Submit to the Architect-Engineer prior to final acceptance.

I. Maintenance Manuals: Organize operating and maintenance data into suitable sets of manageable size. Bind properly indexed data in individual heavy-duty 2-inch, 3-ring vinyl-covered binders, with pocket folders for folded sheet information. Mark appropriate identification on front and spine of each binder. Provide the Architect-Engineer with 2 copies of each manual prior to the time that system or equipment tests are performed, and 3 additional copies 90 days before start of operation by the Owner or any instruction period specified. Include the following types of information:

1. Emergency instructions.

2. Spare parts list.

3. Copies of warranties.

4. Wiring diagrams.

5. Recommended "turn around" cycles.

6. Inspection procedures.

7. Shop drawings and product data.

8. Fixture lamping schedule.

PART 2 - PRODUCTS

NOT USED.

PART 3 - EXECUTION

3.1 CLOSEOUT PROCEDURES

A. Operating and Maintenance Instructions: Arrange for each installer of equipment that requires regular maintenance to meet with the Owner's personnel to provide instruction in proper operation and maintenance. If installers are not experienced in procedures, provide instruction by manufacturer's representatives. Include a detailed review of the following items:

1. Maintenance manuals.

2. Record documents.

3. Spare parts and materials.

4. Tools.

5. Lubricants.

6. Fuels.

7. Identification systems.

8. Control sequences.

9. Hazards.

10. Cleaning.

11. Warranties and bonds.

12. Maintenance agreements and similar continuing commitments.

B. As part of instruction for operating equipment, demonstrate the following procedures:

1. Start-up.

2. Shutdown.

3. Emergency operations.

4. Noise and vibration adjustments.

5. Safety procedures.

6. Economy and efficiency adjustments.

7. Effective energy utilization.

C. Upon completion, obtain written acknowledgment from the Architect-Engineer that the required instruction was completed.

3.2 FINAL CLEANING

A. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to the condition expected in a normal, commercial building cleaning and maintenance program. Comply with manufacturer's instructions.

1. Complete the following cleaning operations before requesting inspection for certification of substantial completion.

a. Remove labels that are not permanent labels.

b. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compound and other substances that are noticeable vision-obscuring materials. Replace chipped or broken glass and other damaged transparent materials.

c. Clean exposed exterior and interior hard-surfaced finishes to a dust-free condition, free of stains, films and similar foreign substances. Restore reflective surfaces to their original reflective condition. Leave concrete floors broom clean. Vacuum carpeted surfaces.

d. Wipe surfaces of mechanical and electrical equipment. Remove excess lubrication and other substances. Clean plumbing fixtures to a sanitary condition. Clean light fixtures and lamps.

e. Clean the site, including landscape development areas, of rubbish, litter and other foreign substances. Sweep paved areas broom clean; remove stains, spills and other foreign deposits. Rake grounds that are neither paved nor planted, to a smooth even-textured surface.

f. Remove debris and surface dust from limited-access spaces including roofs, plenums, shafts, trenches, equipment vaults, manholes and similar spaces.

g. Pressure clean and, if necessary, scrape all exterior concrete sidewalk and plaza areas. Final appearance shall be uniform without blemish as acceptable to the Architect-Engineer.

B. Pest Control: Engage an experienced exterminator to make a final inspection, and rid the project of rodents, insects and other pests.

C. Removal of Protection: Remove temporary protection and facilities installed for protection of the work during construction.

D. Compliance: Comply with regulations of authorities having jurisdiction and safety standards for cleaning. Do not burn waste materials. Do not bury debris or excess materials on the Owner's property. Do not discharge volatile, harmful or dangerous materials into drainage systems. Remove waste materials from the site and dispose of in a lawful manner.

1. Where extra materials of value remaining after completion of associated work have become the Owner's property, arrange for disposition of these materials as directed.

END OF SECTION 017700

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ITEM G-100 MOBILIZATION & GENERAL CONDITIONS

DESCRIPTION

100-1.1 This item shall consist of work and operations, but is not limited to, work and operations necessary for the movement of personnel, equipment, material and supplies to and from the project site for work on the project except as provided in the contract as separate pay items. The work specified in this item shall also include the preparatory work and operations in mobilizing for beginning work on the project, including, but not limited to, those operations necessary for the establishment of temporary offices, buildings, guard houses, utilities, safety equipment and first aid supplies, sanitary facilities and any other work not included in other contract pay items. The cost of bonds and any required insurance and any other preconstruction expenses necessary for the start of the work, excluding the cost of construction materials, shall also be included in this section.
100-1.2 Posted notices. Prior to commencement of construction activities, the Contractor must post the following documents in a prominent and accessible place where they may be easily viewed by all employees of the prime Contractor and by all employees of subcontractors engaged by the prime Contractor: Equal Employment Opportunity (EEO) Poster “Equal Employment Opportunity is the Law” in accordance with the Office of Federal Contract Compliance Programs Executive Order 11246, as amended; Davis Bacon Wage Poster (WH 1321) - DOL “Notice to All Employees” Poster; and Applicable Davis-Bacon Wage Rate Determination. These notices must remain posted until final acceptance of the work by the Owner.

METHOD OF MEASUREMENT

100-2.1 No separate measurement for Mobilization and General Conditions shall be made.

BASIS OF PAYMENT

100-3.1 The work and incidental costs covered under this item will be paid for at the Contract lump sum price. The Engineer shall make the final determination of the allowable percentage of completion for the payment of mobilization and shall approve the percentage paid based on the percent of contract amount actually earned which will be based upon actual work completed.

Partial payments will be allowed as follows:
a. With first pay request, 25%.
b. When 25% or more of the original contract is earned, an additional 25%.
c. When 50% or more of the original contract is earned, an additional 40%.
d. After Final Inspection, Staging area clean-up and delivery of all Project Closeout materials as required by Section 90-11 of the General Provisions, the final 10%.

* The Percent of Contract Amount Earned equals the work completed to date (including the total of all previous mobilization) plus or minus work completed associated with executed change orders, if any, divided by the Total Original Contract Amount plus or minus the Total Executed Change Order Amounts, if any.

** In the event the lump sum bid for mobilization exceeds 7.5 percent of the original contract amount for the project, the amount in excess of 7.5% will not be paid until the project is complete and the Engineer and Owner have issued a statement of final acceptance as of the date when the Contractor has furnished all of the required reports, certifications and other documentation. The date of final acceptance by the Engineer and Owner will govern, in accordance with statutes and regulations, for payment of retainage or other monies due to the Contractor.

Payment shall be made under:

Item G-100-3.1 Mobilization and General Conditions -- Per Lump Sum.

TESTING REQUIREMENTS
100-4.1 None.

END OF ITEM G-100

ITEM G-102 SAFETY AND SECURITY

DESCRIPTION

102-1.1 General. This work shall consist of complying with the provisions of the construction safety and phasing plan and as contained in this specification and other contract documents. A complete understanding of all safety and security procedures and requirements contained in the contract documents is required to ensure safety during construction.

Required reference material associated with this safety plan includes the current versions of the following documents:

FAA AC 150/5200-18, Airport Safety Self-Inspection
FAA AC 150/5210-5, Painting, Marking and Lighting of Vehicles Used on an Airport
FAA AC 150/5340-1, Standards for Airport Markings
FAA AC 150/5370-2, Operational Safety on Airports During Construction
FAA AC 150/5370-13, Offpeak Construction of Airports Using Hot-Mix Asphalt

Copies of these documents are available for download at www.faa.gov

CONTRACTOR SAFETY AND SECURITY OFFICER

102-2.1 CONTRACTOR SAFETY AND SECURITY OFFICER (CSSO). The Contractor shall appoint its on-site Construction Superintendent or other qualified individual(s) as its duly authorized representative to serve as Contractor Safety and Security Officer (CSSO) for the duration of the Contract. The CSSO shall thoroughly understand the safety and security requirements of the Contract, the necessity for them and shall have sufficient authority to implement its provisions without significant deviation. The Contractor shall notify the Engineer in writing of the name of the individual(s) selected for the assignment.

The CSSO shall represent the Contractor on safety and security requirements compliance. The CSSO shall be especially knowledgeable regarding the requirements of FAA AC's 150/5200-18, Airport Self Inspection Guide and 150/5370-2 Operational Safety on Airports During Construction, current editions.

102-2.2 RESPONSIBILITIES OF THE CONTRACTOR SAFETY AND SECURITY OFFICER. Prior to the desired date for commencement of any work on the project, the CSSO shall accomplish the following:

a. Develop and submit in writing a detailed work sequence schedule with dates and times specified for all milestone events. This sequence schedule shall conform, as a minimum, to the events specified in Section 3.1, Construction Sequence, and shall be subject to the approval of the Engineer. To assure adequate time for coordination, this document shall be submitted at least one week prior to the date of the Preconstruction Conference.

b. Develop and submit in writing a detailed outline of the procedures to be followed to maintain safety and security of both Contractor operations and the integrity of airport landside and airside operations during the prosecution of contract work. This plan shall detail, in addition, the procedures to be followed in the event of an accident or fire involving Contractor personnel and the Contractor's efforts to maintain fire protection and security. These procedures shall be subject to the approval of the Engineer and reflect any change as may be deemed necessary.

c. Conduct at least one meeting of all Contractor supervisory personnel prior to the start of contract work. The purpose of this meeting is to review the approved Work sequence schedule and safety and security procedures. Attendance at this meeting by the CSSO, all Contractor supervisory personnel and the Engineer is mandatory. This meeting shall also be open to other employees of the Contractor and others as the Engineer may deem appropriate. Minutes of this meeting shall be taken by the CSSO, copies provided to each supervisor and kept on file in the Contractor's construction office for periodic review and updating.

d. Develop a safety and security orientation program and provide a briefing for all employees of the Contractor and subcontractors that will be used on the project. A similar briefing will be given to new employees prior to their use on contract work. In addition, the CSSO shall be responsible for briefing, from time to time, all Contractor personnel on any changes to safety and security measures deemed necessary.

CONSTRUCTION SEQUENCING

102-3.1 CONSTRUCTION SEQUENCE. The Contractor shall prepare a construction schedule and submit to the Engineer at least one week prior to the pre-construction conference.

102-3.2 CLOSING RUNWAYS. The Contractor shall acquaint his supervisors and employees with the sequence of construction and its relationship to airport activity and aircraft operations that are inherent to this airport. No runway, taxiway, apron or airport roadway shall be closed without the written approval of the Owner, to enable necessary NOTAMS and/or advisories to airport fixed based operators (FBOs), tenants and users.

The Contractor shall contact the Engineer a minimum of ten (10) days prior to any requested closing.

Any construction activity within [250] feet of the centerline of an active runway or within [93] feet of the centerline of an active taxiway or apron requires closure of the impacted area. These safety areas are shown on the phasing plan.

The Engineer will arrange for an inspection, prior to return to service, of any facility that has been closed for work, on or adjacent thereto, or that has been used for a crossing point or haul route by the Contractor.

MARKING AND LIGHTING

102-4.1 Proper marking and lighting of areas on the airfield associated with the construction shall be the responsibility of the Contractor. This will include properly marking and lighting closed runways, taxiways, taxilanes, and aprons, the limits of construction, material storage areas, equipment storage areas, haul routes, parking areas and other areas defined as required for the Contractor's exclusive use. The Contractor shall erect and maintain around the perimeter of these areas suitable marking and warning devices visible for day and night use. Temporary barricades, flagging, and flashing warning lights shall be required at critical access points. The type and location of marking and warning devices will be as shown on the plans or approved by the Engineer.

Special emphasis shall be given to open trenches, excavations, heavy equipment marshalling areas, and stockpiled material located in the airport operations area, which shall be predominantly marked by the Contractor with flags and lighted by approved light units during hours of restricted visibility and darkness. All marking shall be in accordance with FAA Advisory Circular (AC) 150/5340-1, current edition.

TRAFFIC CONTROL

102-5.1 VEHICLE IDENTIFICATION. The Contractor shall establish and maintain a list of Contractor and subcontractor vehicles authorized to operate on the site. Contractor employee vehicles shall be restricted to the Contractor’s staging area and are not allowed in the Airport Operations Area (AOA) at any time. To be authorized to operate on the airport, each Contractor or subcontractor’s vehicle shall:

a. be marked/flagged for high daytime visibility and lighted for nighttime operations. Vehicles that are not marked and/or lighted shall be escorted by a vehicle appropriately marked and/or lighted. Vehicles requiring escort shall be identified on the list.

b. be identified with the name and/or logo of the Contractor and be of sufficient size to be identified at a distance. Vehicles needing intermittent identification could be marked with tape or with commercially available magnetically attached markers. Vehicles that are not appropriately identified shall be escorted by a vehicle that conforms to this requirement. Vehicles requiring escort shall be identified on the list.

c. be operated in a manner that does not compromise the safety of either landside or airside airport operations. If, in the opinion of the Engineer, any vehicle is operated in a manner not fully consistent with this requirement, the Engineer has the right to restrict operation of the vehicle or prohibit its use on the airport.

102-5.2 ACCESS TO THE SITE OF CONSTRUCTION. The Contractor's access to the site shall be as shown in the plans. No other access points shall be allowed unless approved by the Engineer. All Contractor traffic authorized to enter the site shall be experienced in the route or guided by Contractor personnel. The Contractor shall be responsible for traffic control to and from the various construction areas on the site, and for the operation and security of the access gate to the site. A Contractor's flagman or traffic control person shall monitor and coordinate all Contractor traffic at the access gate with Airport Security. The Contractor shall not permit any unauthorized construction personnel or traffic on the site. Access gates to the site shall be locked and secured at all times when not attended by the Contractor. If the Contractor chooses to leave any access gate open, it shall be attended by Contractor personnel who are familiar with the requirements of the Airport Security Program. The Contractor is responsible for the immediate cleanup of any debris deposited along the access route as a result of his construction traffic. Directional signing from the access gate along the delivery route to the storage area, plant site or work site shall be as directed by the Engineer. In addition, the following requirements are applicable:

a. All Contractor traffic authorized to travel on the airport shall have been briefed as part of the Contractor's construction safety and security orientation program, be thoroughly familiar with the access procedures and route for travel or be escorted by personnel authorized by the Contractor Safety and Security Officer (CSSO).

b. The Contractor shall install work site identification signs at the authorized access point(s). If, in the opinion of the Engineer, directional signs are needed for clarity, they shall be installed along the route authorized for access to each construction site.

c. Under no circumstance will Contractor personnel be permitted to drive their individually owned vehicles to any construction site on the airport. All vehicles must be parked in the area designated for employee parking and out of secured airport property.

d. In addition to the inspection and cleanup required at the end of each shift, the Contractor is responsible for the immediate cleanup of any debris generated along the construction site access route(s) as a result of construction related traffic or operations whether or not created by Contractor personnel.

102-5.3 MATERIAL SUPPLIERS. All material suppliers, subcontractors and visitors to the work site are obligated to follow the same safety and security operating procedures as the Contractor. All material suppliers shall make their deliveries using the same access points and routes as the Contractor and shall be advised of the appropriate delivery procedures at the time the materials order is placed. The Contractor shall not use the Airport address for any delivery but shall use the street address appropriate to the location of the entrance to the work site. If it is not practical to conform to the vehicle identification requirements of Section 102-5.1 and the safety and security operations program requirements of Section 102-2.2, the Contractor shall be prepared to escort all suppliers, subcontractors and visitors while they are on the airport.

102-5.4 PERSONNEL IDENTIFICATION. All employees, agents, vendors, invitees, etc. of the Contractor or subcontractors requiring access to the construction site shall, conform to the Security Program.

GENERAL SAFETY REQUIREMENTS

102-6.1 All Contractor vehicles that are authorized to operate on the airport outside of the designated construction area limits or haul routes as defined herein shall display in full view above the vehicle a flashing amber (yellow) dome-type light or a three-foot by three-foot, or larger, orange and white checkerboard flag, each checkerboard color being one-foot square. Vehicles must be under control of a Contractor mobile (two-way) radio operator (flagmen) monitoring the Airport frequency. Vehicle operators must be vigilant for conflict with any aircraft and give way to any operating aircraft.

All Contractor vehicles that are required to operate outside of the construction area limits as defined herein and cross active runways, taxiways, aprons, or runway approach clear zones shall do so under the direct control of a flagman who is monitoring the Airport frequency. Flagmen and two-way radios shall be furnished by the Contractor. Flagmen shall be instructed in the use of two-way radios prior to use. All aircraft traffic on runways, taxiways and aprons shall have priority over Contractor's traffic.

Construction vehicles not in use for extended periods during the work day, or during nights and weekends (nonwork periods) shall be parked away from active runways, taxiways, and aprons in designated vehicle marshalling areas.

102-6.2 In order to protect all aircraft traffic, aviation related businesses, terminal apron areas, etc. from potential damage caused by foreign object debris (FOD) generated by construction activities, the Contractor shall provide a vacuum truck as required at the startup of construction to daily vacuum all pavements affected by construction. The vacuum truck shall remain on-site for the duration of the project and shall be available at the discretion of the Owner to vacuum pavement areas adjacent to the construction areas to ensure no FOD is present on pavements within 500 feet of any construction area. Protecting the aircraft, airport tenants, users, public, etc. against FOD is a critical safety issue therefore the cost of the vacuum truck will be included in the cost established for this specification item.

CONSTRUCTION CONTROL

102-7.1 A primary and alternate responsible Contractor's representative shall be designated by the Contractor. The Contractor's representatives shall be available locally on a 24-hour basis. Names of the primary and alternate, including phone number, shall be made available to the Engineer by the Contractor. The Contractor shall insure that the names and phone numbers are kept current and made available to the Engineer.

CONSTRUCTION TECHNIQUES

102-8.1 Construction shall be planned and conducted throughout this project in such a manner as to maintain safe airport operations. Every effort shall be made to reduce the impact of construction activity on overall airport operations. To this end, the Contractor's activities shall be conducted in such a manner so as to preclude, except where absolutely required, open excavations, trenches, ditches and above ground obstacles such as booms on cranes. The primary responsibility for assuring that safe construction techniques are followed rests with the Contractor Safety and Security Officer (CSSO).

METHOD OF MEASUREMENT

102-9.1 No separate measurement for Safety and Security shall be made.

BASIS OF PAYMENT

102-10.1 Payment for safety and security measures for personnel, labor, equipment, materials and incidentals related to this specification item and required to satisfy the specified objectives will be paid at the contract lump sum price. In the event the contract completion date is extended, no additional payment will be made for Safety and Security.

No payment will be made under safety and security for each calendar day during which there are substantial deficiencies in compliance with the Specification requirements of any subsection of this Section as determined by the Engineer.

The amount of such calendar day non-payment will be determined by dividing the lump sum amount bid for safety and security by the number of calendar days between the date the Contractor commences work and the date of completion as designated in this proposal, without regard to any extension of time. If the Contractor fails to maintain and protect traffic adequately and safely for a period of 24 hours, the Owner shall correct the adverse conditions by any means it deems appropriate and shall deduct the cost of the corrective work from any monies due the Contractor. The cost of this work shall be in addition to any liquidated damages and non-payment for safety and security listed above.

However, where major non-conformance with the requirements of this Specification is noted by the Engineer and prompt Contractor compliance is deemed not to be obtainable, all contract work may be stopped by direct order of the Engineer regardless of whether corrections are made by the Owner as stated above.

Partial payments will be made in accordance with the following schedule:

Percentage of Original Contract Amount Earned	Percent of the Lump Sum Price for the Item
5	15
15	20
25	25
50	50
75	75
100 (or Contract Completion)	100

Payment shall be made under:

Item G-102-10.1 Safety and Security - Per Lump Sum.

TESTING REQUIREMENTS

102-11.1 None.

END OF ITEM G-102

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ITEM G-104 PROJECT SURVEY AND STAKEOUT

DESCRIPTION

104-1.1 Under this item, the Contractor shall perform all necessary surveying required to construct all elements of the work as shown in the contract documents. This shall include, but not be limited to, stakeout, layout and elevations for grading, base courses, pavements, structures, forms and other appurtenances and items as shown and required to construct the project. Methods shall be consistent with current practices and shall be performed by qualified personnel acceptable to the Engineer. All survey work shall be provided under the direction of a licensed land surveyor.

MATERIALS

104-2.1 All instruments, equipment, stakes and any other material necessary to perform the work shall be provided by the Contractor.

All stakes used shall be of a type approved by the Engineer. It shall be the Contractor's responsibility to maintain these stakes in their proper position and location at all times.

CONSTRUCTION METHODS

104-3.1 GENERAL. The Contractor shall trim trees, brush and other interfering objects from survey lines in advance of all survey work to permit accurate and unimpeded work by his stakeout survey crews.

The exact position of all work shall be established from control points, baseline transit points or other points of similar nature that are shown on the Contract Drawings or approved by the Engineer. Before any layout work is accomplished, the Contractor shall first verify that the control point data shown on the plans is accurate. Any error, apparent discrepancy or absence of data shown or required for accurately accomplishing the stakeout survey shall be immediately referred to the Engineer for interpretation or resolution before the control point(s) in question are used for construction layout.

The Contractor shall place layout stakes as detailed in Section 50-06 of the General Provisions and at such intermediate locations as the Engineer may direct. From computations and measurements made by the Contractor, these stakes shall be clearly and legibly marked with the correct station number, offset and cut or fill so as to permit the establishment of the exact centerline location and elevation during construction. If markings become faded or blurred for any reason, the markings shall be restored by the Contractor at the request of the Engineer. All control points shall be properly guarded and flagged for easy identification.

Drainage structures shall be staked out by the Contractor at the locations and elevations shown on the Contract Drawings or specified by the Engineer.

Reference points, baselines, stakes and benchmarks for borrow pits shall be established by the Contractor.
Permanent survey marker locations shall be established and referenced by the Contractor.

The Contractor shall be responsible for the accuracy of his work and shall maintain all reference points, stakes, etc., throughout the life of the work. Damaged or destroyed points, benchmarks or stakes, or any reference points made inaccessible by the progress of the construction, shall be replaced or transferred by the Contractor. Any of the above points which may be destroyed or damaged shall be transferred by the Contractor before they are damaged or destroyed. All control points shall be referenced by ties to acceptable objects and recorded. Any alterations or revisions in the ties shall be so noted and the information furnished to the Engineer immediately. All stakeout survey work shall be referenced to the centerlines shown on the Contract Drawings. All computations necessary to establish the exact position of the work from control points shall be made and preserved by the Contractor. All computations, survey

notes and other records necessary to accomplish the work, shall be neatly made. Such computations, survey notes and other records shall be made available to the Engineer upon request and shall become the property of the Owner and delivered to the Engineer in a timely manner.

The Contractor shall furnish, at his expense, all horizontal and vertical control and all staking and layout of construction work called for on the plans The Engineer and Owner shall not be responsible for such work. However, the Owner and Engineer reserve the right to check all said lines, grades, and measurements with their appointed surveyor. Should the Owner's surveyor detect errors in said lines, grades, and measurements, the Contractor shall pay for all said surveying costs and subsequent surveying costs performed to correct and verify correction of errors found in said lines, grades and measurements. Definition of an error shall be a discrepancy of 1/4" or more. In the case of a discrepancy between the technical specifications and this defined tolerance, this tolerance shall govern.

Prior to the final cross-section survey of the work by the Contractor, the Contractor shall reestablish centerline or baseline points and stationing as required by the Engineer.

Any existing stakes, iron pins, survey monuments or other markers defining property lines which may be disturbed during construction shall be properly tied into fixed reference points before being disturbed and accurately reset in their proper position upon completion of the work.

Just prior to completion of the work, the Contractor shall reestablish, if necessary, and retie all control points as permanently as possible and to the satisfaction of the Engineer.

104-3.2 CROSS SECTIONAL DATA FOR PAYMENT. The Contractor shall be required to submit cross sectional or Digital Terrain Model (DTM) data to the Engineer at monthly intervals prior to the Contractor submittal of the monthly application for payment so that the Engineer can verify the quantities of earthwork and other pay item volumes for payment. All cross sectional data provided will be in AutoCAD Civil 3D 2014 or higher format only. No other formats will be accepted. If the data is submitted in another format other than AutoCAD, no earthwork or other materials volumes will be calculated and approved for payment.

104-3.3 AUTOMATED MACHINE GUIDANCE. If the Contractor elects to use Global Positioning System (GPS) machine control grading, a work plan including, but not limited to, proposed equipment, control software, types of work to be completed and methods shall be submitted to the Engineer for approval. The use of this technology is referenced as Automated Machine Guidance (AMG). All equipment using AMG shall be able to generate end results that meet the requirements of the specifications. The Contractor shall be responsible for developing a Digital Terrain Model (DTM) of the design surfaces for use with the AMG equipment. The DTM shall be submitted to the Engineer for review and approval prior to beginning work. Perform test sections for each type of work to be completed with AMG to demonstrate that the system has the capability to achieve acceptable results. If acceptable results cannot be achieved, conform to the requirements for conventional stakeout. The Contractor shall be responsible for all errors resulting from the use of AMG and shall correct deficiencies to the satisfaction of the Engineer at no cost to the Owner.

104-3.4 PRE-CONSTRUCTION SURVEYS. The Contractor shall be required to survey and confirm existing field conditions prior to beginning construction in each work area. Confirmation of existing conditions shall include, but is not limited to, drainage structure locations, elevations and inverts, pipe inverts, existing ground elevations, existing pavement elevations where the proposed work will tie into, existing utility locations and elevations, and any other existing features and conditions that may impact the proposed construction. The contractor shall notify the Engineer of any discrepancies that are found in the existing conditions compared to the information contained in the plans prior to beginning work in each work area.

METHOD OF MEASUREMENT

104-4.1 Survey and Stakeout shall be measured for payment on a lump sum basis.

BASIS OF PAYMENT

104-5.1 Payment for Survey and Stakeout shall be made at the contract lump sum price. This price shall include the cost of furnishing all labor, equipment, instruments and all other material necessary to satisfactorily complete this item. Partial payments will be made at the discretion of the Engineer as the work progresses based generally on the percentage of actual work completed compared to the total construction cost.

Payment will be made under:

Item G-104-5.1 Project Survey and Stakeout - Per Lump Sum.

TESTING REQUIREMENTS

104-6.1 None.

END OF ITEM G-104

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ITEM G-105 TEMPORARY CONSTRUCTION ITEMS

DESCRIPTION

105-1.1 This item consists of furnishing all labor, materials and equipment for temporary construction items necessary for the safe and proper execution of work not otherwise included in other contract bid items. The Contractor will be expected to supply and utilize the temporary construction items listed below and other items contained in the plans and specifications. Temporary construction items to be provided may include, but are not limited to, the following: construction flag persons, portable floodlighting, steel plates for temporary covering of excavations and structures, construction barricades, test pits, vacuum trucks and sweepers, portable bathroom facilities, waste disposal containers and runway/taxiway closure markers.

MATERIALS

105-2.1 CONSTRUCTION BARRICADES. Construction barricades shall be constructed in accordance with the details shown in the plans and shall be placed in accordance with the phasing plans and as directed by the Engineer.

105-2.2 PORTABLE FLOODLIGHTING. Portable floodlighting shall be provided, as required, for construction that must occur during nighttime operations. The Contractor shall provide sufficient units so that all work areas are illuminated to a level of 5 horizontal footcandles. The lighting levels shall be calculated and measured in accordance with the current standards of the Illumination Engineering Society. Lights shall be positioned in such a way that they do not impact air traffic control operations.

105-2.3 STEEL PLATES. Steel plates of adequate size and thickness shall be furnished as necessary to cover temporary excavations, unfinished structures or surfaces requiring protection or for safety purposes. Plates shall be securely fastened down and shall be adequate to safely support any anticipated loadings to be imposed.

105-2.4 VACUUM TRUCKS. A vacuum truck(s) shall be provided by the Contractor to vacuum haul routes and other pavement areas traversed by construction vehicles and equipment. These areas shall be kept clean and free of mud, dirt, debris and other FOD to the satisfaction of the Engineer.

105-2.5 OTHER MISCELLANEOUS ITEMS. Any other items not listed herein but which are associated directly or indirectly with temporary construction related work shall, by reference, be included in the requirements of this specification. No additional payment will be made for any temporary construction related item not specifically listed herein. The Contractor shall be responsible for providing any and all items necessary to ensure a safe, secure and functioning project construction site.

CONSTRUCTION METHODS

105-3.1 CONSTRUCTION BARRICADES. Barricades shall be placed around each phase of the work in accordance with the phasing plans and shall remain in place until completion of work in each phase.

105-3.2 FLAGGERS. Flaggers shall be provided, as necessary, to control the Contractor's traffic during the prosecution of work. All Contractor vehicles or equipment that are required to cross active airfield pavement or safety areas shall do so under the direct control of a competent flagger.

105-3.3 PORTABLE FLOODLIGHTING. Portable floodlighting is required for construction during periods of limited visibility (i.e., nighttime). Illumination requirements shall be those contained in Paragraph 105-2.2.

METHOD OF MEASUREMENT

105-4.1 No direct measurement will be made for this item. Payment will be made on a lump sum basis.

BASIS OF PAYMENT

105-5.1 Payment will be made at the lump sum bid price for Temporary Construction Items. This payment shall be full compensation for furnishing all materials and labor for placing, moving and removing construction barricades and steel plates, providing flaggers, furnishing portable floodlighting, test pitting, and for any other labor, materials, equipment, tools and incidentals necessary for temporary items required for construction of this work.

Partial payments will be allowed as follows:

a. With first pay request, 25%.
b. When 25% or more of the original contract is earned, an additional 25%.
c. When 50% or more of the original contract is earned, an additional 40%.
d. After Final Inspection, Staging area clean-up and delivery of all Project Closeout materials as required by Section 90-11 of the General Provisions, the final 10%.

* The Percent of Contract Amount Earned equals the work completed to date (including the total of all previous mobilization) plus or minus work completed associated with executed change orders, if any, divided by the Total Original Contract Amount plus or minus the Total Executed Change Order Amounts, if any.

Payment will be made under:

Item G-105-5.1	Temporary Construction Items - Per Lump Sum.

TESTING REQUIREMENTS

105-6.1 None.

END OF ITEM G-105

ITEM G-112 CONSTRUCTION SCHEDULES

DESCRIPTION

112-1.1 The work specified in this item consists of procedures for preparation and submittal of Construction Progress Schedules and periodic updating that will be used for coordination, monitoring, and payment of all work under the Contract.

The Contractor's timely performance of all construction related activities shall be in compliance with the approved Project Schedule, however, means and methods of construction in accordance with the Contract Documents shall remain the sole responsibility of the Contractor.

FORMAT

112-2.1 Preparation of the progress schedules and associated updating shall be in a network analysis system using a computerized critical path method (CPM) format such as Primavera Project Planner or Microsoft Project. The software shall be capable of providing all requirements of this specification. Failure of the Contractor to meet all of the requirements of this specification shall result in the disapproval of the schedule.

CONTENT

112-3.1 The construction schedule shall include the level of detail defined herein. Failure to develop or update the construction schedule or provide data at the level of detail defined herein, shall result in the disapproval of the construction schedule. The overall project schedule shall be in the form of a time scaled precedence diagram and associated computer analysis and shall consist of detailed activities and their restraining relationships as required to complete the project from Notice-To-Proceed through completion of the work and shall indicate the following:

a. Show complete sequence of construction by activity, with dates for beginning, end date and duration in calendar days for each element of construction (activities in occupied areas and activities requiring premium time shall be differentiated from each other and from the balance of project activities). These elements shall be based either on the unit bid items or the construction schedule of values.

b. Identify work items by major specification section number.

c. Identity of Contractor/Subcontractors for each work activity.

d. Provide activity code identity for each stage of work.

e. Specific location of each work activity per the Engineer’s phasing drawings or alternative location drawings approved by the Owner.

f. Detailed schedule of all “utility shut-downs” which could impact the Airport, airlines, tenants, and other building operations or functions including, but not limited to: power, telephone telecommunication systems, FAA facilities, domestic and fire hydrant water systems, and sanitary sewer systems.

g. Sequence and interdependence of all activities required for complete performance of all items of work under this contract.

h. All network restraints (restraining ties between activities which restrict the start or finish of another activity).

i. Fabrication and delivery activities for all equipment, including that furnished by the Owner, and materials to be installed during the project.

j. Dates for ordering long lead items (materials, equipment, or specialty shop fabricated work) should include but not be limited to submittals, approvals, procurement, fabrication and delivery.

k. When all permits (if required) will be submitted and anticipated dates when they will be in hand.

l. Provide submittal dates for shop drawings, product data and samples, including Owner or Agency furnished products, and dates submittals review will be required from the Engineer. Show decision dates for selection of finishes (if applicable). Provide schedule of shop drawings submittals within fourteen (14) days from the Notice to Proceed.

m. Changes in scope requiring a change order or field order must be identified in the schedule.

n. Submission and approval of Operational and Maintenance (O & M) manuals.

o. Submission and approval of as-built drawings.

p. Controls testing.

q. Performance Verification testing.

r. Other systems testing, if required.

s. Pre-final inspection.

t. Correction of punch list from pre-final inspection.

u. Final inspection.

v. Owner, Engineer and agencies activities that could impact progress shall be shown. These activities include but are not limited to: approvals, change order reviews, environmental testing or permitting approvals by any authority having jurisdiction, special inspections by others, utility tie-ins, Owner, government or agency furnished equipment and special phasing notice(s) to-proceed.

w. Other changes required due to delays in completion of any activity or group of activities that include: 1) delays beyond the Contractor's control, such as strikes and unusual weather, 2) delays encountered due to submittals, government or Owner activities, deliveries or work stoppages which make re-planning the work necessary, 3) changes required to correct a schedule which does not represent the actual or planned prosecution and progress of the work.

The critical path for the entire project shall be clearly shown on the initial and all updated construction schedules.

Actual start and finish dates shall not be automatically updated by default mechanisms that may be included in CPM scheduling software systems. Actual start and finish dates on the CPM schedule shall match those dates provided by the Contractor and verified by the Engineer as work is completed. Failure of the Contractor to document the actual start and finish dates on the schedule shall result in the disapproval of the Contractor's schedule and the inability of the Engineer and Owner to evaluate the Contractor's progress for payment purposes. Updating of the percent complete and the remaining duration of any activity shall be independent functions. Program features which calculate one of these parameters from the other shall be disabled.

Appropriate advance notice to tenant(s) is required prior to start of work in occupied or used tenant spaces.

The Contractor shall also provide the following information: work days per week, holidays, number of shifts per day, number of hours per shift, number of prime time work hours, proposed schedule of "utility

shut-downs", special equipment or machinery to be used, and list of work activities which must be performed during restricted or special working hours including night work.

Long-term construction activities shall be broken down into reasonable smaller activities that can be easily evaluated and understood.

The schedule shall be sufficiently detailed to track the progress of each activity and the project, as a whole, on a daily basis. The activities shall be clearly described so that the work is readily identifiable. The progress of each activity is to be reasonable and based on either the amount of bid item quantities involved or value of the project schedule of values. When added together, the dollar value of all activities shall equal the Contract.

The precedence diagram submitted by the Contractor shall be drawn in the format approved by the Owner and shall be accompanied by a computer generated and plotted schedule utilizing the software identified in Section 112-2.1. The Contractor shall exercise sufficient care to produce clear, legible, and accurate diagrams. The Contractor shall group activities related to specific physical areas on the diagram for ease of understanding and simplification.

The Engineer will review the overall project schedule for compliance with the Contract requirements as to staging, phasing, and the time of completion. Such review and acceptance of these schedules does not imply either the Engineer's or the Owner's endorsement and/or responsibility of each and every activity duration or sequence of activities.

The duration of the overall project schedule shall be in agreement with the duration of the Contract as stipulated in the Bid Schedule, or as modified by the Contract provisions described in these Contract Documents.

In the event the Contractor requests an extension of the contract completion date, or any interim milestone date, the Contractor shall furnish the following for a determination as to whether or not the Contractor is entitled to an extension of time under the provisions of the contract: 1) justification, project schedule data, and supporting evidence as the Engineer and Owner may deem necessary, 2) submission of proof of delay, based on revised activity logic, duration and costs (updated to the specific date that the delay occurred) is obligatory to any approvals. The construction schedule shall clearly display that the Contractor has used, in full, all of the float time available for the work involved with this request. The Engineer and Owner’s determination as to the number of allowable days of contract time extension shall be based upon the construction schedule updates in effect for the time period in question, and other factual information as required elsewhere in the contract documents. Actual delays that are found to be caused by the Contractor’s own actions, which result in the extension of the schedule, will not be a cause for a time extension to the contract completion date.

CONSTRUCTION PROGRESS REPORT

112-4.1 As part of the monthly updating process, the Contractor shall prepare a construction progress report describing the physical progress during the report period, plans for the forthcoming report period, actions to correct any negative float predictions, and potential delays and problems and their estimated impact on performance, and the overall project completion date.

a. Clearly describe all approved revisions to the accepted overall project schedule for that period.

b. Report actual progress by updating the mathematical analysis for the accepted overall project schedule.

c. Show tasks/activities, or portions of activities completed during the reporting period, and actual quantities installed.

d. State the percentage of work actually completed as of the report date, and the progress along the

critical path in terms of days ahead of or days behind the allowable dates.

e. Report progress along other paths with negative float, if the work is behind schedule.

f. Include a narrative report that describes, but is not necessarily limited to:

(1) Description of the problem areas, current and anticipated;

(2) List of delaying factors and their impact;

(3) Explanation of corrective actions taken or proposed.

g. Describe plans/actions for the next report period.

SCHEDULE REVISIONS

112-5.1 The overall project schedule shall be revised from time to time as conditions may require, however, nothing in this specification shall be construed to authorize or approve any extension of time or increase in Contract price, it being expressly understood and agreed that time extensions or increase in contract price, if any, may only be granted in accordance with the applicable requirements of the Contract Documents. Any further revisions to the overall project schedule durations, restrictions, lags or any other logic or cost related components of the schedule must be accepted, in writing, by the Owner.

The Contractor may make only those revisions to the construction schedule as are accepted in advance by the Owner. In the event of a revision, the Contractor shall make certain that not more than one activity shall have the same activity identification number. The activity numbers of deleted activities shall not be used again.

Changes to the Contract by Change Order are to be included in the overall project schedule.

Once the changes are accepted, the Contractor's schedule revisions shall be incorporated into the previously accepted overall project schedule with the same force as the original schedule. It is understood that should the Contractor fall behind in the schedule and not be entitled to any time extension other than the extension already reflected, the Contractor shall submit his plan for bringing his work back up to schedule and shall implement the plan. If other measures are not sufficient to make up the lag, the Contractor's plan and implementation thereof shall include increasing the number of workers, shifts, days of work, and/or instituting or increasing overtime, all at no additional cost to the Owner.

SCHEDULE SUBMITTALS

112-6.1 To facilitate and enhance the use of Contractor provided scheduling and cost related information required by the Contract Documents, the Contractor shall utilize one of the software programs defined in Section 112-2.1 and provide the following:

a. Initial Baseline Schedule Submittal. The overall project schedule submittal (all activities required for the entire contract) shall be submitted within fourteen (14) calendar days after notice to proceed (NTP) or at the Preconstruction Conference whichever is earliest. Submit a hard copy of the overall project schedule with detailed predecessor and successor analysis. Submit three (3) color copies of the schedule and an electronic version for Engineer's and Owner's use.

b. Monthly Update Submittals. The overall project schedule shall be updated at least monthly starting at the first monthly contractor progress payment request and continuing for the remainder of the project. This monthly update shall generate a report that will indicate the remaining duration along with a schedule and percent complete for each activity. This report together with the monthly sorts, organized by bid items, will act as the basis for the Contractor's requests for partial payment and shall be submitted with it. No payment will be made to the Contractor without an approved updated schedule accompanying each

contractor progress payment request.

c. Submit one hard copy and an electronic copy with each of the above submittals, containing the files used to generate the above reports, and the current overall project schedule.

d. Contractor is solely responsible for the preparation, revision and updating of the overall project schedule in the form and content prescribed within this Item P-112 Construction Schedules.

e. The timely execution or performance of all construction related activities and the duration and sequencing of those activities in accordance with the approved project schedule is the Contractor's sole responsibility.

METHOD OF MEASUREMENT

112-7.1 The acquisition of software and the development, updating, revising and submittal of schedules or progress reports will not be measured for payment.

BASIS OF PAYMENT

112-8.1 No separate payment will be made for Construction Schedules. The cost of the work described in this item shall be considered incidental to the various other elements included in the project. Lack of an approved construction schedule will result in an inability of the Engineer and Owner to adequately evaluate the progress for the purposes of payment. Failure of the Contractor to provide all information, as specified above, shall result in the disapproval of the entire construction schedule submission and the inability of the Engineer and Owner to evaluate Contractor progress for payment purposes.

Although there is no direct payment for the development and maintenance of the schedule, the schedule is a requirement of Section 100-04 PROJECT PROGRESS SCHEDULE of the General Provisions. As quality is a requirement of all items of the contract, if the project schedule is not maintained in a satisfactory manner, all items of work will be considered incomplete and no payment can or will be made for any item until such time as the schedule is current and approved.

TESTING REQUIREMENTS

112-9.1 None.

END OF ITEM G-112

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ITEM P-001 – AIR TRAFFIC CONTROL TOWER

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including Contract Forms, General Conditions, FAA General Provisions, Mandatory Federal Contract Provisions, and all other Technical Specifications, apply to this Section.

1.2 SUMMARY

A. This Section includes terms and definitions pertaining to the measurement and payment for a new Air Traffic Control Tower (ATCT).

PART 2 – MEASUREMENT AND PAYMENT

2.1 MEASUREMENT

A. Measurement of item P-001-1, Air Traffic Control Tower, as specified herein will be on a lump sum basis.

2.2 BASIS OF PAYMENT

A. The work and incidental costs covered under this item will be paid for at the Contract lump sum price. The Engineer shall make the final determination of the allowable percentage of completion for the payment and shall approve the percentage paid based on the percent of contract amount actually earned which will be based upon actual work completed.

B. The lump sum price bid shall include all materials, labor, equipment, submittals, shop drawings, warranties, transportation, services, testing, permitting, and incidentals required to construct and complete an Air Traffic Control Tower in accordance with the contract documents, technical specifications, and drawings. Installation and connection of utilities within five feet of the air traffic control tower foundation shall be considered incidental to this bid item.

C. The lump sum price bid shall include connection of parking lot lights and pedestrian gate to new ATCT.

Payment will be made under

Section P-001-1 Air Traffic Control Tower - Per Lump Sum.

END OF SECTION P-001-1

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SECTION VDOT P-099 VDOT STANDARD SPECIFICATIONS

DESCRIPTION

099-1.1 The construction details for various items of work as required by the Project Documents and/or shown on the Project Plans shall conform in their entirety to the Virginia Department of Transportation Road and Bridge Specifications, latest edition, including all VDOT Supplements and as modified hereinafter except as noted. The construction details contained in the Divisions, which are not required to accomplish the work set out in the Project Documents and/or shown on the Project Plans, will have no application to these specifications.

GENERAL

099-2.1 STANDARD SPECIFICATIONS AND DESIGN STANDARDS. These standard specifications can be obtained from the Virginia Department of Transportation as follows:

Virginia Department of Transportation Road and Bridge Specifications, latest edition

Virginia Department of Transportation
1401 East Broad St.
Richmond, VA 23219
Attn: Scheduling and Contract Division
vdotcoplanroom@vdot.virginia.gov

The Contractor shall have at least one (1) copy of the documents outlined above available at the project site at all times during construction.

099-2.2 CONFLICTS. In the event of any conflict(s) between the Contract Documents and the VDOT Road and Bridge Specifications, the precedence in resolving such conflict(s) shall be as follows:

a. Bidding and Contract Requirements, and Technical Specifications for this project as located in the Project Documents shall govern over VDOT Bid and Contract Requirements.

b. Greater quantities shall govern over lesser.

c. Higher quality and/or more stringent requirements as adjudged by the Engineer shall govern over lessor.

099-2.3 GENERAL INTENT. The general intent in the use of the VDOT Standard Specifications and Design Standards is to simplify and standardize the construction of the project by allowing the Contractor to follow common construction practices and use readily available material, equipment and construction methods. The VDOT Specifications are not to be used to modify or change the Project Contract Documents.

099-2.4 DEFINITIONS. The definitions of terms as used in the VDOT Specifications shall be as modify as follows:

a. Any reference to “Department”, “Virginia Department of Transportation”, “State” or “VDOT”, it shall be understood to mean the “Owner” when referencing contractual requirements.

b. Definitions of terms as given in the Project Documents.

099-2.5 METHOD OF MEASUREMENT. Given that this project has a limited number of bid items, none of which are in the VDOT standard specification, all sections concerning the "method of measurement" shall be deleted. The method of measurement shall be as given in the Project Contract Documents.

099-2.6 BASIS OF PAYMENT. Given that this project has a limited number of bid items, none of which are in the VDOT standard specification, all sections concerning the "basis of payment" shall be deleted. The "basis of payment" for all costs required to complete this project shall be included in the bid items as given in the Project Contract Documents.

099-2.7 WAIVER OF SPECIFICATION REQUIREMENTS. The Owner's Representative with the approval of the Owner and Engineer may waive any standard specification requirement that does not apply to this project.

REQUIRED SPECIFICATIONS

099-3.1 PERTINENT SECTIONS. The following specification sections are most pertinent to this project:

VDOT Section	Description
302	Drainage Structures
512	Maintaining Traffic
701	Traffic Signs
704	Pavement Markings and Markers

This is not a complete list and other sections may apply as required. Specification sections and design standards not specified above but cross-referenced in the above individual sections are also included herewith and made a part of these Contract Documents.

END OF SECTION P-099

SECTION 024100 – EXISTING ATCT DEMOLITION

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Demolition and removal of all construction of the existing ATCT building.
1. Demolition is to be performed using mechanical methods, without implosion or explosives.
2. Deconstruction for reuse will not be required.
3. In the interest of conservation, salvage and recycling shall be pursued to the maximum extent possible and shall be included in the Demolition Plan and Waste Management Plan.
4. Hangar Road, adjacent to the site, shall remain open and operational during all parts of the demolition work. Suitable protection and safety precautions shall be taken to protect the road and Airfield from dust and debris.
5. Construction/Demolition Phasing will be required for all aspects of this project. All demolition items shall be coordinated with the phasing plans and the Owner prior to demolition.
6. Demolition is occurring in close proximity to an airport and dust control is extremely important.

1.2 REFERENCES

A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.
1. Air-Conditioning, Heating and Refrigeration Institute (AHRI)
   a. AHRI Guideline K (2009) Guideline for Containers for Recovered Non-Flammable Fluorocarbon Refrigerants
2. American Association of State Highway and Transportation Officials (AASHTO)
   a. AASHTO M 145 (1991; R 2008) Standard Specification for Classification of Soils and Soil-Aggregate Mixtures for Highway Construction Purposes
   b. AASHTO T 180 (2010) Standard Method of Test for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop
3. American Society of Safety Engineers (ASSE/SAFE)
   a. ASSE/SAFE A10.6 (2006) Safety Requirements for Demolition Operations
4. American Gas Association's (AGA)
   a. Gas Piping Technology Committee (GPTC) guide ANSI/AGA GPTC Z380.1
5. Carpet and Rug Institute (CRI)
   a. CRI 104 (2002) Standard for Installation Specification of Commercial Carpet
6. National Emissions Standards for Hazardous Air Pollutants (NESHAP)
   a. 40 CFR, Subpart M, Section 61.145 Written Notification of Demolition or Renovation Operations
7. Occupational Safety & Health Administration (OSHA)
   a. OSHA Standard 29 CFR 1926.850(a)
8. U.S. Army Corps of Engineers (USACE)
   a. EM 385-1-1 (2008; Errata 1-2010; Changes 1-3 2010; Changes 4-6 2011; Change 7 2012) Safety and Health Requirements Manual
9. U.S. Federal Aviation Administration (FAA)
   a. FAA AC 70/7460-1 (2007; Rev K) Obstruction Marking and Lighting

1.3 DEMOLITION PLANNING

A. Pre-Demolition Survey
1. Prior to starting all demolition operations, the Demolition Contractor shall obtain an engineering survey of the structure from a professional engineer licensed in the state

where the project is located. The condition of the framing, floors, and walls shall be noted so that measures can be taken, if necessary, to prevent the premature collapse of any portion of the structure. The Demolition Contractor must maintain a written copy of this survey. Photographing the existing structure and any existing damage is advisable.

2. The engineering survey shall also take into account potential hazards such as fires, cave-ins, and potential for injuries from demolition operations.
3. The Demolition Contractor shall retain a Virginia Certified Surveyor to perform site utilities and surface survey prior to start of construction. A copy of this survey shall be reviewed with the Engineer prior to start of demolition activities.

B. Demolition Plan

1. Prepare a Demolition Plan and submit proposed demolition and removal procedures for approval before work is started.
   a. Demolition shall proceed in a controlled manner utilizing the latest technology available. Provide a detailed description of methods and cut sheets of proposed equipment to be used for each operation and of the sequence of operations.
      1) Except for cutting holes in floors for chutes, holes through which to drop materials, preparation of storage space, and similar preparatory work, the demolition of floors and exterior walls shall begin at the top of the structure and proceed downward.
      2) Each story of exterior wall and floor construction shall be removed and dropped into the storage space before commencing the removal of exterior walls and floors in the next story below.
   b. <u>Schedule of Building Demolition Activities:</u> Provide a detailed sequence of demolition and backfilling work in accordance with the schedule and phasing limitations in this specification. Include hazardous materials removal, utility cut and caps, fencing, and backfill.
   c. Indicate safeguards that will be taken, including warning signs, barricades, temporary fences, warning lights and other items that are required for protection of all personnel during demolition and removal operations.
   d. Describe detailed methods for debris control on haul routes both on and off the project site.
   e. Provide protection of the Hangar Road by the erection of barriers, fencing, fabric or other methods to prevent any dust or debris from entering Hangar Road roadway right-of-way.
   f. Procedures for careful removal and disposition of materials specified to be salvaged, if any.
   g. Coordination with other work in progress.
   h. A disconnection schedule of utility services.
   i. Coordination with Waste Management Plan.
   j. The Pre-Demolition Survey shall be included as an appendix to the Demolition Plan.
2. Include statements affirming Contractor inspection of the existing roof deck and its suitability to perform as a safe working platform or if inspection reveals a safety hazard to workers, state provisions for securing the safety of the workers throughout the performance of the work. If shoring is required, submit a shoring plan and supporting calculations, prepared and signed and sealed by a professional engineer.
3. Determined if any hazardous building materials, hazardous chemicals, gases, explosives, flammable materials, or dangerous substances have been used in any building construction, pipes, tanks, or other equipment on the property.
   a. When such hazards are identified, testing shall be conducted to determine the type and concentration of the hazardous substance and test results shall be provided to the Owner.
   b. Such hazards shall be controlled or eliminated before demolition is started.
4. Provide procedures for safe conduct of the work in accordance with EM 385-1-1.

5. Plan shall be approved by a Structural Engineer, licensed in the State where the project is located, and Owner prior to work beginning. The demolition plan shall be signed and sealed by a licensed structural engineer and submitted for review and approval prior to the start of Work.
6. Within the criteria given in this paragraph, the Demolition Plan submitted shall effectively provide, at a minimum, the following information:
    a. Preparatory Work
        1) HAZMAT Verification Plan
        2) Utility Isolation Plan
        3) Emergency Response Plan
        4) Mobilization of Equipment and Materials
        5) Temporary Power and Water
        6) Site Security Plan
        7) Temporary Shoring Requirements
        8) Determination of the area potentially affected by the Work
    b. Protection During Demolition
        1) Scaffolding (if required)
        2) Dust Control
        3) Fire Protection
        4) Vibration and Noise Control
        5) Protection of Adjacent Structures and Roadways
    c. Demolition Methods
        1) Interior Demolition
        2) Superstructure Demolition
        3) Foundation Demolition
        4) Demolition of Site Features (sidewalks, paved areas, etc.- as shown on plans)
    d. Material-Handling Methods
        1) Traffic Control
        2) Soft Demolition Materials and MEP Materials
        3) Structural Steel, Machinery, Piping
        4) Concrete, CMU, Brick, Asphalt Paving
        5) Recycling
        6) Disposal
        7) Storage of Salvage Materials for Reuse

C. Waste Management Plan
1. Contractor shall submit a waste management plan detailing anticipated waste streams, handling, processing and packaging of waste streams and disposition of waste streams.
2. Recycling/Salvage
    a. Construction and Demolition Debris
        1) The Contractor is required to make an effort to utilize any recycling option that is economical for the project.
        2) The practices and procedures to be implemented shall be identified in the Waste Management Plan.
    b. Scrap/Salvage
        1) All scrap materials and other items not identified by the Owner for salvage shall become the property of the Contractor.
            a) Existing ATCT Beacon shall be turned over to the Owner. At the Owner's option, Contractor shall be permitted to recycle/sell existing beacon to a refurbishment beacon company and provide cost back to Owner.
        2) All revenue generated from the sale of said materials shall accrue to the Contractor.
3. Waste Disposal Sites
    a. Contractor shall submit proposed disposal sites for approval by the Owner.

b. Waste Disposal/Recycling
   1) Transportation
      a) Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
      b) All materials removed from the project site are to be legally transported to the waste disposal or recycling site.
      c) All concrete demolished from the project site assumed to be inert materials.
   2) Waste Disposal Site
      a) All waste materials shall be removed from the project site and legally disposed of in an EPA and Owner-approved landfill or recycling facility.
      b) No onsite burning of materials allowed.
   3) Recycling Facility
      a) Any recycling facilities utilized for the project shall be an approved facility.

D. Health and Safety Plan
   1. Contractor shall prepare and make available, on site a Health and Safety Plan (HASP). HASP shall conform to current regulations.

E. Storm Water Pollution Prevention Plan
   1. Contractor shall prepare a Storm Water Pollution Prevention Plan as required by code.

F. General Requirements
   1. Do not begin demolition or deconstruction until authorization is received from the Owner. Remove rubbish and debris from the project site; do not allow accumulations inside or outside the buildings. Remove rubbish and debris from property daily, unless otherwise directed. Store materials that cannot be removed daily in areas specified by the Owner. In the interest of occupational safety and health, perform the work in accordance with EM 385-1-1, Section 23, Demolition, and other applicable Sections.

1.4 HAZARDOUS MATERIALS

A. Surveys of hazardous materials has been performed and provided in this Project Manual as an Attachment. Legal disposal of all hazardous materials identified in the attachment documents shall be included in the lump sum bid price Item No. 024100-1. Legal disposal of hazardous materials by the Contractor specifically not identified in the Attachment documents shall be compensated under agreed upon terms.

1.5 PERMITS & NOTIFICATIONS

A. The Contractor shall provide and secure permits, in accordance with all applicable regulations. The Contractor shall complete and submit all Federal, State, and Local forms required by this building demolition.

B. The Contractor shall comply with all Federal, State and Local notification requirements.

1.6 INSURANCE

A. Contractor shall provide a copy of a current Certificate of Insurance and any subcontractor's Certificate of Insurance. Policies will need to include worker's compensation, comprehensive general liability, automobile liability and environmental/asbestos/pollution liability. Coverage shall be written on an occurrence basis with A. M. Best A-rated companies.

1. Submit documentation demonstrating compliance with CAF 170 Insurance Requirements.

1.7 LICENSES

A. Contractor shall submit to Owner all applicable, current licenses. Licenses shall be kept current for the duration of project. All employees on site must be properly licensed in accordance with State statutes and as acceptable to the authorities having jurisdiction.

1.8 TEMPORARY FACILITIES

A. Contractor shall be responsible for providing the following temporary facilities:
1. Fencing
2. Toilets
3. Offices
4. Signage
5. Barracades
6. Other Temp Facilities as deemed necessary by project details or Demolition Plan.

1.9 SCHEDULE

A. This scope of work will be completed by the date of Substantial Completion. Work shall be performed to minimize disruption to Owners, tenants, and operations of aforementioned.

B. Availability of Work Areas
1. Areas in which the work is to be accomplished will be available in accordance with the phasing plan.

C. Phasing
1. Demolition is to be performed in strict accordance with the phasing plans and Section 024119 – SELECTIVE DEMOLITION in the Contract Documents. Conflicts, questions, unforeseen circumstances are to be referred to the Owner for clarification and direction prior to proceeding with the demolition work.

1.10 ITEMS TO REMAIN IN PLACE

A. Take necessary precautions to avoid damage to existing items to remain in place, to be reused, or to remain the property of the CITY, COUNTY, OR OWNER. Repair or replace damaged items as approved by the Owner. Coordinate the work of this section with all other work indicated. Construct and maintain shoring, bracing, and supports as required. Ensure that structural elements are not overloaded. Increase structural supports or add new supports as may be required as a result of any cutting, removal, deconstruction, or demolition work performed under this contract. Do not overload structural elements or pavements to remain. Provide new supports and reinforcement for existing construction weakened by demolition, deconstruction, or removal work. Repairs, reinforcement, or structural replacement require approval by the Owner prior to performing such work.

B. Existing Construction Limits and Protection
1. Do not disturb existing construction beyond the extent indicated or necessary for installation of new construction. Provide temporary shoring and bracing for support of building components to prevent settlement or other movement. Provide protective measures to control accumulation and migration of dust and dirt in all work areas. (Refer to Paragraph 1.17).

C. Trees

1. Protect trees within the project site that might be damaged during demolition, and which are indicated to be left in place, by a 6-foot-high fence. Erect and secure fence a minimum of 5 feet from the trunk of individual trees or follow the outer perimeter of branches or clumps of trees. Replace any tree designated to remain that is damaged during the work under this contract with like-kind or as approved by the Owner at the expense of the Contractor.

D. Utility Service
1. Maintain existing utilities indicated to stay in service or any live utility not specifically shown and protect against damage during demolition and deconstruction operations. Prior to start of work, utilities serving each area of alteration or removal will be shut off and disconnected and sealed by the Contractor.

E. Facilities
1. Protect electrical and mechanical services and utilities unless they are shown to be demolished. Where removal of existing utilities and pavement is specified or indicated, provide approved barricades, temporary covering of exposed areas, and temporary services or connections for electrical and mechanical utilities.

2. Floors, roofs, walls, columns, pilasters, and other structural components that are designed and constructed to stand without lateral support or shoring, and are determined to be in stable condition, must remain standing without additional bracing, shoring, or lateral support until demolished, unless directed otherwise by the Owner. Ensure that no elements determined to be unstable are left unsupported and place and secure bracing, shoring, or lateral supports as may be required as a result of any cutting, removal, deconstruction, or demolition work performed under this contract.

1.11 BURNING

A. The use of burning at the project site for the disposal of refuse and debris will **not** be permitted.

1.12 SUBMITTALS

A. Submit the following in accordance with Division 1 requirements for submittals:
1. Engineering Survey
2. Demolition Plan
3. Waste Management Plan
4. Permits and notices authorizing building demolition.
5. Certificates of severance of utility services, approvals from governing agencies for materials and the like.
6. Permits, as applicable, for transport and disposal of debris and hazardous materials.
7. Submit receipts for tipping fees.

1.13 QUALITY ASSURANCE

A. Requirements of Regulatory Agencies
1. All work of this section will be accomplished in strict conformance to applicable provisions of the Local and/or State codes.
2. OSHA Code requirements governing demolition work.
3. Comply with applicable requirements of American National Standards Institute (ANSI) Standard A10.6, Safety Requirements for Demolition.

B. Submit timely notification of demolition projects to Federal, State, regional, and local authorities in accordance with 40 CFR 61, Subpart M.

1. Notify the State's environmental protection agency, local air pollution control district/agency and the Owner in writing 10 working days prior to the commencement of work in accordance with 40 CFR 61, Subpart M.
2. Comply with all federal, state, and local hauling and disposal regulations.
3. In addition to the requirements of the Contract Clauses, conform to the safety requirements contained in ASSE/SAFE A10.6.
4. Comply with the Environmental Protection Agency requirements specified.
5. **Use of explosives will not be permitted.**
6. **Implosion as a means of demolition will not be permitted.**

1.14 PROTECTION

A. Protection of Personnel
1. During demolition, continuing inspections by a competent person shall detect hazards resulting from weakened or deteriorated floors, walls, or loosened material. No employee shall be permitted to work where such hazards exist until they are corrected by shoring, bracing, or other means.
2. No area, section, or component of floors, roofs, walls, columns, pilasters, or other structural element will be allowed to be left standing without sufficient bracing, shoring, or lateral support to prevent collapse or failure while workmen remove debris or perform other work in the immediate area.
3. Hazards to anyone from the fragmentation of glass shall be controlled.
4. Mechanical equipment shall not be used on floors on working surfaces unless such floors or surfaces are of sufficient strength to support the imposed load.
5. Employee entrances to multistory structures being demolished shall be protected by sidewalk sheds, canopies, or both.
6. Protection shall be provided from the face of the building.
7. Only those stairways, passageways, and ladders designated as means of access to the structure shall be used.
8. The designated means of access shall be indicated on the Demolition Plan. Other access ways shall be indicated as not safe for access and closed at all times.
9. The stairwell shall be covered at a point no less than two floors below the floor on which work is being performed.
10. Access to a floor where work is in progress shall be through a separate lighted, protected passageway.

B. Protection of Roadways & Parking Lot:
1. The roadway adjacent to the site shall not be shut down during any phase of the demolition. Provide adequate protection of the roadways by the erection of barriers, fencing, fabric or other methods to prevent any dust or debris from entering the roadway right-of-ways.
2. The sequence of demolition shall be detailed in the Demolition Plan to indicate precautions taken to prevent accidental collapse of the building onto any roadways or the parking lot. Shoring, bracing, guy lines or other methods shall be employed to ensure no portion of the partially demolished structure shall fail in the direction of the Airfield.
3. The parking lot shall remain partially open during the demolition of the existing building. The parking row adjacent to the new ATCT will be used for tenants of the new ATCT. Contractor shall be responsible for protection of vehicles from demo debris.

C. Traffic Control Signs
1. Where pedestrian and driver safety is endangered in the area of removal work, use traffic barricades with flashing lights. Anchor barricades in a manner to prevent displacement by wind. Notify the Owner prior to beginning such work.
2. Provide a minimum of 2 aviation red or high intensity white obstruction lights on temporary structures (including cranes) over 100 feet above ground level. Light construction and installation shall comply with FAA AC 70/7460-1. Lights shall be

operational during periods of reduced visibility, darkness, and as directed by the Owner. Maintain the temporary services during the period of construction and remove only after permanent services have been installed and tested and are in operation.

1.15 DAMAGES

A. Should adjacent property be damaged in any manner, the Contractor shall stop work immediately and contact the Owner.

B. Contractor shall promptly repair damages caused to adjacent facilities, property, streets, and sidewalks by demolition operations as directed by the Owner and at no cost to the Owner.

1.16 DUST CONTROL

A. The Contractor shall suppress fugitive airborne dust as necessary by sweeping of loose particles or by spraying the materials with an adequate amount of water to prevent the creation of dust particles. Water will be obtained from an approved local water supply. The use of any hydrant system will be coordinated with the local water provider (City of Lynchburg). Water will be used routinely as required to effectively wet demolition areas and building surfaces. Dirt roads, bare ground and the surrounding soil will be sprayed to suppress dust generated at ground level. The use of excessive amounts of water will be avoided to prevent hazardous, slippery or other objectionable conditions such as ponding, flooding, mud, or runoff that could adversely affect the work area or adjacent facilities. Appropriate erosion control/filtration measures will be used as necessary to prevent sediment from entering the storm drainage system and surrounding waterways.

1. Prevent the spread of dust and debris to occupied portions of the building, on airfield pavements and avoid the creation of a nuisance or hazard in the surrounding area.
2. Sweep pavements as often as necessary to control the spread of debris that may result in foreign object damage potential to vehicles.

B. The Contractor shall anticipate providing a water meter on all taps to existing water supply, whether hydrants or water service to buildings to be demolished. The Contractor shall coordinate all water usage with the City of Lynchburg. All costs associated with dust control, including water consumption charges, shall be included in the lump sum bid items.

1. If these primary water sources are not adequate to meet the dust control needs, the Contractor shall augment dust control measures using water with water trucks or other means acceptable to the County.
2. Use of water from surrounding waterways is strictly prohibited.

C. If the sustained wind speed (the wind speed obtained by averaging the measured values over a one minute period) exceeds 20 miles per hour, it is a “high wind condition”. When there is a high wind condition, all active facility demolition and debris/waste loading and placement must cease until the sustained wind speed declines to 20 miles per hour or lower. Non dust-producing activities (equipment maintenance, etc.) may still be conducted during these periods.

D. If visible dust is present in the demolition work area, increased wetting of the area using water trucks and spray misters must be implemented. If visible dust is observed leaving the active demolition work area, work will stop and additional dust control measures shall be implemented. These additional dust control measures may include:

1. Increased wetting/misting of demolition work areas.
2. Adding surfactant to the water used for dust control.
3. Adjusting the rate/speed and/or quantity of equipment in the demolition work areas.

E. Refer to Specification P-156 for additional requirements.

PART 2 - PRODUCTS

2.1 FILL MATERIAL

A. Comply with excavating, backfilling, and compacting procedures for soils used as backfill material to fill basements, voids, depressions or excavations resulting from demolition or deconstruction of structures.

B. See Section 312000 for fill material requirements, compaction requirements, testing, etc.

PART 3 - EXECUTION

3.1 INSPECTION AND VERIFICATION OF CONDITIONS

A. Examine all drawings covering the work of this Section and refer to all other drawings, including mechanical and electrical drawings, which may affect the work of this section or require coordination by this trade.

B. Visit the site, verify all conditions covering or affecting the work of this Section.

C. Before starting any work, make a thorough examination of the structure on which the work is to be performed to insure that areas to be demolished are unoccupied and discontinued in use.

D. Do not commence work until conditions are acceptable to the Owner.

1. NOTE: Failure to acquaint oneself with all known or apparent conditions will not be cause for extra compensation.

3.2 PREPARATION

A. Provide temporary construction fence and gates along with “anti-tracking” pads and wheel wash station, as specified below, at each entrance to the site.

B. Protect existing landscaping materials, appurtenances, and structures, which are not to be demolished. Repair damage caused by demolition operations at no cost to Owner.

C. Prevent movement or settlement of adjacent structures. Provide bracing and shoring as needed.

D. Mark location of utilities. Protect and maintain in safe and operable condition utilities that are to remain. Prevent interruption of existing utility service to occupied or used facilities, except when authorized in writing by authorities having jurisdiction. Provide temporary services during interruptions to existing utilities as acceptable to governing authorities and Owner.

E. Notify adjacent owners of work that may affect their property, potential noise, utility outages or disruptions. Contractor to coordinate with Owner.

F. Prior to the start of any demolition operations on the existing building, the Contractor shall make a compete sweep of the entire facility to ensure there are no remaining individuals (authorized or unauthorized). Once the Contractor has made assurances that there are no individuals in the building, all accessible entrances to the facilities shall be sealed with tamper-proof tape at all times the Contractor is not on site (even nightly between work days) to ensure no trespassers enter. If the tamper-proof tape is found compromised at any time, the Contractor shall make another complete sweep of the facility to assure it is unoccupied before starting work.

3.3 STRUCTURE REMOVAL

A. General Requirements
1. Remove existing structures indicated to be removed and their foundations in their entirety. Interior walls, other than retaining walls and partitions, shall be removed in their entirety. Break up basement slabs to permit drainage. Remove sidewalks, curbs, gutters and street light bases as indicated.
2. Demolish structures in a systematic manner from the top of the structure to the ground.
   a. Complete demolition work above each tier or floor before the supporting members on the lower level are disturbed.
   b. Demolish concrete and masonry walls in small sections.
   c. Remove structural framing members and lower to ground by means of derricks, platforms hoists, or other suitable methods as approved by the Owner.
3. Locate demolition and deconstruction equipment throughout the structure and remove materials so as to not impose excessive loads to supporting walls, floors, or framing.
4. Buildings shall be demolished by the mechanical method of demolition. **Implosion is strictly prohibited**.
5. Voids left from removal of structures shall be filled in accordance with this specification.

B. Mechanical Demolition
1. No person shall be permitted in any area that can be affected by demolition when balling or clamming is being performed. Only those persons necessary for the operations shall be permitted in this area at any other time.
2. High-reach excavators can be utilized as necessary for demolition operations.
3. The use of a demolition ball is prohibited.
4. The crane boom and load line shall be as short as possible. Maximum boom length shall be 200 feet. Verify maximum crane boom with Airport Operations prior to commencing work to verify airspace restrictions are not breached.
5. When pulling over walls or portions of walls, all steel members affected shall have been cut free.
6. All roof cornices or other ornamental stonework shall be removed prior to pulling walls over.

C. Wall Removal
1. Masonry walls, or sections of masonry, shall not be permitted to fall upon the floors of the building in such masses as to exceed the safe carrying capacities of the floors.
2. No wall section that is more than 6 feet in height shall be permitted to stand without lateral bracing, unless such wall was designed and constructed to stand without such lateral support and is in a condition safe enough to be self-supporting. No wall section shall be left standing without lateral bracing any longer than necessary for removal of adjacent debris interfering with demolition of the wall. Exception to this requirement will be allowed for such wall sections that are designed and constructed to stand without lateral support.
3. Employees shall not be permitted to work on the top of a wall when weather constitutes a hazard.
4. Structural or load-supporting members on any floor shall not be cut or removed until all stories above such a floor have been demolished and removed. This shall not prohibit the cutting of floor beams for the disposal of materials or for the installation of equipment, providing the requirements of debris and floor removal are met.

D. Floor Removal
1. Openings cut in a floor shall extend the full span between supports.
2. Before demolishing any floor member, debris and other material shall be removed from such member and other adjacent floor area.
3. Safe walkways shall be provided and used by personnel when necessary to enable them to reach any point without walking upon exposed beams.

4. When floor members are being removed, employees shall not be allowed in the area directly underneath. The area shall be barricaded to prevent access and signed to warn of the hazard.

E. Structural Steel
1. Dismantle structural steel at field connections and in a manner that will prevent bending or damage. Salvage for recycle structural steel, steel joists, girders, angles, plates, columns and shapes. Flame-cutting torches are permitted when other methods of dismantling are not practical. Transport structural steel to a designated recycling facility.
2. Steel construction shall be dismantled column-by-column and tier-by-tier (columns may be in two-story lengths).
3. Any structural member being dismembered shall not be overstressed.

F. Pre-stressed Concrete
1. Stressed tendons should never be cut.
2. Pre-stressed concrete with grouted and un-grouted ducts shall be demolished by destroying the concrete around the stressed tendons.

3.4 UNDERGROUND CONCRETE STRUCTURES

A. Underground concrete structures to remain shall be prepared as follows:

1. Contractor shall include in bid complete removal of underground building structure. Any unidentified unground structures, verify with owner that remaining structures can remain.
a. Building foundation/walls shall be removed in their entirety.

3.5 UTILITIES

A. Do not interrupt existing utilities serving occupied or used facilities, except when authorized in writing by the Owner. Do not interrupt existing utilities serving facilities occupied and used by the Owner except when approved in writing and then only after temporary utility services have been approved and provided. **Do not begin demolition or deconstruction work until all utility disconnections have been made. Shut off and cap utilities for future use, as indicated.**

B. Utility companies shall be notified in advance.

C. Any power, water, or other utilities to be maintained during demolition shall be temporarily relocated and protected.

D. Abandoned or partially demolished existing gas lines are to be accurately located using procedures and installations in accordance with the ANSI/American Gas Association's (AGA) Gas Piping Technology Committee (GPTC) guide ANSI/AGA GPTC Z380.1.

E. Disconnecting Existing Utilities
1. Remove existing utilities, as indicated and as uncovered by work, and terminate in a manner conforming to the nationally recognized code covering the specific utility and approved by the Owner. When utility lines are encountered but are not indicated on the drawings, notify the Owner prior to further work in that area. Remove meters and related equipment and deliver in accordance with instructions of the Owner.

3.6 MISCELLANEOUS

A. Chain Link Fencing
1. Remove and dispose of all chain link fencing, gates and other related items as indicated.

B. Roofing

1. Remove and dispose of existing roof system and associated components. Sequence work to minimize building exposure complications during demolition.

C. Miscellaneous Metal
1. Remove and dispose of all miscellaneous non-structural metal items such as access doors and frames, steel gratings, metal ladders, wire mesh partitions, metal railings, metal windows, light-gage and cold-formed metal framing, such as steel studs, steel trusses, metal gutters, roofing and siding, metal toilet partitions, toilet accessories and similar items. Scrap metal shall become the Contractor's property. Provide separate containers to collect scrap metal and transport to a scrap metal collection or recycling facility, in accordance with the Waste Management Plan.

D. Carpentry
1. Remove and dispose of all windows, doors, frames, and cabinets, and similar items, complete with trim and accessories.

E. Carpet
1. Remove existing carpet for reclamation in accordance with manufacturer recommendations and as follows. Remove used carpet in large pieces, roll tightly, and pack neatly in a container. Recycle removed carpet cushion.

F. Acoustic Ceiling Tile
1. Remove, neatly stack, and recycle acoustic ceiling tiles. Recycling may be available with manufacturer. Otherwise, priority shall be given to a local recycling organization. Recycling is not required if the tiles contain or may have been exposed to asbestos material.

G. Air Conditioning Equipment
1. Remove and dispose of all air conditioning, refrigeration, and other equipment containing refrigerants without releasing chlorofluorocarbon refrigerants to the atmosphere in accordance with the Clean Air Act Amendment of 1990. Recover all refrigerants prior to removing air conditioning, refrigeration, and other equipment containing refrigerants and dispose of in accordance with the paragraph entitled "Disposal of Ozone Depleting Substance (ODS)." Turn in salvaged Class I ODS refrigerants as specified in paragraph, "Salvaged Materials and Equipment."

H. Fire Suppression Cylinders and Canisters
1. Remove and dispose of all fire suppression system cylinders and canisters and dispose of in accordance with the paragraph entitled "Disposal of Ozone Depleting Substance (ODS)."

I. Mechanical Equipment and Fixtures
1. Remove and dispose of all mechanical equipment, piping, ductwork, fixtures, motors and machines.

J. Electrical Equipment and Fixtures
1. Remove and dispose of all motors, motor controllers, operating and control equipment that are attached to the driven equipment, and fixtures.
   a. Recycle incandescent, mercury-vapor, and fluorescent lamps and fluorescent ballasts manufactured prior to 1978, boxed and tagged for identification, and protected from breakage.

K. Electrical Devices
1. Remove and dispose of all switches, switchgear, transformers, conductors including wire and nonmetallic sheathed and flexible armored cable, regulators, meters, instruments, plates, circuit breakers, panel boards, outlet boxes, and similar items.

L. Elevators and Hoists
   1. Remove and dispose of all elevators, hoists, and similar conveying equipment. Recycle structural steel in accordance with the Waste Management Plan.

M. Pavements

   1. Existing pavements shall be broken into pieces of such size easily handled by power-driven machinery or other suitable means.
   2. Where only a portion of the existing pavement is to be demolished, special care shall be exercised to avoid damage to that portion of the pavement to remain in place. The existing pavement shall be cut to the neat lines shown on the plans or established by the Engineer, and any existing pavement beyond the neat lines so established which is damaged or destroyed by these operations shall be replaced at the Contractor's expense with no additional compensation from the Owner.
   3. Bituminous concrete pavements which are demolished shall be legally disposed of off Airport property. Portland cement concrete pavements which are demolished shall be legally disposed of off Airport property. The cost of removal, hauling and disposal of all demolished pavement shall be included in the lump sum bid.
   4. Pavement demolition, including sidewalks and curb and gutter, will include but not necessarily be limited to, any existing visible or buried foundations, slabs, footings, etc. either made of concrete or asphalt which must, in the opinion of the Engineer, be removed to install new pavements, earthwork, seeding, sod, perform proper site grading, provide for positive site grading, etc. to complete the project to the intent established within the plans and specifications. It is incumbent upon the Contractor to visit the site and include all such existing conditions in the bid item provided for in the bid schedule. Pavement demolition shall also include bollards, islands, guardrail and other miscellaneous items which must be removed to complete the project to the intent established within the plans and specifications.

3.7 DEBRIS REMOVAL

A. Any chute opening into which debris is dumped shall be protected by a guardrail 42 inches above the floor or other surface on which personnel stand to dump the material. Any space between the chute and the edge of openings in the floors through which it passes shall be covered.

B. When debris is dropped through openings in the floors without chutes, the openings and the area onto which the material is dropped shall be enclosed with barricades not less than 42 inches high and not less than 6 feet back from the projected edge of the opening above.
   1. Signs warning of the hazard of falling materials shall be posted at each side of the debris opening at each floor.
   2. Debris removal shall not be permitted in lower areas until debris handling ceases on the floors above.

C. All material chutes, or sections thereof, at an angle of more than 45° from the horizontal shall be enclosed, except for openings equipped with closures at or about floor level for the insertion of materials.
   1. The openings shall not exceed 48 inches in height measured along the wall of the chute.

D. Such openings, when not in use, shall be kept closed at all floors below the top floor.

E. A substantial gate shall be installed in each chute at or near the discharge end. A competent employee shall be assigned to control operation of the gate and the backing and loading of trucks.

F. When operations are not in progress, the area surrounding the discharge end of a chute shall be closed.

G. Where material is dumped from mechanical equipment or wheelbarrows, a toe board or bumper, not less than 4 inches thick and 6 inches high, shall be attached at each chute opening.

H. Chutes shall be designed and constructed of such strength as to eliminate failure due to impact of materials or debris loaded therein.

I. The storage of waste and debris on any floor shall not exceed the allowable floor loads.

J. Storage space into which material is dumped shall be blocked off, except for openings for the removal of materials. Such openings shall be kept closed when material is not being removed.

K. Floor openings shall have curbs or stop-logs to prevent equipment from running over the edge.

L. Any opening cut in a floor for the disposal of materials shall not be longer in size than 25% of the aggregate of the total floor area, unless the lateral supports of the removed flooring remain in place. Floors weakened or otherwise made unsafe by demolition shall be shored to carry safely the intended imposed load for demolition.

3.8 CONCURRENT EARTH-MOVING OPERATIONS

A. Do not begin excavation, filling, and other earth-moving operations in areas occupied by structures to be demolished or deconstructed until all demolition and deconstruction in the area has been completed and debris removed. Fill holes, open basements and other hazardous openings.

3.9 DISPOSITION OF MATERIAL

A. Title to Materials

1. Except for salvaged items specified in related Sections, and for materials or equipment scheduled for salvage, all materials and equipment removed and not reused or salvaged, shall become the property of the Contractor and shall be removed from Owner property. Title to materials resulting from demolition and deconstruction, and materials and equipment to be removed, is vested in the Contractor upon approval by the Owner of the Contractor's demolition, deconstruction, and removal procedures, and authorization by the Owner to begin demolition and deconstruction. The Owner will not be responsible for the condition or loss of, or damage to, such property after contract award. Showing for sale or selling materials and equipment on site is prohibited.

B. Reuse of Materials and Equipment

1. The Owner will not assume ownership of any materials from the facilities to be demolished and will not reuse any materials or equipment that are the byproducts of demolition. Reuse of materials and equipment is encouraged for sustainability and shall be indicated by the Contractor in the Waste Management Plan.

C. Salvaged Materials and Equipment

1. The Owner will not assume ownership of any materials from the facilities to be demolished and will not reuse any materials or equipment that are the byproducts of demolition unless otherwise indicated. Salvage of materials and equipment is encouraged for sustainability and shall be indicated by the Contractor in the Waste Management Plan.

a. Salvage items and material to the maximum extent possible.

b. Store all materials salvaged for the Contractor as approved by the Owner and remove from Owner property before completion of the contract. On site sales of salvaged material is prohibited.
c. Notify the Owner before removal of any items suspected to be historical items.
d. Remove and capture all Class I ODS refrigerants in accordance with the Clean Air Act Amendment of 1990, and dispose of in a lawful manner.

D. Disposal of Ozone Depleting Substance (ODS)

1. Class I and Class II ODS are defined in Section, 602(a) and (b), of The Clean Air Act. Prevent discharge of Class I and Class II ODS to the atmosphere. Place recovered ODS in cylinders meeting AHRI Guideline K suitable for the type ODS (filled to no more than 80 percent capacity) and provide appropriate labeling. Recovered ODS shall be removed from Owner property and disposed of in accordance with 40 CFR 82. Products, equipment and appliances containing ODS in a sealed, self-contained system (e.g. residential refrigerators and window air conditioners) shall be disposed of in accordance with 40 CFR 82. Submit Receipts or bills of lading, as specified.

2. Special Instructions

a. No more than one type of ODS is permitted in each container. A warning/hazardous label shall be applied to the containers in accordance with Department of Transportation regulations. All cylinders including but not limited to fire extinguishers, spheres, or canisters containing an ODS shall have a tag with the following information:

1) Activity name and unit identification code
2) Activity point of contact and phone number
3) Type of ODS and pounds of ODS contained
4) Date of shipment

3. Fire Suppression Containers

a. Deactivate fire suppression system cylinders and canisters with electrical charges or initiators prior to shipment. Also, safety caps must be used to cover exposed actuation mechanisms and discharge ports on these special cylinders.

4. Transportation Guidance

a. Ship all ODS containers in accordance with MIL-STD-129, DLA 4145.25 .

E. Unsalvageable and Non-Recyclable Material

1. Dispose of unsalvageable and non-recyclable noncombustible material in a lawful manner. Dispose of unsalvageable and non-recyclable combustible material in a legally designated sanitary fill area located off the site.

3.10 CLEANUP

A. Remove debris and rubbish from basement and similar excavations. Remove and transport the debris in a manner that prevents spillage on streets or adjacent areas. Apply local regulations regarding hauling and disposal.

3.11 DISPOSAL OF REMOVED MATERIALS

A. Regulation of Removed Materials

1. Dispose of debris, rubbish, scrap, and other nonsalvageable materials resulting from removal operations with all applicable federal, state and local regulations as contractually specified in the Waste Management Plan. Storage of removed materials on the project site is prohibited.

B. Removal from Owner Property

1. Transport all waste materials removed from demolished and deconstructed structures from Owner property for legal disposal.

3.12 RESTORATION/CLOSEOUT

A. Earthwork Operations
1. Fill Material
a. See Paragraph 2.1.
2. Below Grade Areas
a. Contractor shall rough grade below grade areas and make ready for excavation or backfill, as required.
b. Contractor shall assure that areas are free of standing water, frozen material, and/or debris, prior to backfilling.
3. Site Grading
a. Rough grade site to a uniform rough grade, so as to minimize pooling and collection of surface water.
b. Grade so as to provide positive surface water drainage to inlets and other drainage features.
c. Contractor shall grade the site to minimize the transition between existing and new grades.

B. Project Closeout

1. Upon completion of project, contractor shall provide the following documentation, as deemed necessary for the project.
a. Waste Disposal Documentation.
b. Applicable sign-offs from building department.
c. Compaction Report, if required.
d. Accurately record actual locations of capped utilities and subsurface obstructions that will remain after demolition.

PART 4 - METHOD OF MEASUREMENT

4.1 EXISTING ATCT DEMO – ALL STRUCTURAL COMPONENTS

A. Demolition of all structural components will **not** be measured for payment.

4.2 EXISTING ATCT DEMO – ALL ELECTRICAL COMPONENTS

A. Demolition of all electrical components will **not** be measured for payment.

4.3 EXISTING ATCT DEMO – ALL MECHANICAL COMPONENTS

A. Demolition of all mechanical components will **not** be measured for payment.

4.4 EXISTING ATCT DEMO – ALL PLUMBING COMPONENTS

A. Demolition of all plumbing components will **not** be measured for payment.

4.5 EXISTING ATCT DEMO – LANDSCAPING

A. Demolition of all landscaping components will **not** be measured for payment.

4.6 BACKFILL AND COMPACTION OF BUILDING FOOTPRINT AFTER FOUNDATION REMOVAL

A. The quantity of backfill materials required to infill all voids left after complete removal of all building foundations shall be measured by the number of cubic yards of acceptable backfill material provided. Acceptable backfill and compaction shall be in compliance with Sections 2.1 and 3.12 of this specification. The Contractor shall survey the area of excavations at the completion of foundation demolition and then survey after completion of the backfill process to determine the in-place volume in cubic yards that have been placed and compacted.

PART 5 - BASIS OF PAYMENT (Payment will be made under the following:)

5.1 EXISTING AIR TRAFFIC CONTROL TOWER DEMO – ALL COMPONENTS

A. Payments will be made under:

Item 024100 – 1: Demo of Existing ATCT - Per Lump Sum.

Payment will include all personnel, labor, equipment, material, testing, and incidentals to demolish and remove the existing ATCT, and for backfill and compaction of building footprint to finished grade. **Cost shall also include any costs associated with hazardous material, including but not limited to, asbestos abatement (See Asbestos Abatement Specification and Design included in Project Manual).**

END OF SECTION 024100

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SECTION 024119 – SELECTIVE DEMOLITION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 through 32 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Demolition and removal of selected portions of a building or structure.

2. Demolition and removal of selected site elements.

3. Repair procedures for selective demolition operations.

1.3 DEFINITIONS

A. Remove: Detach items from existing construction and legally dispose of them off-site, unless indicated to be removed and salvaged or removed and reinstalled.

B. Remove and Salvage: Detach items from existing construction and deliver them to Owner.

C. Remove and Reinstall: Detach items from existing construction, prepare them for reuse, and reinstall them where indicated.

D. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

1.4 MATERIALS OWNERSHIP

A. Except for items or materials indicated to be reused, salvaged, reinstalled, or otherwise indicated to remain Owner's property, demolished materials shall become Contractor's property and shall be removed from Project site.

1.5 SUBMITTALS

A. Qualification Data: For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

B. Schedule of Selective Demolition Activities: Indicate the following:

3. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity. Ensure Owner's and other tenants' on-site operations are uninterrupted.

4. Interruption of utility services.

5. Coordination for shutoff, capping, and continuation of utility services.

6. Use of elevator and stairs.

7. Locations of temporary partitions and means of egress.

8. Coordination of Owner's continuing occupancy of portions of existing building and of Owner's partial occupancy of completed Work.

C. Inventory: After selective demolition is complete, submit a list of items that have been removed and salvaged.

D. Predemolition Photographs or Videotape: Show existing conditions of adjoining construction and site improvements, including finish surfaces, that might be misconstrued as damage caused by selective demolition operations. Submit before Work begins.

1.6 QUALITY ASSURANCE

A. Demolition Firm Qualifications: An experienced firm that has specialized in demolition work similar in material and extent to that indicated for this Project.

B. Professional Engineer Qualifications: Comply with Division 1 Section "Quality Requirements."

C. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.

D. Standards: Comply with ANSI A10.6 and NFPA 241.

E. Predemolition Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Coordination." Review methods and procedures related to selective demolition including, but not limited to, the following:

1. Inspect and discuss condition of construction to be selectively demolished.

2. Review structural load limitations of existing structure.

3. Review and finalize selective demolition schedule and verify availability of materials, demolition personnel, equipment, and facilities needed to make progress and avoid delays.

4. Review requirements of work performed by other trades that rely on substrates exposed by selective demolition operations.

1.7 PROJECT CONDITIONS

A. Owner will occupy portions of building immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted. Provide not less than 7 days notice to Owner of activities that will affect Owner's operations.

B. Maintain access to existing walkways, corridors, and other adjacent occupied or used facilities.

1. Do not close or obstruct walkways, corridors, or other occupied or used facilities without written permission from authorities having jurisdiction.

C. Owner assumes no responsibility for condition of areas to be selectively demolished.

1. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.

D. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.

1. If materials suspected of containing hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Hazardous materials will be removed by Owner under a separate contract.

E. Storage or sale of removed items or materials on-site will not be permitted.

F. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.

1. Maintain fire-protection facilities in service during selective demolition operations.

1.8 WARRANTY

A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during selective demolition, by methods and with materials so as not to void existing warranties.

1. If possible, retain original Installer or fabricator to patch the exposed Work listed below that is damaged during selective demolition. If it is impossible to

engage original Installer or fabricator, engage another recognized experienced and specialized firm.

a. Roofing.

PART 2 - PRODUCTS

2.1 REPAIR MATERIALS

A. Use repair materials identical to existing materials.

1. If identical materials are unavailable or cannot be used for exposed surfaces, use materials that visually match existing adjacent surfaces to the fullest extent possible.

2. Use materials whose installed performance equals or surpasses that of existing materials.

B. Comply with material and installation requirements specified in individual Specification Sections.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that utilities have been disconnected and capped.

B. Survey existing conditions and correlate with requirements indicated to determine extent of selective demolition required.

C. Inventory and record the condition of items to be removed and reinstalled and items to be removed and salvaged.

D. When unanticipated mechanical, electrical, or structural elements that conflict with intended function or design are encountered, investigate and measure the nature and extent of conflict. Promptly submit a written report to Architect.

E. Notify Architect/Engineer prior to removing any structural element that might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during selective demolition operations.

F. Perform surveys as the Work progresses to detect hazards resulting from selective demolition activities.

3.2 UTILITY SERVICES

A. Existing Utilities: Maintain services indicated to remain and protect them against damage during selective demolition operations.

B. Do not interrupt existing utilities serving occupied or operating facilities unless authorized in writing by Owner and authorities having jurisdiction. Provide temporary services during interruptions to existing utilities, as acceptable to Owner and to authorities having jurisdiction.

1. Provide at least 72 hours' notice to Owner if shutdown of service is required during changeover.

C. Utility Requirements: Locate, identify, disconnect, and seal or cap off indicated utilities serving areas to be selectively demolished.

1. Owner will arrange to shut off indicated utilities when requested by Contractor.

2. If utility services are required to be removed, relocated, or abandoned, before proceeding with selective demolition provide temporary utilities that bypass area of selective demolition and that maintain continuity of service to other parts of building.

3. Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit after bypassing.

D. Utility Requirements: Refer to Division 21 through 27 Sections for shutting off, disconnecting, removing, and sealing or capping utilities. Do not start selective demolition work until utility disconnecting and sealing have been completed and verified in writing.

3.3 PREPARATION

A. Dangerous Materials: Drain, purge, or otherwise remove, collect, and dispose of chemicals, gases, explosives, acids, flammables, grease ducts/fans or other dangerous materials before proceeding with selective demolition operations.

B. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with adjacent occupied and used facilities.

1. Do not close or obstruct adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by governing regulations.

2. Erect temporary protection, such as walks, fences, railings, canopies, and covered passageways, where required by authorities having jurisdiction.

3. Protect existing site improvements, appurtenances, and landscaping to remain.

4. Erect a plainly visible fence around drip line of individual trees or around perimeter drip line of groups of trees to remain.

C. Temporary Facilities: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.

1. Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of building.

2. Provide temporary weather protection, during interval between selective demolition of existing construction on exterior surfaces and new construction, to prevent water leakage and damage to structure and interior areas.

3. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.

4. Cover and protect furniture, furnishings, and equipment that have not been removed.

D. Temporary Enclosures: Provide temporary enclosures for protection of existing building and construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities. Provide temporary weathertight enclosure for building exterior.

1. Where heating or cooling is needed and permanent enclosure is not complete, provide insulated temporary enclosures. Coordinate enclosure with ventilating and material drying or curing requirements to avoid dangerous conditions and effects.

E. Temporary Partitions: Erect and maintain dustproof partitions and temporary enclosures to limit dust and dirt migration and to separate areas from fumes and noise.

F. Temporary Shoring: Provide and maintain [interior] [and] [exterior] shoring, bracing, or structural support to preserve stability and prevent movement, settlement, or collapse of construction to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.

1. Strengthen or add new supports when required during progress of selective demolition.

3.4 POLLUTION CONTROLS

A. Dust Control: Use water mist, temporary enclosures, and other suitable methods to limit spread of dust and dirt. Comply with governing environmental-protection regulations.

1. Do not use water when it may damage existing construction or create hazardous or objectionable conditions, such as ice, flooding, and pollution.

2. Wet mop floors to eliminate trackable dirt and wipe down walls and doors of demolition enclosure. Vacuum carpeted areas.

B. Disposal: Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.

1. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.

C. Cleaning: Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

3.5 SELECTIVE DEMOLITION

A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:

1. Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on the next lower level.

2. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping, to minimize disturbance of adjacent surfaces. Temporarily cover openings to remain.

3. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.

4. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain portable fire-suppression devices during flame-cutting operations.

5. Maintain adequate ventilation when using cutting torches.

6. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.

7. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.

8. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.

9. Dispose of demolished items and materials promptly.

10. Return elements of construction and surfaces that are to remain to condition existing before selective demolition operations began. Provide approved concrete patch at damaged areas disturbed during demolition.

B. Existing Facilities: Comply with building manager's requirements for using and protecting elevators, stairs, walkways, loading docks, building entries, and other building facilities during selective demolition operations.

C. Removed and Salvaged Items: Comply with the following:

1. Clean salvaged items.

2. Pack or crate items after cleaning. Identify contents of containers.

3. Store items in a secure area until delivery to Owner.

4. Transport items to Owner's storage area designated by Owner.

5. Protect items from damage during transport and storage.

D. Removed and Reinstalled Items: Comply with the following:

1. Clean and repair items to functional condition adequate for intended reuse. Paint equipment to match new equipment.

2. Pack or crate items after cleaning and repairing. Identify contents of containers.

3. Protect items from damage during transport and storage.

4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.

E. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Architect, items may be removed to a suitable, protected storage location during selective demolition [and cleaned] and reinstalled in their original locations after selective demolition operations are complete.

F. Concrete: Demolish in sections. Cut concrete full depth at junctures with construction to remain and at regular intervals, using power-driven saw, then remove concrete between saw cuts.

G. Masonry: Demolish in small sections. Cut masonry at junctures with construction to remain, using power-driven saw, then remove masonry between saw cuts.

H. Concrete Slabs-on-Grade: Saw-cut perimeter of area to be demolished, then break up and remove.

I. Roofing: Remove no more existing roofing than can be covered in one day by new roofing. Refer to applicable Division 7 Section for new roofing requirements.

J. Air -Conditioning Equipment: Remove equipment without releasing refrigerants.

3.6 PATCHING AND REPAIRS

A. General: Promptly repair damage to adjacent construction caused by selective demolition operations.

B. Patching: Comply with Division 2 Section "Cutting and Patching."

C. Repairs: Where repairs to existing surfaces are required, patch to produce surfaces suitable for new materials.

1. Completely fill holes and depressions in existing masonry walls that are to remain with an approved masonry patching material applied according to manufacturer's written recommendations.

D. Finishes: Restore exposed finishes of patched areas and extend restoration into adjoining construction in a manner that eliminates evidence of patching and refinishing.

E. Floors and Walls: Where walls or partitions that are demolished extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish color, texture, and appearance. Remove existing floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.

1. Patch with durable seams that are as invisible as possible. Provide materials and comply with installation requirements specified in other Sections of these Specifications.

2. Where patching occurs in a painted surface, apply primer and intermediate paint coats over patch and apply final paint coat over entire unbroken surface containing patch. Provide additional coats until patch blends with adjacent surfaces.

3. Where feasible, test and inspect patched areas after completion to demonstrate integrity of installation.

F. Ceilings: Patch, repair, or rehang existing ceilings as necessary to provide an even-plane surface of uniform appearance.

3.7 DISPOSAL OF DEMOLISHED MATERIALS

A. General: Promptly dispose of demolished materials. Do not allow demolished materials to accumulate on-site.

B. Burning: Do not burn demolished materials.

C. Disposal: Transport demolished materials off Owner's property and legally dispose of them.

PART 4 – METHOD OF MEASUREMENT

4.1 PAVEMENT REMOVAL

A. Bituminous concrete pavement demolition as described above will be measured by the square yard of pavement material demolished regardless of its thickness.

PART 5 – BASIS OF PAYMENT

5.1 ASPHALT PAVEMENT REMOVAL

A. Payment shall be made at the contract unit price per square yard or fraction thereof, which price and payment shall be full compensation for all labor, equipment, tools, and incidentals necessary to complete the work prescribed in this item.

Item 024119-1: Asphalt Pavement Removal – per square yard.

END OF SECTION 024119

SECTION 024120 – CUTTING AND PATCHING

PART 1 - GENERAL

1.1 SUMMARY

A. Definition: "Cutting and patching" includes cutting into existing construction to provide for the installation or performance of other work and subsequent fitting and patching required to restore surfaces to their original condition.

1. Cutting and patching is performed for coordination of the work, to uncover work for access or inspection, to obtain samples for testing, to permit alterations to be performed or for other similar purposes.

2. Cutting and patching performed during the manufacture of products, or during the initial fabrication, erection or installation processes is not considered to be "cutting and patching" under this definition. Drilling of holes to install fasteners, sleeving and similar operations are also not considered to be "cutting and patching."

B. Refer to other sections for specific requirements and limitations applicable to cutting and patching individual parts of the work.

1.2 SUBMITTALS

A. Cutting and Patching Proposal: Where approval of procedures for cutting and patching is required before proceeding, submit a proposal describing procedures for this work a minimum of 15 working days in advance of the time cutting and patching will be performed and request approval to proceed. Include the following information, as applicable, in the proposal:

1. Describe the extent of cutting and patching required and how it is to be performed; indicate why it cannot be avoided.

2. Describe anticipated results in terms of changes to existing construction; include changes to structural elements and operating components as well as changes in appearance and other significant visual elements.

3. List products to be used and firms or entities that will perform work.

4. Indicate dates when cutting and patching is to be performed.

5. List utilities that will be disturbed or affected, including those that will be relocated and those that will be temporarily out-of-service. Indicate how long service will be disrupted.

6. Where cutting and patching involves addition of reinforcement to structural elements, submit details and engineering calculations to show how reinforcement is integrated with the original structure.

7. Approval by the Architect-Engineer to proceed with cutting and patching does not waive any rights to later require complete removal and replacement of a part of the work found to be unsatisfactory.

1.3 QUALITY ASSURANCE

A. Requirements for Structural Work: Do not cut and patch structural elements in a manner that would reduce their load-carrying capacity or load-deflection ratio.

1. Obtain approval of the Architect-Engineer before cutting and patching any structural elements including, but not limited to, the following:

a. Foundation construction.

b. Bearing and retaining walls.

c. Structural concrete.

d. Structural steel.

e. Lintels.

f. Structural decking.

g. Stair systems.

h. Miscellaneous structural metals.

i. Exterior curtain wall construction.

j. Equipment supports.

k. Shoring, bracing and sheeting.

l. Street paving.

B. Operational and Safety Limitations: Do not cut and patch operating elements or safety related components in a manner that would result in reducing their capacity to perform as intended, or result in increased maintenance, or decreased operational life or safety.

1. Obtain approval of the Architect-Engineer before cutting and patching any operating elements or safety related systems including, but not limited to, the following:

a. Primary operational systems and equipment.

b. Air or smoke barriers.

c. Water, moisture, or vapor barriers.

d. Membranes and flashings.

e. Fire protection systems.

f. Noise and vibration control elements and systems.

g. Control systems.

h. Communication systems.

i. Conveying systems.

j. Electrical wiring systems.

k. Piping, ductwork, vessels and equipment.

C. Visual Requirements: Do not cut and patch construction exposed on the exterior or in occupied spaces, in a manner that would, in the Architect-Engineer's opinion, reduce aesthetic qualities, or result in visual evidence of cutting and patching. Remove and replace work cut and patched in a visually unsatisfactory manner, as judged by the Architect-Engineer, at no additional cost to the Owner.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Except as otherwise indicated, or as directed by the Architect-Engineer, use materials that are identical to existing materials. If identical materials are not available or cannot be used where exposed surfaces are involved, use materials that match existing adjacent surfaces to the fullest extent possible with regard to visual effect. Use materials whose installed performance will equal or surpass that of existing materials.

PART 3 - EXECUTION

3.1 INSPECTION

A. Before cutting existing surfaces, examine surfaces to be cut and patched and conditions under which cutting and patching is to be performed. Take corrective action before proceeding, if unsafe or unsatisfactory conditions are encountered.

1. Before the start of cutting work, meet at the work site with all parties involved in cutting and patching, including mechanical and electrical trades. Review areas of potential interference and conflict between the various trades. Coordinate layout of the work and resolve potential conflicts before proceeding with the work.

3.2 PREPARATION

A. Temporary Support: To prevent failure, provide temporary support of work to be cut.

B. Protection: Protect existing construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of the Project that might be exposed during cutting and patching operations.

3.3 PERFORMANCE

A. General: Employ skilled workmen to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time and complete without delay.

B. Cutting: Cut existing construction using methods least likely to damage elements to be retained or adjoining construction. Where possible review proposed procedures with the original installer; comply with the original installer's recommendations.

1. In general, where cutting is required, use hand or small power tools designed for sawing or grinding, not hammering and chopping. Cut through concrete and masonry using a cutting machine such as a carborundum saw or core drill to ensure a neat hole.

2. Cut holes and slots neatly to size required with minimum disturbance of adjacent work. To avoid marring existing finished surfaces, cut or drill from the exposed or finished side into concealed surfaces. Temporarily cover openings when not in use.

3. Comply with requirements of other applicable sections where cutting and patching requires excavating and backfilling.

4. Bypass utility services such as pipe and conduit, before cutting, where such utility services are shown or required to be removed, relocated or abandoned. Cut off conduit and pipe in walls or partitions to be removed. After bypass and cutting, cap, valve or plug and seal tight remaining portion of pipe and conduit to prevent entrance of moisture or other foreign matter.

C. Patching: Patch with durable seams that are as invisible as possible. Comply with specified tolerances.

1. Inspect and test patched areas to demonstrate integrity of the installation.

2. Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.

3.4 CLEANING

A. Thoroughly clean areas and spaces where cutting and patching is performed or used as access. Remove completely paint, mortar, oils, putty and items of similar nature. Thoroughly clean piping, conduit and similar features before painting or other finishing is applied. Restore damaged pipe covering to its original condition.

PART 4 – METHOD OF MEASUREMENT

4.1 Cutting and patching will not be measured for payment

PART 5 – BASIS OF PAYMENT

5.1 No separate payment will be made for Cutting and patching. The cost of the work described in this Item shall be considered incidental to installation of the various other elements included in the project.

END OF SECTION 024120

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SECTION P-109 SAWCUTTING

DESCRIPTION

109-1.1 This work shall consist of sawcutting the edge of existing portland cement and/or asphaltic concrete pavements to provide a uniform joint alignment in sound material, as shown on the Plans or as directed by the Engineer.

EQUIPMENT

109-2.1 Saws shall be power-driven, self-propelled, wheel or track-mounted, and capable of cutting to a depth of at least three (3) inches in one pass. The Contractor shall make the necessary number of passes to cut through the portland cement and/or bituminous concrete pavement. The use of a cutting wheel mounted on a roller, grader or similar equipment, or the use of pneumatically driven hand-held tools, will only be approved if the Contractor can demonstrate to the satisfaction of the Engineer that such equipment can consistently produce satisfactory results. Multi-blade arbor saws shall be used to construct sealant reservoirs.

CONSTRUCTION METHODS

109-3.1 The Contractor shall establish the line to be cut using chalkline or similar means in accordance with the details shown on the Plans or as directed by the Engineer. The finished cut shall be true to line, smooth and vertical and shall not deviate from the established line more than 1/2-inch from side to side or end to end of the pavement being sawcut.

109-3.2 The existing paving material beyond the saw cut on the construction side shall be removed to the depth of the final cut and disposed of legally off Airport property. The saw cut depth shall be full depth so that spalling or other breakage of the existing pavement along the bottom of the pavement does not occur. If spalling or other breakage of the existing pavement along the bottom of the pavement does occur, the Contractor shall relocate the saw cut line to a point deeper in the existing pavement to remove completely any spalled or broken pavement so that the subbase under the existing pavement is not damaged and the new pavement can be constructed up against the existing pavement without either the new or existing pavement strength and pavement section being compromised.

109-3.3 All dust, chips, slurry, or waste material shall be carefully collected and removed from the site in accordance with the general safety requirements of the Contract and disposed of legally off the airport property.

METHOD OF MEASUREMENT

109-4.1 Sawcutting will not be measured for payment.

BASIS OF PAYMENT

109-5.1 No separate payment will be made for Sawcutting. The cost of the work described in this Item shall be considered incidental to installation of the various other elements included in the project.

TESTING REQUIREMENTS

109-6.1 None.

END OF SECTION P-109

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SECTION 030130 - MAINTENANCE OF CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Removal of deteriorated concrete and subsequent replacement and patching.
2. Floor joint repair.
3. Epoxy crack injection.
4. Corrosion-inhibiting treatment.
5. Polymer overlays.
6. Polymer sealers.
7. Composite structural reinforcement.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference:

1. Review methods and procedures related to concrete maintenance including, but not limited to, the following:

   a. Verify concrete-maintenance specialist's personnel, equipment, and facilities needed to make progress and avoid delays.
   b. Materials, material application, sequencing, tolerances, and required clearances.
   c. Quality-control program.
   d. Coordination with building occupants.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, chemical composition, physical properties, test data, and mixing, preparation, and application instructions.

B. Samples: Cured Samples for each exposed product and for each color and texture specified, in manufacturer's standard size appropriate for each type of work.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For concrete-maintenance specialist.

B. Material Certificates: For each type of portland cement and aggregate supplied for mixing or adding to products at Project site.

C. Product Test Reports: For each manufactured bonding agent, cementitious patching mortar, joint-filler, crack-injection adhesive, polymer overlay, polymer sealer, and composite structural reinforcement, for tests performed by manufacturer and witnessed by a qualified testing agency.

D. Field quality-control reports.

E. Quality-Control Program: Submit before work begins.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: Each manufactured bonding agent, cementitious patching mortar, joint-filler, crack-injection adhesive, polymer overlay, polymer sealer, and composite structural reinforcement manufacturer shall employ factory-authorized service representatives who are available for consultation and Project-site inspection and on-site assistance.

B. Concrete-Maintenance Specialist Qualifications: Engage an experienced concrete-maintenance firm that employs installers and supervisors who are trained and approved by manufacturer to apply manufactured bonding agent, cementitious patching mortar, joint-filler, crack-injection adhesive, polymer overlay, polymer sealer, and composite structural reinforcement to perform work of this Section. Firm shall have completed work similar in material, design, and extent to that indicated for this Project with a record of successful in-service performance. Experience in only installing or patching new concrete is insufficient experience for concrete-maintenance work.

1. Field Supervision: Concrete-maintenance specialist firm shall maintain experienced full-time supervisors on Project site during times that concrete-maintenance work is in progress.

C. Quality-Control Program: Prepare a written plan for concrete maintenance to systematically demonstrate the ability of personnel to properly perform maintenance work, including each phase or process, protection of surrounding materials during operations, and control of debris and runoff during the Work. Describe in detail materials, methods, equipment, and sequence of operations to be used for each phase of the Work.

D. Mockups: Build mockups to demonstrate aesthetic effects and to set quality standards for materials and execution.

1. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Engineer specifically approves such deviations in writing.

2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Comply with manufacturer's written instructions for minimum and maximum temperature requirements and other conditions for storage.

B. Store cementitious materials off the ground, under cover, and in a dry location.

C. Store aggregates covered and in a dry location; maintain grading and other required characteristics and prevent contamination.

1.8 FIELD CONDITIONS

A. Environmental Limitations for Epoxies: Do not apply when air and substrate temperatures are outside limits permitted by manufacturer. During hot weather, cool epoxy components before mixing, store mixed products in shade, and cool unused mixed products to retard setting. Do not apply to wet substrates unless approved by manufacturer.

1. Use only Class A epoxies when substrate temperatures are below or are expected to go below 40 deg F (5 deg C) within eight hours.
2. Use only Class A or B epoxies when substrate temperatures are below or are expected to go below 60 deg F (16 deg C) within eight hours.
3. Use only Class C epoxies when substrate temperatures are above and are expected to stay above 60 deg F (16 deg C) for eight hours.

B. Cold-Weather Requirements for Cementitious Materials: Comply with the following procedures:

1. When air temperature is below 40 deg F (5 deg C), heat patching-material ingredients and existing concrete to produce temperatures between 40 and 90 deg F (5 and 32 deg C).
2. When mean daily air temperature is between 25 and 40 deg F (minus 4 and plus 5 deg C), cover completed Work with weather-resistant insulating blankets for 48 hours after repair or provide enclosure and heat to maintain temperatures above 32 deg F (0 deg C) within the enclosure for 48 hours after repair.
3. When mean daily air temperature is below 25 deg F (minus 4 deg C), provide enclosure and heat to maintain temperatures above 32 deg F (0 deg C) within the enclosure for 48 hours after repair.

C. Hot-Weather Requirements for Cementitious Materials: Protect repair work when temperature and humidity conditions produce excessive evaporation of water from

patching materials. Provide artificial shade and wind breaks, and use cooled materials as required. Do not apply to substrates with temperatures of 90 deg F (32 deg C) and above.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: For repair products, obtain each color, grade, finish, type, and variety of product from single source and from single manufacturer with resources to provide products of consistent quality in appearance and physical properties.

2.2 BONDING AGENTS

A. Epoxy-Modified, Cementitious Bonding and Anticorrosion Agent: Manufactured product that consists of water-insensitive epoxy adhesive, portland cement, and water-based solution of corrosion-inhibiting chemicals that forms a protective film on steel reinforcement.

1. Basis-of-Design Product: Subject to compliance with requirements, provide MAPEI Corporation; Planibond 3C or a comparable product by one of the following:

   a. BASF Construction Chemicals - Construction Systems.
   b. Euclid Chemical Company (The), an RPM company.
   c. Sika Corporation.

B. Epoxy Bonding Agent: ASTM C 881/C 881M, bonding system Type II and free of VOCs.

1. Basis-of-Design Product: Subject to compliance with requirements, provide MAPEI Corporation; Planibond EBA or comparable product by one of the following:

   a. BASF Construction Chemicals - Construction Systems.
   b. Euclid Chemical Company (The); an RPM company.
   c. Sika Corporation.

C. Latex Bonding Agent, Non-Redispersible: ASTM C 1059/C 1059M, Type II.

1. Basis-of-Design Product: Subject to compliance with requirements, provide MAPEI Corporation; Planicrete AC or comparable product by one of the following:

   a. Euclid Chemical Company (The); an RPM company.
   b. Approved equal.

D. Mortar Scrub Coat: Mix consisting of 1 part portland cement and 1 part fine aggregate complying with ASTM C 144 except 100 percent passing a No. 16 (1.18-mm) sieve.

2.3 PATCHING MORTAR

A. Patching Mortar Requirements:

1. Only use patching mortars that are recommended by manufacturer for each applicable horizontal, vertical, or overhead use orientation.
2. Color and Aggregate Texture: Provide patching mortar and aggregates of colors and sizes necessary to produce patching mortar that matches existing, adjacent, exposed concrete. Blend several aggregates if necessary to achieve suitable matches.

3. Coarse Aggregate for Patching Mortar: ASTM C 33/C 33M, washed aggregate, Size No. 8, Class 5S. Add to patching-mortar mix only as permitted by patching-mortar manufacturer.

B. Cementitious Patching Mortar: Packaged, dry mix for repair of concrete.

1. Basis-of-Design Product: Subject to compliance with requirements, provide MAPEI Corporation; Mapecem Quickpatch or comparable product by one of the following:

   a. BASF Construction Chemicals - Construction Systems.
   b. Euclid Chemical Company (The); an RPM company.
   c. Sika Corporation.

2. Compressive Strength: Not less than 3000 psi (20.7 MPa) at 28 days when tested according to ASTM C 109/C 109M.

2.4 FORM AND POUR/PUMP CONCRETE REPAIR PRODUCTS

A. Flowable, Shrinkage-Compensated, Concrete Repair Mortar: Packaged, dry mix for repair of concrete, and containing a latex additive as either a dry powder or a separate liquid added during mixing.

1. Basis-of-Design Product: Subject to compliance with requirements, provide MAPEI Corporation; Planitop FD or comparable product by one of the following:

   a. BASF Construction Chemicals - Construction Systems.
   b. Euclid Chemical Company (The); an RPM company.
   c. Sika Corporation.

2. Compressive Strength: Not less than 3000 psi (20.7 MPa) within twenty-eight days when tested according to ASTM C 109/C 109M.

B. One-Component, Pre-Extended, Pumpable and Pourable, Cememtitious Repair Material: Packaged, dry mix for repair of concrete, and containing a latex additive as either a dry powder or a separate liquid added during mixing.

1. Basis-of-Design Product: Subject to compliance with requirements, provide MAPEI Corporation; Planitop 11 or comparable product by one of the following:

a. BASF Construction Chemicals - Construction Systems.
b. Euclid Chemical Company (The); an RPM company.
c. Sika Corporation.

2. Compressive Strength: Not less than 3000 psi (20.7 MPa) within twenty-eight days when tested according to ASTM C 109/C 109M.

2.5 PREPLACED CONCRETE MATERIALS

A. Preplaced Aggregate: Washed aggregate, ASTM C 33/C 33M, Class 5S, with 100 percent passing a 1-1/2-inch (37.5-mm) sieve, 95 to 100 percent passing a 1-inch (25-mm) sieve, 40 to 80 percent passing a 3/4-inch (19-mm) sieve, zero to 15 percent passing a 1/2-inch (12.5-mm) sieve, and zero to 2 percent passing a 3/8-inch (9.5-mm) sieve.

B. Fine Aggregate for Grout: Fine aggregate according to ASTM C 33/C 33M, but with 100 percent passing a No. 8 (2.36-mm) sieve, 95 to 100 percent passing a No. 16 (1.18-mm) sieve, 55 to 80 percent passing a No. 30 (0.6-mm) sieve, 30 to 55 percent passing a No. 50 (0.3-mm) sieve, 10 to 30 percent passing a No. 100 (0.15-mm) sieve, zero to 10 percent passing a No. 200 (0.075-mm) sieve, and having a fineness modulus of 1.30 to 2.10.

C. Grout Fluidifier for Grout: ASTM C 937.

D. Pozzolans for Grout: ASTM C 618.

2.6 JOINT FILLER

A. Epoxy Joint Filler: Two-component, semirigid, 100 percent solids, epoxy resin with a Type A Shore durometer hardness of at least 80 according to ASTM D 2240.

1. Basis-of-Design Product: Subject to compliance with requirements, provide MAPEI Corporation; Planibond JF or comparable product by one of the following:

a. BASF Construction Chemicals - Construction Systems.
b. Euclid Chemical Company (The); an RPM company.
c. Sika Corporation.

2.7 EPOXY CRACK-INJECTION MATERIALS

A. Epoxy Crack-Injection Adhesive: ASTM C 881/C 881M, bonding system Type IV at structural locations and where indicated, Type I at other locations; free of VOCs.

1. Basis-of-Design Product: Subject to compliance with requirements, provide MAPEI Corporation; Planibond CR 50 or comparable product by one of the following:

   a. BASF Construction Chemicals - Construction Systems.
   b. Euclid Chemical Company (The); an RPM company.
   c. Sika Corporation.

2. Capping Adhesive: MAPEI Corporation; Planibond AE product manufactured for use with crack-injection adhesive by same manufacturer.

B. Epoxy Crack Adhesive: ASTM C 881/C 881M, bonding system Type IV at structural locations and where indicated, Type I at other locations; free of VOCs.

1. Basis-of-Design Product: Subject to compliance with requirements, provide MAPEI Corporation; Planibond AE or comparable product by one of the following:

   a. BASF Construction Chemicals - Construction Systems.
   b. Euclid Chemical Company (The); an RPM company.
   c. Sika Corporation.

2.8 CORROSION-INHIBITING MATERIALS

A. Corrosion-Inhibiting Treatment: Waterborne solution of alkaline corrosion-inhibiting chemicals for concrete-surface application that penetrates concrete by diffusion and forms a protective film on steel reinforcement.

1. Basis-of-Design Products: Subject to compliance with requirements, provide MAPEI Corporation; Mapeshield CI 100 or comparable product by one of the following:

   a. Euclid Chemical Company (The), an RPM company.
   b. Sika Corporation.

2.9 POLYMER-OVERLAY MATERIALS

A. Polymer Overlay: Epoxy adhesive complying with ASTM C 881/C 881M, bonding system Type III, with surface-applied aggregate for skid resistance; free of VOCs.

1. Basis-of-Design Product: Subject to compliance with requirements, provide MAPEI Corporation; Planiseal Traffic Coat or comparable product by one of the following:

a. Euclid Chemical Company (The); an RPM company.
b. Sika Corporation.

2. Aggregate: ACI 503.3, oven-dried, washed silica sand.

2.10 POLYMER-SEALER MATERIALS

A. Epoxy Polymer Sealer: Low-viscosity epoxy, penetrating sealer and crack filler recommended by manufacturer for penetrating and sealing cracks in exterior concrete traffic surfaces; VOC content 400 g/L or less.

1. Basis-of-Design Product: Subject to compliance with requirements, provide MAPEI Corporation; Planiseal LVB or comparable product by one of the following:

a. BASF Construction Chemicals - Construction Systems.
b. Euclid Chemical Company (The), an RPM company.
c. Sika Corporation.

2.11 MISCELLANEOUS MATERIALS

A. Portland Cement: ASTM C 150/C 150M, Type I, II, or III unless otherwise indicated.

B. Water: Potable.

2.12 MIXES

A. General: Mix products, in clean containers, according to manufacturer's written instructions.

1. Do not add water, thinners, or additives unless recommended by manufacturer.
2. When practical, use manufacturer's premeasured packages to ensure that materials are mixed in proper proportions. When premeasured packages are not used, measure ingredients using graduated measuring containers; do not estimate quantities or use shovel or trowel as unit of measure.
3. Do not mix more materials than can be used within time limits recommended by manufacturer. Discard materials that have begun to set.

B. Mortar Scrub Coat: Mix dry ingredients with enough water to provide consistency of thick cream.

C. Dry-Pack Mortar: Mix required type(s) of patching-mortar dry ingredients with just enough liquid to form damp cohesive mixture that can be squeezed by hand into a ball but is not plastic.

D. Concrete: Comply with Section 033000 "Cast-in-Place Concrete."

E. Grout for Use with Preplaced Aggregate: Proportion according to ASTM C 938. Add grout fluidifier to mixing water followed by portland cement, pozzolan, and fine aggregate.

PART 3 - EXECUTION

3.1 CONCRETE MAINTENANCE

A. Have concrete-maintenance work performed only by qualified concrete-maintenance specialist.

B. Comply with manufacturers' written instructions for surface preparation and product application.

3.2 EXAMINATION

A. Notify Engineer seven days in advance of dates when areas of deteriorated or delaminated concrete and deteriorated reinforcing bars will be located.

B. Locate areas of deteriorated or delaminated concrete using hammer or chain-drag sounding and mark boundaries. Mark areas for removal by simplifying and squaring off boundaries. At columns and walls make boundaries level and plumb unless otherwise indicated.

C. Perform surveys as the Work progresses to detect hazards resulting from concrete-maintenance work.

3.3 PREPARATION

A. Ensure that supervisory personnel are on-site and on duty when concrete maintenance work begins and during its progress.

B. Protect persons, motor vehicles, surrounding surfaces of building being repaired, building site, plants, and surrounding buildings from harm resulting from concrete maintenance work.

1. Comply with each product manufacturer's written instructions for protections and precautions. Protect against adverse effects of products and procedures on people and adjacent materials, components, and vegetation.
2. Use only proven protection methods appropriate to each area and surface being protected.
3. Provide temporary barricades, barriers, and directional signage to exclude public from areas where concrete maintenance work is being performed.
4. Erect temporary protective covers over walkways and at points of pedestrian and vehicular entrance and exit that must remain in service during course of concrete maintenance work.

5. Contain dust and debris generated by concrete maintenance work and prevent it from reaching the public or adjacent surfaces.
6. Use water-mist sprinkling and other wet methods to control dust only with adequate, approved procedures and equipment that ensure that such water will not create a hazard or adversely affect other building areas or materials.
7. Protect floors and other surfaces along haul routes from damage, wear, and staining.
8. Protect adjacent surfaces and equipment by covering them with heavy polyethylene film and waterproof masking tape. If practical, remove items, store, and reinstall after potentially damaging operations are complete.
9. Neutralize and collect alkaline and acid wastes for disposal off Owner's property.
10. Dispose of debris and runoff from operations by legal means and in a manner that prevents soil erosion, undermining of paving and foundations, damage to landscaping, and water penetration into building interiors.

C. Existing Drains: Prior to the start of work in an area, test drainage system to ensure that it is functioning properly. Notify Engineer immediately of inadequate drainage or blockage. Do not begin work in an area until the drainage system is in working order.

1. Prevent solids such as aggregate or mortar residue from entering the drainage system. Clean out drains and drain lines that become sluggish or blocked by sand or other materials resulting from concrete maintenance work.
2. Protect drains from pollutants. Block drains or filter out sediments, allowing only clean water to pass.

D. Preparation for Concrete Removal: Examine construction to be repaired to determine best methods to safely and effectively perform concrete maintenance work. Examine adjacent work to determine what protective measures will be necessary. Make explorations, probes, and inquiries as necessary to determine condition of construction to be removed in the course of repair.

1. Verify that affected utilities have been disconnected and capped.
2. Inventory and record the condition of items to be removed for reinstallation or salvage.
3. Provide and maintain shoring, bracing, and temporary structural supports as required to preserve stability and prevent unexpected or uncontrolled movement, settlement, or collapse of construction being demolished and construction and finishes to remain. Strengthen or add new supports when required during progress of removal work.

E. Reinforcing-Bar Preparation: Remove loose and flaking rust from exposed reinforcing bars by wire brushing until only tightly adhered light rust remains.

1. Where section loss of reinforcing bar is more than 25 percent, or 20 percent in two or more adjacent bars, cut bars and remove and replace as indicated on Drawings.
2. Remove additional concrete as necessary to provide at least 3/4-inch (19-mm) clearance at existing and replacement bars.
3. Splice replacement bars to existing bars according to ACI 318 (ACI 318M) by lapping, welding, or using mechanical couplings.

F. Preparation of Floor Joints for Repair: Saw-cut joints full width to edges and depth of spalls, but not less than 1 inch (25 mm) deep. Clean out debris and loose concrete; vacuum or blow clear with compressed air.

G. Surface Preparation for Corrosion-Inhibiting Treatment: Clean concrete to remove dirt, oils, films, and other materials detrimental to treatment application.

1. Use low-pressure water cleaning.
2. Allow surface to dry before applying corrosion-inhibiting treatment.

H. Surface Preparation for Composite Structural Reinforcement: Clean concrete where reinforcement and epoxy patching mortar is to be placed by low-pressure water cleaning to remove dirt, oils, films, and other materials detrimental to epoxy patching mortar.

1. Roughen surface of concrete by sand blasting.
2. Remove delaminated material and deteriorated concrete surface material.
3. Sweep and vacuum roughened surface to remove debris followed by low-pressure water cleaning.

3.4 CONCRETE REMOVAL

A. Do not overload structural elements with debris.

B. Saw-cut perimeter of areas indicated for removal to a depth of at least 1/2 inch (13 mm). Make cuts perpendicular to concrete surfaces and no deeper than cover on reinforcement.

C. Remove deteriorated and delaminated concrete by breaking up and dislodging from reinforcement.

D. Remove additional concrete if necessary to provide a depth of removal of at least 1/2 inch (13 mm) over entire removal area.

E. Where half or more of the perimeter of reinforcing bar is exposed, bond between reinforcing bar and surrounding concrete is broken, or reinforcing bar is corroded, remove concrete from entire perimeter of bar and to provide at least 3/4-inch (19-mm) clearance around bar.

F. Test areas where concrete has been removed by tapping with hammer, and remove additional concrete until unsound and disbonded concrete is completely removed.

G. Provide surfaces with a fractured profile of at least 1/8 inch (3 mm) that are approximately perpendicular or parallel to original concrete surfaces. At columns and walls, make top and bottom surfaces level unless otherwise directed.

H. Thoroughly clean removal areas of loose concrete, dust, and debris.

3.5 BONDING AGENT APPLICATION

A. Epoxy-Modified, Cementitious Bonding and Anticorrosion Agent: Apply to reinforcing bars by stiff brush or hopper spray according to manufacturer's written instructions. Apply to reinforcing bars in two coats, allowing first coat to dry two to three hours before applying second coat. Allow to dry before placing patching mortar or concrete.

B. Epoxy Bonding Agent: Apply to reinforcing bars by brush, roller, or spray according to manufacturer's written instructions, leaving no pinholes or other uncoated areas. Place patching mortar or concrete while epoxy is still tacky. If epoxy dries, recoat before placing patching mortar or concrete.

C. Latex Bonding Agent, Type I: Apply to concrete by brush roller or spray. Allow to dry before placing patching mortar or concrete.

D. Latex Bonding Agent, Type II: Mix with portland cement and scrub into concrete surface according to manufacturer's written instructions. Place patching mortar or concrete while bonding agent is still wet. If bonding agent dries, recoat before placing patching mortar or concrete.

E. Mortar Scrub Coat for Job-Mixed Patching Mortar: Dampen repair area and surrounding concrete 6 inches (150 mm) beyond repair area. Remove standing water and apply scrub coat with a brush, scrubbing it into surface and thoroughly coating repair area. If scrub coat dries, recoat before placing patching mortar or concrete.

F. Slurry Coat for Cementitious Patching Mortar: Wet substrate thoroughly and then remove standing water. Scrub a slurry of neat patching mortar into substrate, filling pores and voids.

3.6 PATCHING MORTAR APPLICATION

A. Place patching mortar as specified in this article unless otherwise recommended in writing by manufacturer.

1. Provide forms where necessary to confine patch to required shape.
2. Wet substrate and forms thoroughly and then remove standing water.

B. General Placement: Place patching mortar by troweling toward edges of patch to force intimate contact with edge surfaces. For large patches, fill edges first and then work toward center, always troweling toward edges of patch. At fully exposed reinforcing bars, force patching mortar to fill space behind bars by compacting with trowel from sides of bars.

C. Consolidation: After each lift is placed, consolidate material and screed surface.

D. Multiple Lifts: Where multiple lifts are used, score surface of lifts to provide a rough surface for placing subsequent lifts. Allow each lift to reach final set before placing subsequent lifts.

E. Finishing: Allow surfaces of lifts that are to remain exposed to become firm and then finish to a rough surface with a broom or burlap drag.

F. Curing: Wet-cure cementitious patching materials, including polymer-modified cementitious patching materials, for not less than seven days by water-fog spray or water-saturated absorptive cover.

3.7 DRY-PACK-MORTAR APPLICATION

A. Use dry-pack mortar for deep cavities. Place as specified in this article unless otherwise recommended in writing by manufacturer.

1. Provide forms where necessary to confine patch to required shape.
2. Wet substrate and forms thoroughly and then remove standing water.

B. Place dry-pack mortar into cavity by hand, and compact tightly into place. Do not place more material at a time than can be properly compacted. Continue placing and compacting until patch is approximately level with surrounding surface.

C. After cavity is filled and patch is compacted, trowel surface to match profile and finish of surrounding concrete. A thin coat of patching mortar may be troweled into the surface of patch to help obtain required finish.

D. Wet-cure patch for not less than seven days by water-fog spray or water-saturated absorptive cover.

3.8 CONCRETE PLACEMENT

A. Place concrete according to Section 033000 "Cast-in-Place Concrete” and as specified in this article.

B. Standard Placement: Place concrete by form-and-pump method unless otherwise indicated.

1. Use vibrators to consolidate concrete as it is placed.
2. At unformed surfaces, screed concrete to produce a surface that when finished with patching mortar will match required profile and surrounding concrete.

C. Form-and-Pump Placement: Place concrete by form-and-pump method where indicated.

1. Design and construct forms to resist pumping pressure in addition to weight of wet concrete. Seal joints and seams in forms and where forms abut existing concrete.
2. Pump concrete into place from bottom to top, releasing air from forms as concrete is introduced. When formed space is full, close air vents and pressurize to 14 psi (96 kPa).

D. Wet-cure concrete for not less than seven days by leaving forms in place or keeping surfaces continuously wet by water-fog spray or water-saturated absorptive cover.

E. Fill placement cavities with dry-pack mortar and repair voids with patching mortar. Finish to match surrounding concrete.

3.9 EPOXY CRACK INJECTION

A. Clean cracks with oil-free compressed air or low-pressure water to remove loose particles.

B. Clean areas to receive capping adhesive of oil, dirt, and other substances that would interfere with bond.

C. Place injection ports as recommended by epoxy manufacturer, spacing no farther apart than thickness of member being injected. Seal injection ports in place with capping adhesive.

D. Seal cracks at exposed surfaces with a ribbon of capping adhesive at least 1/4 inch (6 mm) thick by 1 inch (25 mm) wider than crack.

E. Inject cracks wider than 0.003 inch (0.075 mm) to a depth of 8 inches (200 mm).

F. Inject epoxy adhesive, beginning at widest part of crack and working toward narrower parts. Inject adhesive into ports to refusal, capping adjacent ports when they extrude epoxy. Cap injected ports and inject through adjacent ports until crack is filled.

G. After epoxy adhesive has set, remove injection ports and grind surfaces smooth.

3.10 POLYMER OVERLAY APPLICATION

A. Apply polymer overlay according to ACI 503.3.

B. Apply to traffic-bearing surfaces, including parking areas and walks.

3.11 POLYMER SEALER APPLICATION

A. Apply polymer sealer by brush, roller, or airless spray at manufacturer's recommended application rate.

B. Apply to traffic-bearing surfaces, including parking areas and walks.

3.12 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Perform the following tests and inspections:

1. Packaged, Cementitious Patching Mortar: 5 randomly selected sets of samples for each type of mortar required, tested according to ASTM C 928/C 928M.
2. Job-Mixed Patching Mortar: 5 randomly selected sets of samples for each type of mortar required, tested for compressive strength according to ASTM C 109/C 109M.
3. Concrete: As specified in Section 033000 "Cast-in-Place Concrete."
4. Grout for Preplaced Aggregate: Tested for compressive strength according to ASTM C 942.

    a. Testing Frequency: One sample for each 25 cu. yd. (19 cu. m) of grout or fraction thereof, but not less than one sample for each day's work.

5. Joint Filler: Core-drilled samples to verify proper installation.

    a. Testing Frequency: One sample for each 100 feet (30 m) of joint filled.
    b. Where samples are taken, refill holes with joint filler.

6. Epoxy Crack Injection: Core-drilled samples to verify proper installation.

    a. Testing Frequency: One sample for each 100 feet (30 m) of crack injected.
    b. Where samples are taken, refill holes with epoxy mortar.

C. Product will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

END OF SECTION 030130

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SECTION 033000 – CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 SUMMARY

A. All concrete work shown within the Air Traffic Control Tower buildings is governed by this section. Refer to Section P-610 for structural Portland Cement Concrete applicable to sidewalks, drainage structures, drainage pipe, curb, gutter, chain link fence footings, and electrical/utility encasements.

B. Concrete strength not otherwise designated shall be 4000 psi, as determined by the use of ASTM C31 and C39.

1.2 SUBMITTALS

A. Shop Drawings: Submit shop drawings for fabrication, bending, and placement of concrete reinforcement. Comply with ACI Manual 315 "Manual of Standard Practice for Detailing Reinforced Concrete Structures" showing bar schedules, stirrup spacing, diagrams of bent bars, arrangement of reinforcement. Show location of planned construction joints.

B. Manufacturer's Data: Submit manufacturer's product data, specifications with application and installation instructions for proprietary materials and items, including admixtures, bonding agents, waterstops, joint systems, curing and sealing compounds, chemical hardeners and dry shake finish materials.

C. Mix Design Test Reports: Submit proportions and testing facility reports for each proposed mix. Tests for mixes to be placed by pumping shall be made on samples from discharge end of similar pumping equipment. The submittal shall demonstrate compliance with ACI 318 Chapter 5. Concrete placed prior to approval of the mix shall be subject to removal and replacement as directed by the Architect-Engineer.

D. Field Test Reports: The independent testing laboratory shall provide reports as described herein.

1. Field test results shall be reported in writing to the Architect-Engineer and Contractor on the same day that tests are made.

2. Reports of compressive strength tests shall contain the project title and AEP file number, date of concrete placement, name of Contractor, name of concrete supplier and truck number, name of concrete testing service, concrete mix number, location of concrete batch in the structure, batch time, placement time, quantity of any added water, slump, design and actual compressive strength and type of break for both 7-day tests and 28-day tests.

3. If core tests become necessary, the core test results shall include the project identification name and number, date, name of Contractor, name of concrete testing service, location of test core in structure, concrete mix number represented by core sample, nominal maximum size aggregate, design compressive strength, compression breaking strength and type of break (corrected for length-diameter ratio, direction of applied load to core with respect to horizontal plan of the concrete as placed and the moisture condition of the core at time of testing.

1.3 QUALITY ASSURANCE

A. Codes and Standards: Comply with the provisions of the following codes, specifications and standards, except as otherwise shown or specified. Where provisions of these codes and standards are in conflict with the building code in force for this project, the building code shall govern.

1. ACI 301 "Specifications for Structural Concrete for Buildings."

2. ACI 302 "Guide for Concrete Floor and Slab Construction."

3. ACI 318 "Building Code Requirements for Reinforced Concrete."

4. ACI 304 "Recommended Practice for Measuring, Mixing, Transporting and Placing Concrete."

5. ACI 311 "Recommended Practice for Concrete Inspection."

6. ACI 347 "Recommended Practice for Concrete Formwork."

7. ACI 117 "Standard Tolerances for Concrete Construction and Materials."

8. AWS D1.4 "Structural Welding Code-Reinforcing Steel."

9. CRSI "Manual of Standard Practice."

B. Workmanship: The Contractor is responsible for correction of concrete work which does not conform to the specified requirements, including strength, tolerances and finishes. Correct deficient concrete as directed by the Architect-Engineer. Should construction or cold joints occur in an unapproved location or cylinders and cores indicate unacceptable concrete, load testing or removal and replacement of the concrete may be required as directed by the Architect-Engineer at no cost to the Owner.

C. Design Mix: The Contractor shall employ, at his own expense, or obtain reports from a testing laboratory experienced in testing of concrete materials and mixes to perform material evaluation tests for the design of concrete mixes. Testing agency shall meet the requirements of ASTM E329.

D. Quality Control Testing During Construction: Specified in PART 3.

1. The Contractor shall will employ and pay an independent testing laboratory acceptable to the Architect-Engineer to perform required tests during construction.

E. Welding of reinforcing steel shall not be permitted.

PART 2 - PRODUCTS

2.1 FORM MATERIALS

A. Forms for Exposed Finish Concrete:

1. Unless otherwise shown or specified, construct formwork for exposed concrete surfaces with plywood, metal-framed plywood faced or other acceptable panel-type materials, to provide continuous, straight, smooth, exposed surfaces. Furnish in largest practicable sizes to minimize number of joints and to conform to joint system shown on drawings. Provide form material with sufficient

thickness to withstand pressure of newly-placed concrete without bow or deflection.

2. Use overlaid plywood complying with U. S. Product Standard PS-1 "B-B High Density Overlaid Concrete Form," Class I.

B. Form for Unexposed Finish Concrete: Form concrete surface which will be unexposed in finished structure with plywood, lumber, metal or other acceptable material. Provide lumber dressed on at least two edges and one side for tight fit.

C. Form Coatings: Provide commercial formulation form-coating compounds that will not bond with, stain nor adversely affect concrete surfaces, and will not impair subsequent treatments of concrete surfaces to be cured with water or curing compound.

1. Provide bond breaker on surfaces underneath thin brick liner.

D. Form surfaces shall be blown clean.

2.2 REINFORCING MATERIALS

A. Reinforcing Bar: ASTM A615 (S1), Grade 60.

B. Galvanized Reinforcing Bar: ASTM A767, after fabrication and bending, only where specified or noted on drawings.

C. Steel Wire: ASTM A82, plain, cold-drawn, steel.

D. Welded Wire Fabric: ASTM A185, welded steel wire fabric.

E. Welded Deformed Steel Wire Fabric: ASTM A497.

F. Supports for Reinforcement: Provide supports for reinforcement including bolsters, chairs, spacers and other devices for spacing, supporting and fastening reinforcing bars and welded wire fabric in place. Use wire bar type supports complying with CRSI recommendations, unless otherwise indicated. Wood, clay brick and other devices will not be acceptable.

1. Slabs-On-Grade: Use supports or horizontal runners where wetted base material will not support chair legs.

2. Exposed-To-View Concrete Surfaces: Where legs of supports are in contact with forms, provide supports with legs which are hot-dip galvanized or plastic protected or stainless steel protected.

2.3 CONCRETE MATERIALS

A. Portland Cement: ASTM C150, as follows:

1. Provide Type I cement, except as otherwise indicated.

2. Provide White cement where shown or scheduled.

3. Use only one brand of cement for each required type throughout the project, unless otherwise accepted by the Architect-Engineer.

B. Aggregates:

1. General: Maximum aggregate size shall not be larger than 1/5 of the narrowest dimension between sides of forms, 1/3 of the depths of slabs, nor 3/4 of the minimum clear spacing between individual reinforcing bars or bundles of bars. Provide aggregates from one source of supply to ensure uniformity in color, size and shape.

2. Normal Weight Aggregates: ASTM C33, and as herein specified. Local aggregates not complying with ASTM C33 but which have shown by special test or actual service to produce concrete of adequate strength and durability may by used when acceptable to the Architect-Engineer.

   a. Fine Aggregate: Clean, sharp, natural sand free from loam, clay, lumps or other deleterious substances.
   b. Coarse Aggregate: Clean, uncoated, processed aggregate containing no clay, mud, loam, or foreign matter, as follows:

      1) Crushed stone, processed from natural rock or stone.

      2) Washed gravel, either natural or crushed. Use of pit or bank run gravel is not permitted.

3. Lightweight Aggregate: ASTM C330.

C. Water: Clean, fresh, drinkable.

D. Admixtures: Provide admixtures produced by established reputable manufacturers and use in compliance with the manufacturer's printed directions. Do not use admixtures which have not been incorporated and tested in accepted mixes unless otherwise authorized in writing by the Architect-Engineer.

1. Air-Entraining Admixture: ASTM C260.

2. Water-Reducing Admixture: ASTM C494, Type A.

3. Set-Control Admixture: ASTM C494, as follows:

   a. Type D, Water-reducing and Retarding.

   b. Type E, Water-reducing and Accelerating.

4. Fly Ash: ASTM C618, Class F.

5. Chloride Ions: Do not use calcium chloride in concrete unless otherwise authorized in writing by the Architect-Engineer. Do not use admixtures containing chloride ions in excess of amount found in municipal potable water.

6. Superplasticizer: ASTM C494, Type F, not containing more chloride ions than potable water.

2.4 RELATED MATERIALS

A. Waterstops: Provide flat, dumbbell type or centerbulb type waterstops at construction joints and other joints as shown. Size to suit joints.

1. Rubber or PVC waterstops, at Contractor's option, with rubber units complying with Corps of Engineers CRD-C513 and PVC units complying with CRD-C572.

B. Preformed Expansion Joint Fillers: Fiber type conforming to ASTM D1751 or Cork, ASTM D1752, Type II.

C. Joint Sealing Compound: See Division 7.

D. Moisture Barrier: See Division 7.

E. Chemical Hardener: Colorless aqueous solution containing a blend of magnesium fluosilicate and zinc fluosilicate combined with a wetting agent, containing not less than two pounds of fluosilicates per gal.

F. Nonslip Aggregate Finish: Provide fused aluminum oxide grits, or crushed emery, as abrasive aggregate for nonslip finish with emery aggregate containing not less than 40 percent aluminum oxide and not less than 25 percent ferric oxide. Use material that is factory-graded, packaged, rust-proofed and nonglazing, and is unaffected by freezing, moisture and cleaning materials.

G. Color Wear-Resistant Finish: Packages, dry, combination of materials, consisting of Portland cement, graded quartz aggregate, coloring pigments and dispersing agents. Use coloring pigments that are finely ground, nonfading mineral oxides, interground with the cement. Color, as selected by Architect-Engineer, unless otherwise indicated.

H. Nonshrink Grout:

1. As specified in Section 051200 - STRUCTURAL STEEL FRAMING

I. Curing Materials:

1. Absorptive Cover: Burlap cloth made from jute or kenaf, weighing approximately 9 ounces per square yard, complying with AASHTO M 182, Class 3.

2. Moisture-Retaining Cover: One of the following, complying with ASTM C171.

a. Waterproof paper.

b. Polyethylene film.

c. Polyethylene-coated burlap.

3. Membrane-Forming Curing Compound: ASTM C309, Type I. Fully dissipating type compatible with all subsequently applied sealers, finishes, and other materials.

J. Repair Materials: Proprietary systems recommended by the manufacturer for the specific applications required. Examples are as follows:

1. Bonding Compound: Sikadur 32 Hi-Mod LPL.

2. Patching Mortar: Sikatop 111 and 122.

3. Injection Adhesive: Sikadur 35 Hi-Mod LV.

2.5 PROPORTIONING AND DESIGN OF MIXES

A. General:

1. All concrete shall contain a minimum of 5-1/2 sacks of cement per cubic yard. Tremie concrete, where required, shall contain a minimum of seven sacks of cement per cubic yard.

2. All concrete not specifically designated shall be proportioned for a compressive strength of 4000 pounds per square inch at 28 days of age.

3. Water-Cement Ratio: All concrete subjected to freezing and thawing and all concrete used for caisson work shall have a maximum water-cement ratio of 0.45.

B. Slump Limits:

Type of Construction	Slump in Inches Design	Tolerance
Reinforced foundation walls and footing	3-1/2	+/- 1-1/2
Slabs and beams	4	+/- 1
Reinforced walls and columns	4-1/2	+/- 1-1/2
Concrete Pavements	1-1/2	+/- 1/2
Masonry Cell fill	9	+/- 1
Caissons	6	+/-1

1. Where use of superplasticizer is permitted, the slump shall be no greater than the design slump prior to addition of the admixture, and no greater than the supplier's recommendations, as indicated on the approved mix design submittal, after addition of the admixture.

2. For pump placement of concrete the slump shall be in accordance with the above limits at point of discharge. At the point of entry the slump shall not exceed the design slump plus the tolerance by more than 1 inch.

C. Proportion mixes by either trial mixture or field experience methods, using materials to be employed on the project for each class of concrete required, complying with ACI 211.1 for normal weight concrete. Mix design proportioning shall be in accordance with ACI 318 Chapter 5 including all required documentation.

D. Admixtures:

1. Use air-entraining admixture in all concrete, unless otherwise indicated. Add air-entraining admixture at the manufacturer's prescribed rate to result in concrete at the point of placement having 4-1/2 percent entrained air with tolerance in either direction from this optimum of 1-1/2 percent for normal weight concrete. Provide additional entrained air for small aggregate concrete where required for conformance with ACI 318 Table 4.2.1. Interior slabs in conditioned spaces to receive a trowel finish are not required to contain air-entraining admixture.

2. Use amounts of admixtures as recommended by the manufacturer for climatic conditions prevailing at the time of placing and approved in the mix design for the work. Adjust quantities and types of admixtures as required to maintain quality control.

E. Lightweight Concrete:

1. Proportion the mix as herein specified. Design the mix to produce the strength as noted on the drawings. The air dry weight determine in accordance with ASTM C567 shall not be less than 107 pounds or more than 116 pounds after 28 days. Limit drying shrinkage to 0.03 percent at 28 days. Aggregates shall be presoaked in accordance with ACI 304.2R when placement of concrete is by pumping.

2. The responsibility for providing concrete within the specified dry weight limits is the Contractor's; however, concrete arriving at the job site with a wet weight in excess of 125 psf, as determined by ASTM C138 and C567, is subject to rejection.

F. Adjustment to Concrete Mixes: Mix design adjustments may be requested by the Contractor when characteristics of materials, job conditions, weather, test results, or other circumstances warrant; at no additional cost to the Owner and as accepted by the Architect-Engineer. Laboratory test data for revised mix designs and strength results shall be submitted to and accepted by the Architect-Engineer before using in the work.

2.6 PUMP PLACEMENT EQUIPMENT

A. Minimum inside diameter of the pipe line shall be at least three times the maximum coarse aggregate size.

B. Aluminum pipe shall not be used.

C. Pump shall have an actual field service demonstrated capacity of placing not less than 25 cubic yards per hour.

D. Standby placement capability equal to that being used shall be available on the job site at all times during pumping.

2.16 VAPOR RETARDER

A. Plastic Vapor Retarder: ASTM E 1745, Class A. Include manufacturer's recommended adhesive or pressure-sensitive tape.

1. Products:

a. Fortifiber Corporation; Moistop Ultra A.
b. Raven Industries Inc.; Vapor Block 15.
c. Reef Industries Inc.; Griffolyn Type-65G.
d. Approved equivalent.

B. Place, protect and repair vapor retarders according to ASTM E 1643 and manufacturer's written instructions."

2.17 SEALING COMPOUND

A. Clear, Waterborne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1, Class A.

1. Products:

a. ChemMasters; Polyseal WB.

b. Euclid Chemical Company (The); Super Diamond Clear VOX.
c. Lambert Corporation; UV Safe Seal.
d. Meadows, W.R., Inc.; Vocomp-30.
e. Tamms Industries, Inc.; LusterSeal WB 300.
f. Approved equivalent.

B. Prepare, apply, and finish penetrating liquid floor sealers according to manufacturer's written instructions."

PART 3 - EXECUTION

3.1 FORMS

A. Design: Design of formwork, including shoring and reshoring, for structural stability and sufficiency is the Contractor's responsibility. Refer to Paragraph 3.9 - Shores and Supports herein. Design, erect, support, brace and maintain formwork to support vertical and lateral loads that might be applied until such loads can be supported by the concrete structure.

B. Construction: Construct forms complying with ACI 347, to sizes, shapes, lines and dimensions shown, and to obtain accurate alignment, location, grades, level and plumb work in finished structures. Provide for openings, offsets, keyways, recesses, moldings, rustications, reglets, chamfers, blocking, screeds, bulkheads, anchorages and inserts, and other features required in work. Provide top forms for inclined surfaces where slope is too steep to place concrete with bottom forms only. Use selected materials to obtain required finishes. Solidly butt joints and provide back-up joints to prevent leakage of cement paste.

C. Provisions for Removal: Fabricate forms for easy removal without hammering or prying against the concrete surfaces. Provide crush plates or wrecking plates where stripping may damage cast concrete surfaces. Kerf wood inserts for forming keyways, reglets, and recesses to prevent swelling and for easy removal.

D. Accessibility: Provide temporary openings where interior area of formwork is inaccessible for cleanout, for inspection before concrete placement, and for placement of concrete. Securely brace temporary openings and set tightly to forms to prevent loss of concrete mortar. Locate temporary openings on forms at inconspicuous locations.

E. Edges: Chamfer exposed corners and edges 3/4 inches, unless otherwise noted, using wood, metal, PVC, or rubber chamfer strips fabricated to produce uniform smooth lines and tight edge joints.

F. Form Ties: Factory-fabricated, adjustable-length, removable or snapoff metal form ties, designated to prevent from deflection, and to prevent spalling concrete surfaces upon removal.

1. Unless otherwise shown, provide ties so portion remaining within concrete after removal is at least 1-1/2 inch inside concrete.

2. Unless otherwise shown, provide form ties which will not leave holes larger than 1-inch diameter in concrete surface.

G. Provisions for Other Trades: Provide openings in concrete formwork to accommodate work of other trades. Determine size and location of opening, recesses and chases from trades providing such items. Accurately place and securely support items built into forms.

H. Cleaning and Tightening: Thoroughly clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt or other debris just before concrete is placed. Retighten forms after concrete placement if required to eliminate mortar leaks.

I. Preparation of Form Surfaces:

1. Coat contact surfaces of forms with a form-coating compound before reinforcement is placed.

2. Thin form-coating compounds only with thinning agent of type, and in amount, and under conditions of the form-coating compound manufacturer's directions. Do not allow excess form-coating material to accumulate in the forms or to come into contact with concrete surfaces against which fresh concrete will be placed. Apply in compliance with manufacturer's instructions.

3. Coat steel forms with a nonstaining, rust-preventative form oil or otherwise protect against rusting. Rust-stained formwork is not acceptable.

J. Slab on Grade: Coordinate with items installed by other trades. Verify compliance with applicable Division 32 requirements for subgrade preparation and maintenance prior to placement of reinforcing and concrete.

3.2 PLACING REINFORCEMENT

A. References: Comply with the specified codes and standards, and Concrete Reinforcing Steel Institute's recommended practice for "Placing Reinforcing Bars", for details and methods of reinforcement placement and supports, and as herein specified.

B. Preparation: Clean reinforcement of loose rust and mill scale, hardened concrete paste, earth, ice, and other materials which reduce or destroy bond with concrete.

C. Support: Accurately position, support and secure reinforcement against displacement by formwork, construction, or concrete placement operations. Locate and support reinforcing by metal chair, runners, bolsters, spacers, and hangers, as required. Set wire ties so ends are directed into concrete, not toward exposed concrete surfaces. Do not place reinforcing bars more than 2 inches beyond the last leg of continuous bar support. Do not use supports as bases for runways for concrete conveying equipment and similar construction loads.

D. Coverage: Place reinforcement to obtain at least the minimum coverages for concrete protection.

E. Splices: Provide standard reinforcement splices by lapping ends, placing bars in contact, and tightly wire tying.

F. Do not drop reinforcement on think brick liners

3.3 JOINTS

A. Construction Joints: Locate and install construction joints, which are not shown on the drawings, so as not to impair the strength and appearance of the structure, as acceptable to the Architect-Engineer.

1. Provide keyways at least 1-1/2-inch deep in all construction joints in walls, slabs, beams and between walls and footings; accepted bulkheads designed for this purpose may be used for slabs.

2. Place construction joints perpendicular to the main reinforcement. Continue all reinforcement across construction joints.

B. Waterstops: Provide waterstops in construction joints as shown on the drawings. Install waterstops to form a continuous diaphragm in each joint. Make provisions to support and protect waterstops during the progress of the work. Fabricate field joints in waterstops in accordance with manufacturer's printed instructions. Protect waterstop material from damage where it protrudes from any point.

C. Expansion Joints in Slabs-on-Ground: Construct isolation joints in slabs on ground at all points of contact between slabs on ground and vertical surfaces, such as column pedestals, foundation walls, grade beams and elsewhere as indicated.

D. Construction (Control) Joints in Slabs-on Ground: Provide contraction joints in slabs-on-ground to form panels of patterns as shown. Use saw cuts or approved inserts creating a plane of 1/4 slab thickness. Saw cuts shall be made as soon as possible after final finishing without dislodging the aggregate, but in no case later than 12 hours after placement. Form contraction joints by inserting an approved plastic strip into the fresh concrete using manufacturer's standard straightedge setting tool until the top surface of the strip is flush with the slab surface. Prior to the concrete being floated, remove the top strip.

3.4 INSTALLATION OF EMBEDDED ITEMS

A. General: Set and build into the work anchorage devices and other embedded items required for other work that is attached to, or supported by, cast-in-place concrete. Use templates, setting drawings, diagrams, instructions and directions provided by suppliers of the items to be attached.

B. Edge Forms and Screed Strips for Slabs: Set edge forms or bulkheads and intermediate screed strips for slabs to obtain the required elevations and contours in the finished slab surface. Provide and secure units sufficiently strong to support the types of screed strips by the use of strike-off templates or accepted compacting type screeds.

3.5 CONCRETE MIXING

A. General: Mix materials in an acceptable drum type batch machine mixer. For mixers of one cubic yard, or smaller capacity, continue mixing at least 1-1/2 minutes, but not more than 5 minutes after all ingredients are in the mixer, before any part of the batch is released. For mixers of capacity larger than one cubic yard, increase the minimum 1-1/2 minutes of mixing time by 15 seconds for each additional cubic yard, or fraction thereof. Provide a batch ticket for each batch discharged and used in the work, indicating the project identification name and number, date, mix type, mix time, quantity, and amount of water introduced.

B. Job-Site Mixing: This method is acceptable only for small quantities of concrete.

C. Ready-Mix Concrete: Comply with the requirements of ASTM C94 or ASTM C685, and as herein specified.

1. During hot weather, or under conditions contributing to rapid setting of concrete, a shorter mixing time than specified in ASTM C94 may be required. When the air temperature is between 85 degrees F and 90 degrees F, reduce the mixing and delivery time from 1-1/2 hours to 75 minutes, and when the air temperature is above 90 degrees F, reduce the mixing and delivery time to 60 minutes.

2. No additional water shall be added to concrete without the approval of the Architect-Engineer. Should additional water be required to obtain a slump as specified in this section for the type of concrete, the Contractor shall perform slump tests in accordance with ASTM C143 to determine the actual slump of the concrete in the mixer. The Contractor may then add water, but in no case shall the additional water exceed three percent of the mix-design water content, nor shall the slump of the mix exceed the maximum slump specified for the type concrete. Slump tests and the addition of water to the mixer shall be completed within 15 minutes of the arrival of the mixer at the site. Additional water shall not be added to the mix after the mixer has been on the site longer than 15 minutes. Where use of a superplasticizer is permitted, redosage with a high range water reducing admixture (superplasticizer) to maintain slump during the placing operation may be done only with prior approval of the supplier as to method and procedure.

3. A delivery ticket showing truck number, date, and time that mixing was started shall be given to the Contractor's superintendent at the job site before placing the concrete from the truck mixer. At the job site the Contractor's superintendent shall note on the delivery ticket the time of completion of the concrete placement from the truck and the general area of the structure in which the concrete was placed. A complete file of all delivery tickets shall be maintained and kept available at the job site until completion of the project.

3.6 CONCRETE PLACEMENT

A. General: Comply with ACI 304, and as herein specified.

B. Preplacement Inspection: Before placing concrete, inspect and complete the formwork installation, reinforcing steel, and items to be embedded or cast-in. Thoroughly wet wood forms immediately before placing concrete where form coatings are not used (do not wet thin brick). Coordinate the installation of joint materials and moisture barriers with placement of forms and reinforcing steel.

C. Monolithic Placement: Deposit concrete continuously or in layers of such thickness that no concrete will be placed on concrete which has hardened sufficiently to cause the formation of seams or places of weakness within the section. If a section cannot be placed continuously, provide construction joints as herein specified. Deposit concrete as nearly as practicable to its final location to avoid segregation due to rehandling or flowing. Maintain reinforcing in the proper position during concrete placement operation.

1. Do not disturb thin brick location during concrete placement.
2. Discharge concrete approximately 6” above thin brick

D. Placing Concrete in Forms: Deposit concrete in forms in horizontal layers not deeper than 24 inches and in a manner to avoid inclined cold joints. Where placement consists of several layers, place each layer while preceding layer is still plastic to avoid cold joints.

1. Consolidate placed concrete by mechanical vibrating equipment supplemented by hand-spading, rodding or tamping. Use equipment and procedures for consolidation of concrete in accordance with the recommended practices of ACI 309, to suit the type of concrete and project conditions. Lower frequency vibrators may be used with authorized 8 inches or greater slump concrete.

2. Do not use vibrators to transport concrete inside of forms. Insert and withdraw vibrators vertically at uniformly spaced locations not farther than the visible effectiveness of the machine. Place vibrators to rapidly penetrate the placed layer of concrete and at least 6 inches into the preceding layer. At each insertion limit the duration of vibration to the time necessary to consolidate the concrete and complete embedment of reinforcement and other embedded items without causing segregation of the mix.

E. Placing Concrete Slabs:

1. Deposit and consolidate concrete slabs in a continuous operation, within the limits of construction joints, until the placing of a panel or section is completed.

2. Bring slab surfaces to the correct level with a straightedge and strike-off. Use bull floats or darbies to smooth the surface, leaving it free of humps or hollows. Do not sprinkle water on the plastic surface. Do not disturb the slab surfaces prior to beginning finishing operations.

F. Placing Concrete Columns: Deposit concrete continuously with an unrestricted vertical drop. Pour height will not be limited provided that the stream of concrete is not separated by allowing it to fall freely over rods, spacers, reinforcement or other embedded items.

G. Pump Placement:

1. Pump lines shall be operated on decks in a fashion that will not damage, depress, or displace reinforcing steel already in place. Use hangers, trestles, or brackets, where necessary, to prevent damage or displacement of forms or reinforcing.
2. Lines from pump to the placing area shall contain a minimum number of bends.

3. When short time delays occur because of concrete delivery, form repairs, or other factors, pump shall be operated slowly to and fro to keep concrete in motion.

H. Cold Weather Placing:

1. Protect concrete work from physical damage or reduced strength which could be caused by frost, freezing actions, or low temperatures, in compliance with ACI 306 and as herein specified. When air temperature has fallen to or is expected to fall below 40 degrees F, uniformly heat all water and aggregates before mixing as required to obtain a concrete mixture temperature of not less than 50 degrees F, and not more than 80 degrees F at point of placement.

2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.

3. Do not use calcium chloride, salt and other materials containing antifreeze agents or chemical accelerators, unless otherwise accepted in mix designs.

I. Hot Weather Placing: When hot weather conditions exist that would seriously impair the quality and strength of concrete, place concrete in compliance with ACI 305 and as herein specified.

1. Wet forms thoroughly before placing concrete.

2. Do not use retarding admixtures unless otherwise accepted in mix designs.

3.7 CONCRETE FINISHING

A. Finish of Formed Surfaces:

1. Rough Form Finish: For formed concrete surfaces not exposed-to-view in the finish work or covered by other construction, unless otherwise indicated. This is the concrete surface, having the texture imparted by the form facing material used, with tie holes and defective areas repaired and patched and fins and other projections exceeding 1/4 inch in height rubbed down or chipped off.

2. Smooth Form Finish: For formed concrete surfaces exposed-to-view, or that are to be covered with a coating material applied directly to the concrete, or a covering material bonded to the concrete, such as waterproofing, dampproofing, painting or other similar system. This is the as-cast concrete surface as obtained with selected form facing material, arranged orderly and symmetrically with a minimum of seams. Repair and patch defective areas and form tie holes with all fins or other projections completely removed and smoothed immediately after removal and, for form work not supporting weight of concrete, no later than 72 hours after placement.

3. Smooth Rubbed Finish: Provide smooth rubbed finish to scheduled concrete surfaces, which have received smooth form finish treatment, not later than the day after form removal. Moisten concrete surfaces and rub with carborundum brick or other abrasive until a uniform color and texture is produced. Do not apply cement grout other than that created by the rubbing process.

4. Grout Cleaned Finish: Provide grout cleaned finish to scheduled concrete surfaces which have received smooth form finish treatment.

a. Combine one part portland cement to 1-1/2 parts fine sand by volume, and mix with water to the consistency of thick paint. Blend standard portland cement and white portland cement, amounts determined by trial patches, so that the final color of dry grout will closely match adjacent surfaces using an approved bonding agent.

b. Thoroughly wet concrete surfaces and apply grout immediately to coat surfaces and fill small holes. Remove excess grout by scraping and rubbing with clean burlap. Keep damp by fog spray for at least 36 hours after rubbing.

B. Finish of Unformed Surfaces:

1. Unformed Surfaces Related to Formed Surfaces. At tops of walls, horizontal offsets and similar unformed surfaces occurring adjacent to formed surfaces, strike-off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces, unless otherwise shown.

2. Monolithic Slab Finishes: Water shall not be applied during finishing operations.

a. Scratch Finish: Apply scratch finish to monolithic slab surfaces that are to receive concrete floor topping or mortar setting beds for tile, portland cement terrazzo, and other bonded applied cementitious finish flooring material, and as otherwise shown on drawings. After placing slabs, plane surface to a tolerance so that depressions between high spots do not

exceed 1/2 inch under a 1 foot straightedge. Slope surfaces uniformly to drains where required. After leveling, roughen surface before final set, with stiff brushes, brooms or rakes.

b. Float Finish: Apply float finish to monolithic slab surfaces that are to receive trowel finish and other finishes as hereinafter specified, and slab surfaces which are to be covered with membrane or elastic waterproofing, membrane or elastic roofing, or sandbed terrazzo, and as otherwise shown on drawings or in schedules. After screening and consolidating concrete slabs, do not work surface until ready for floating. Begin floating when surface water has disappeared or when concrete has stiffened sufficiently to permit operation of power-driven floats, or both. Consolidate surface with power-driven floats, or by hand-floating if area is small or inaccessible to power units. Check and level surface plane so that depressions between high spots do not exceed 5/16 inch under a 10-foot straightedge. Cut down high spots and fill low spots. Uniformly slope surfaces to drains. Immediately after leaving, refloat surface to a uniform, smooth, granular texture.

c. Trowel Finish: Apply trowel finish to monolithic slab surfaces that are to be exposed-to-view, unless broom finish is required or as otherwise shown, and slab surfaces that are to be covered with resilient flooring, paint or other thinfilm finish coating system. After floating, begin first trowel finish operation using a power driven trowel. Begin final troweling when surface produces a ringing sound as trowel is moved over surface. Consolidate concrete surface by final hand-troweling to produce surface free of trowel marks, uniform in texture and appearance, and with a surface plane tolerance so that depression between high spots do not exceed 3/16 inch under a 10-foot straightedge. Grind smooth surface defects which would telegraph through applied floor covering system.

d. Nonslip Broom Finish: Apply nonslip broom finish to exterior concrete platforms, steps, sidewalks, and ramps, and elsewhere as shown on drawings or in schedules. Immediately after float finishing, slightly roughen concrete surface by brooming with fiber bristle broom perpendicular to main traffic route. Texture shall be approved by Architect-Engineer from sample panels.

e. Chemical-Hardener Finish: Apply chemical-hardener finish to interior concrete floors where shown on drawings or in schedules. Apply liquid chemical-hardener after complete curing and drying of the concrete surface. Dilute liquid hardener with water, and apply in 3 coats; first coat, 1/3 strength; second coat, 1/2 strength; third coat, 2/3 strength. Evenly apply each coat, and allow 24 hours for drying between coats.

1) Apply proprietary chemical-hardeners, in accordance with manufacturer's printed instructions.

2) After final coat of chemical-hardener solution is applied and dried, remove surplus hardener by scrubbing and mopping with water.

f. Nonslip Aggregate Finish: When specifically indicated on the drawings or in schedules, apply nonslip aggregate finish to concrete stair treads, platforms, ramps, and elsewhere as shown or scheduled.

1) After completion of float finishing, and before starting trowel finish, uniformly spread 25 pounds of dampened nonslip aggregate per 100 square feet of surface. Tamp aggregate flush with surface using a steel trowel, but do not force the nonslip aggregate particles below surface. After broad-casting and tamping, apply trowel finishing as herein specified.

2) After curing, lightly work the surface with a steel wire brush, or an abrasive stone, and water to expose the nonslip aggregate.

g. Colored Mineral Aggregate Hardener: Provide colored mineral aggregate hardener finish to monolithic slab surface where shown on drawings or in schedules.

1) Apply dry shake materials for colored mineral aggregate hardener finish at the rate of not less than 100 pounds per 100 square feet, unless greater amount is recommended by material manufacturer.

2) Immediately following first floating operation, uniformly distribute approximately 2/3 of required weight of dry shake material over concrete surface, and embed by means of power floating. Follow the floating operation with the second shake application, uniformly distributing remainder of dry shake material at right angles to first application, and embed by power floating.

3) After completion of broadcasting and floating, apply trowel finish as herein specified.

4) Apply the clear curing and sealing compound immediately after final finish.

5) Epoxy Joint Filler: All interior joints, in areas receiving the colored mineral aggregate hardener, shall be filled with epoxy joint filler which shall be mixed and installed in strict accordance with the manufacturer's directions. Joints shall not be filled sooner than 90 days after slab placement.

3.8 CONCRETE CURING AND PROTECTION

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperature, and maintain without drying at a relatively constant temperature for a period of time necessary for hydration of cement and proper hardening.

1. Start initial curing as soon as free water has disappeared from concrete surface after placing and finishing. Continue curing for at least 7 days for concrete containing Type 1 cement and 14 days for concrete containing Type II cement. Curing shall be in accordance with ACI 301 procedures. Avoid rapid drying at end of curing period.

B. Curing Methods: Perform curing of concrete by moist curing, by moisture-retaining cover curing, by membrane curing, and by combinations thereof, as herein specified.

1. Provide moist curing by following methods:

a. Keep concrete surface continuously wet by covering with water.

b. Continuous water-fog spray.

c. Covering concrete surface with specified absorptive cover, thoroughly saturating cover with water and keeping continuously wet. Place absorptive cover to provide coverage of concrete surfaces and edges, with 4-inch lap over adjacent absorptive covers. Use Material that will not stain concrete surface.

2. Provide moisture-cover curing as follows: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width with sides and ends lapped at least 3 inches and sealed by waterproof tape or adhesive. Immediately repair any holes or tears during curing period using cover material and waterproof tape.

3. Provide membrane curing as follows:

a. Apply compound uniformly in continuous operation by power-spray or roller in accordance with manufacturer's directions. Recoat areas which are subjected to heavy rainfall within 3 hours after initial application. Maintain continuity of coating and repair damage during curing period.

3.9 SHORES AND SUPPORTS

A. Design: Comply with ACI 347 for shoring and reshoring in multistory construction, and as herein specified. Contractor shall engage the services of a professional structural engineer to design shoring and reshoring and prepare and seal drawings for shoring and reshoring. Engineer shall be registered in the state where the project is located.

B. Reshoring: Remove shores and reshore in a planned sequence to avoid damage to partially cured concrete. Locate and provide adequate reshoring to safely support the work without excessive stress or deflection.

C. Duration: Keep reshores in place a minimum of 15 days after placing upper tier, and longer if required, until the concrete has attained its required 28-day strength and heavy loads due to construction operations have been removed.

3.10 REMOVAL OF FORMS

A. Nonsupporting: Formwork not supporting weight of concrete, such as sides of beams, walls, columns, and similar parts of the work, may be removed after cumulatively curing at not less than 50 degrees F for 24 hours after placing concrete, provided concrete is sufficiently hard to not be damaged by form removal operations, and provided curing and protection operations are maintained.

B. Supporting: Formwork supporting weight of concrete, such as beam soffits, joists, slabs and other structural elements, may not be removed in less than 14 days or until concrete has attained two thirds design compressive strength at 28-days. Determine potential compressive strength of in-place concrete by testing field-cured specimens representative of concrete location or members.

C. Facing Material: Form facing material may be removed 4 days after placement, only if shores and other vertical supports have been arranged to permit removal of form facing material without loosening or disturbing shores and supports.

3.11 REUSE OF FORMS

A. Clean and repair surfaces of forms to be reused in the work. Split, frayed, delaminated or otherwise damaged form facing material will not be acceptable. Apply new form coating compound material to concrete contact form surfaces as specified for new formwork.

B. When forms are extended for successive concrete placement, thoroughly clean surfaces, remove fins and laitance, and tighten forms to close joints. Align and secure joints to avoid offsets. Do not use "patched" forms for exposed concrete surfaces.

3.12 MISCELLANEOUS CONCRETE ITEMS

A. Filling-In: Fill-in holes and openings left in concrete structures for passage of work by other trades, unless otherwise shown or directed, after work of other trades is in place. Mix, place and cure concrete as herein specified, to blend with in-place construction. Provide other miscellaneous concrete filling shown or required to complete work.

B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and steel-troweling surfaces to a hard, dense finish with corners, intersections and terminations slightly rounded.

C. Equipment Bases and Foundations: Provide machine and equipment bases and foundations, as specified or shown on drawings. Set anchor bolts for machines and equipment to template at correct elevations, complying with certified diagrams or templates of the manufacturer furnishing machines and equipment.

D. Steel Pan Stairs: Provide concrete fill for steel pan stair treads and landings and associated items. Cast-in safety inserts and accessories as shown on drawings. Screed, tamp and finish concrete surfaces as specified or scheduled.

E. Nonshrink Grout:

1. Equipment bases, and other locations noted on the structural drawings, shall be grouted with nonshrink grout.
2. Exposed grout shall be the nonmetallic type.

3.13 CONCRETE REPAIRS

A. General:

1. Patching defective areas will be permitted only when Architect-Engineer rules that structural adequacy of the concrete is not endangered and the overall appearance of the work is not materially affected.

2. A proprietary bonding agent, repair mortars, and adhesives may be required, at no extra cost to the Owner to permit patching in lieu of removal and replacement of the defective area.

B. Structural Repair of Defective Areas: Provide drawings of as-built conditions and proposed repair of defective areas for determination by the Architect-Engineer of the structural acceptability of the proposal. Where structural repairs are permitted, use epoxy-based mortar or epoxy adhesive. Do not proceed with repairs prior to written approval by the Architect-Engineer.

C. Cosmetic Repair of Formed Surfaces: Remove and replace concrete having defective surfaces. Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycomb, rock pockets, fins and other projections on surface; and stains and other discolorations that cannot be removed by cleaning. Flush out form tie holes, fill with dry pack mortar, or precast cement cone plugs secured in place with bonding agent.

1. Cut out honeycomb, rock pockets, voids over 1/4 inch in any dimension, and holes left by tie rods and bolts down to solid concrete, but, in no case to a depth of less than 1 inch. Make edges of cuts perpendicular to the concrete surface. Before placing mortar or proprietary patching compound, thoroughly clean, dampen with water and brushcoat the area to be patched with patching material or bonding agent if required.

2. For exposed-to-view surfaces, blend white portland cement and standard portland cement so that, when dry, patching mortar will match color surrounding. Provide test areas at inconspicuous location to verify mixture and color match before proceeding with patching. Compact mortar in place and strike-off slightly higher than surrounding surface.
3. Repair concealed formed surfaces, where possible, that contain defects that adversely affect the durability of the concrete. If defects cannot be repaired, remove and replace the concrete.

D. Cosmetic Repair of Unformed Surfaces: Test unformed surfaces, such as monolithic slabs, for smoothness and to verify surface plane to tolerances specified for each surface and finish. Correct low and high areas as herein specified. Test unformed surfaces sloped to drain for trueness of slope, in addition to smoothness, using a template having required slope.

1. Repair finished unformed surfaces that contain defects which adversely affect durability of concrete. Surface defects include crazing, cracks in excess of 0.01 inch wide or which penetrate to reinforcement or completely through nonreinforced sections regardless of width, spalling, pop-outs, honeycomb, rock pockets, and other objectionable conditions.

2. Correct high areas in unformed surfaces by grinding, after concrete has cured at least 14 days.

3. Correct low areas in unformed surfaces during, or immediately after completion of surface finishing operations by cutting out low areas and replacing with fresh concrete. Finish repaired areas to blend into adjacent concrete. Proprietary patching compounds may be used when acceptable to the Architect-Engineer.

4. Repair defective areas, except random cracks and single holes not exceeding 1-inch diameter, by cutting out and replacing with fresh concrete. Remove defective areas to sound concrete with clean, square cuts and expose reinforcing steel with at least 3/4-inch clearance all around. Dampen concrete surfaces in contact with patching concrete, and apply bonding compound as recommended by manufacturer. Place patching concrete after the bonding compound has dried. Mix patching concrete of same materials to provide concrete of the same type or class as original concrete. Place, compact and finish to blend with adjacent finished concrete. Cure in the same manner as adjacent concrete.

5. Repair isolated random cracks and single holes not over 1 inch in diameter by dry-pack method. Groove top of cracks and cut-out holes to sound concrete and clean off dust, dirt and loose particles. Dampen cleaned concrete surfaces and apply the bonding compound. Place dry pack after the bonding compound has

dried. Mix dry-pack, consisting of one part Portland cement to 2-1/2 parts fine aggregate passing a No. 16 mesh sieve, using only enough water as required for handling and placing. Compact dry-pack mixture in place and finish to match adjacent concrete. Keep patched area continuously moist for not less than 72 hours.

E. Repair methods not specified above may be allowed, subject to acceptance by the Architect-Engineer.

3.14 FIELD QUALITY CONTROL

A. Quality Control Testing During Construction: Sampling and testing for field quality control during the placement of concrete shall include the following:

1. Sampling Fresh Concrete: ASTM C172, except as modified for slump to comply with ASTM C94. Sampling for pumped concrete shall be at the discharge end of the pump.

2. Slump: ASTM C143; one test for each concrete load at point of discharge; and one for each set of compressive strength test specimens.

3. Air Content: ASTM C231 pressure method for normal weight concrete; one for every other concrete load at point of discharge, or when the indication of change requires.

4. Concrete Temperature: Test hourly when air temperature is 40 degrees F and below, and when 80 degrees F and above; and each time a set of compression test specimens are made.

5. Compression Test Specimens: ASTM C31; one set of 4 standard cylinders for each compressive strength. Cast and store cylinders for laboratory cured test specimens and field-cured test specimens as specified in ASTM C31.

6. Compressive Strength Tests: ASTM C39; a compressive strength test consists of the average of 2 specimens tested at each required age. Obtain one set for each 100 cubic yards or fraction thereof, of each mix design placed in any one day or for each 5,000 square feet of surface area placed; 2 specimens tested at 7 days; 2 specimens tested at 28 days.

B. Additional Tests: The testing service shall make additional tests, as directed by the Architect-Engineer, of in-place concrete when test results or field observations indicate the presence of deficient concrete in the structure. The testing service may conduct tests to determine the strength and other characteristics of the in-place concrete by compression tests on cored cylinders complying with ASTM C42, or by load testing specified in ACI 318, or other acceptable nondestructive testing methods. The Contractor shall pay for tests conducted, and any other additional testing as may be required for deficient concrete.

1. Core Testing: The concrete testing service shall take cores drilled from hardened concrete for compressive strength determination, complying with ASTM C42 and as follows.

a. Take at least 3 representative cores from each member or area of suspect strength, from locations directed by the Architect-Engineer.

b. Test cores in a saturated-surface-dry condition per ACI 318 if the concrete will be wet during the use of the completed structure.

c. Test cores in an air-dry condition per ACI 318 if the concrete will be dry at all times during use of the completed structure.

d. Fill core holes solid with patching mortar and finish to match adjacent surfaces.

2. Conduct static load test and evaluation complying with ACI 318 if core tests are not sufficient to verify the strength of the concrete structure, if the results of the core tests are unsatisfactory, or if core tests are impracticable to obtain, as directed by the Architect-Engineer.

C. Injection Adhesive Dowels: A visual check will be made of all injection adhesive dowels and reinforcing bars. In addition, a minimum of 5 percent of all injection adhesive dowels will be tested for compliance with manufacturers recommended maximum allowable tension capacities. The independent testing laboratory will perform this testing. Dowels to be tested will be chosen by the Architect-Engineer. Additional injection adhesive dowels may be tested at the option of the independent testing laboratory. Following evaluation, replace and re-test all dowels that do not meet the acceptance criteria.

3.15 EVALUATION OF QUALITY CONTROL TEST

A. Acceptance Criteria: Strength-level of an individual class of concrete in place shall be considered satisfactory if, on laboratory-cured cylinders, both of the following requirements are met.

1. The average of all sets of three consecutive compressive strength tests equal or exceed the specified strength.

2. No individual compressive strength test falls below specified strength by more than 500 psi.

B. Tests of Field-Cured Cylinders: Strength test of specimens cured under field conditions shall be performed if required by the Architect-Engineer to check the adequacy of curing and protecting of the concrete placed. Specimens shall be molded by the field quality control laboratory at the same time and from the same samples as the laboratory cured specimens.

1. Provide improved means and procedures for protecting concrete when the 28-day compressive strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders.

2. When laboratory-cured cylinders strengths are appreciably higher than the minimum required compressive strength, field-cured cylinder strengths need not exceed the required strength by more than 500 psi even though the 85 percent criterion is not met.

C. Failure to Meet Acceptance Criteria:

1. Failure to meet A.1. above may require improved curing methods (as indicated by tests of field cured cylinders) or adjustment of the concrete mix to achieve compliance.

2. Failure to meet A.2. above will render the concrete represented by such tests to be considered deficient and subject to additional testing.

D. Formed Concrete Dimension Tolerances:

1. Formed concrete having any dimension smaller or greater than required, and outside the specified tolerance limits, will be considered deficient in strength and subject to additional testing as herein specified.

2. Formed concrete having any dimension greater than required will be rejected if the appearance or function of the structure is adversely affected, or if the larger dimensions interfere with other construction. Repair, or remove and replace rejected concrete as required to meet the construction conditions. When permitted, accomplish the removal of excessive material in a manner to maintain the strength of the section without affecting function and appearance.

E. Strength of Concrete Structures: Concrete is considered deficient and the strength of the concrete structure in-place is considered potentially jeopardized if concrete fails to comply with any of the requirements which control the strength of structure, including the following conditions:

1. Failure to meet compressive strength test requirements.
2. Concrete which differs from the required dimensions or location in such a manner to reduce strength.

3. Void free placement.

4. Monolithic placement between approved construction joints with no cold joints.

5. Concrete subjected to damaging mechanical disturbances, particularly load stresses, heavy shock, and excessive vibration.

6. Poor workmanship and quality control likely to result in deficient strength.

F. Acceptance Criteria for Core Tests: Strength of concrete for each series of cores will be considered satisfactory if their average compressive strength is at least 85 percent and no single core is less than 75 percent of the 28-day required compressive strength.

G. Defective Work: Concrete work which does not conform to the specified requirements, including strength, tolerances, and finishes, shall be corrected at the Contractor's expense, without extension of time therefore. The Contractor shall also be responsible for the cost of corrections to any other work affected by or resulting from corrections of the concrete work. Deficient welds will require the Contractor to provide and pay for additional X-rays and tests. Repair or replace defective welds at no cost to the Owner.

3.16 SPECIAL INSPECTIONS

A. General: Special inspection and verification of structural concrete construction shall conform to the requirements of Section 014500 – Statement of Special Inspections. Refer to Section 3.14 – FIELD QUALITY CONTROL for additional requirements.

PART 4 - METHOD OF MEASUREMENT

4.1 CURB AND GUTTER

A. Curb and gutter will be measured for payment, by the linear foot.

4.2 SIDEWALK

A. Concrete sidewalk shall be measured for payment, by the square yared.

PART 5 - BASIS OF PAYMENT (Payment will be made under the following:)

5.1 30” CURB AND GUTTER (CG-6)

5.1.1 Payments will be made under:

Item 024100 – 1: Demo of Existing ATCT - Per Lump Sum.

END OF SECTION 033000

SECTION 034100 - PRECAST CONCRETE

PART 1 -GENERAL

1.1 DESCRIPTION

A. Work Included: Furnish and install all precast concrete structures in accordance with the plans and as specified herein.

B. Related Sections: Additional Sections of the Documents which are referenced in this Section include:

1. Division 33 – Water Distribution
2. Division 33 – Sanitary Sewerage
3. Division 33 – Storm Drainage

1.2 REFERENCES

A. General: The work shall comply with the most recent standards or tentative standards as published at the date of the contract and as listed in this specification using the abbreviation shown.

B. American Society for Testing and Materials (ASTM):

1. C 443- Standard Specification for Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gasket

2. C 478- Standard Specification for Precast Reinforced Concrete Manhole Sections

C. American Association of State Highway and Transportation Officials Standards (AASHTO):

1. M 198- Joints for Circular Concrete Sewer and Culvert Pipe Using Flexible Watertight Gaskets

1.3 SYSTEM DESCRIPTION

A. General: The eccentric design manhole shall be used, except as shown on the plans.

PART 2 -PRODUCTS

2.1 MANHOLES

A. Precast Concrete Manholes: shall meet the following requirements:

1. Precast manhole shall conform to ASTM C 478.

2. Minimum inside diameter shall be 48-inches unless noted on plans, with minimum of 5-inch thick walls. All manholes shall have monolithic bases except when a new manhole is installed on an existing line. See project details.

3. Drop manholes shall be as shown in the project details.

B. Joints: Joints shall be the O-ring joint conforming to ASTM C 443 or butyl rubber rope meeting AASHTO M 198, Type B.

C. Steps: Manhole steps, according the project details, shall be provided in all manholes and shall be on 16-inch center maximum.

D. Pipe Connections:

1. Provision of the indicated pipe connections in manholes shall be made by means of an approved flexible, watertight gasket or boot.

2. Pipe connections in wetwells, through pipe sleeves, shall be in accordance with Division 33 – Sewer Collection System.

3. Existing lines shall be grouted into place.

2.2 SEPTIC TANK

A. General: Tanks shall be constructed of precast concrete having a minimum compressive strength of 5,000 psi. Each tank shall contain two access hatches at least 24 inches square or diameter to be located above the inlet and outlet of each tank. All concrete shall be rodded or vibrated to minimize honeycombing or major surface blemishes. The interiors of all tanks shall receive a mastic or bituminous epoxy coating.

2.3 METER VAULTS

A. General: Precast concrete meter vaults shall be in accordance with Division 33 – Water Distribution.

B. Confined Access: Access to meter vaults shall be provided by one of the following methods:

a. Steps: When possible, manhole steps, according to the project details, shall be provided in all meter vaults and shall be on 16-inch center maximum.

b. Ladder: Where vault access opening is not flush with the vault wall, an access ladder must be installed. The ladder may be installed vertical or at an angle, but must be OSHA approved with 250 pound capacity. An extension bracket shall be installed at the top of the ladder to maintain a fixed distance from the interior vault wall to the hatch opening. Ladder shoes shall be installed on the bottom of the ladder. Both ends of the ladder shall be attached to the vault structure with masonry screws. Where longer ladders are cut to accommodate the height of the vault, care shall be taken to eliminate sharp edges being exposed.

C. Meter Accessories: Provisions shall be made to accommodate the touch read pads to be installed in the top of the meter vault, either by coring the concrete or through another method approved by the Owner or the Owner's representative.

PART 3 -EXECUTION

3.1 INSTALLATION

A. General: The subgrade and bedding for the precast structure shall be prepared similar to that for pipe. All structures shall be installed level. Shaped bottoms shall be formed with concrete as shown on the plans and shall be smooth conforming to the dimensions shown. Joints shall be sealed with a double ring of butyl rubber rope caulk to form a watertight seal. When leveling of frames is required manhole frames shall be set level on a full bed of mortar to the proper grade prior to the application of the butyl caulk.

3.2 TESTS

A. Leakage Testing: Testing shall be conducted for each precast structure or manhole in accordance with one of the following methods:

B. Vacuum Testing: Unless otherwise approved by the Owner, manholes shall be tested by the vacuum method. Vacuum testing shall be in accordance with Division 33 – Sewer Collection System.

C. Exfiltration Testing: When permitted by the Owner, an exfiltration test shall be conducted on each manhole. Testing shall be in accordance with Division 33 – Sewer Collection System.

PART 4 - METHOD OF MEASUREMENT

4.1 CONCRETE WHEEL STOP

A. The quantity of concrete wheel stop to be paid for shall be the number of units (each) measured in place, completed and accepted.

PART 5 - BASIS OF PAYMENT (Payment will be made under the following:)

5.1 CONCRETE WHEEL STOP

A. Payment shall be made at the contract unit price per each, which price and payment shall be full compensation for all labor, equipment, tools, and incidentals necessary to complete the work prescribed in this item.

Item 034100 – 1: Concrete Wheel Stop – per each

END OF SECTION

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SECTION 03 45 00 - BRICK FACED ARCHITECTURAL CONCRETE PANELS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Site Cast or Tilt-Up Brick Faced Concrete Panels.

B. Site Cast or Tilt-Up Split Faced Think Block Concrete Panels.

C. Embedded Split Faced Thin Block

1.2 RELATED SECTIONS

A. Section 033000 - Cast-In-Place Concrete: Concrete, reinforcing, anchors, etc.

B. Section 051200 - Structural Steel: Building structural frame.

C. Section 076000 – Flashings and Sheet metal: Supply of metal flashing reglets for placement by this Section.

D. Section 079000 - Joint Sealers: Caulking of perimeter joint with sealant and backing.

E. Division 8 – Doors, Windows and Glass: Windows and door frames installed in site cast or precast units.

1.3 REFERENCES

A. ACI 117 - Standard Specifications for Tolerances for Concrete Construction and Materials.

B. ACI 318 - Building Code Requirements for Structural Concrete.

C. ASTM C 67 - Standard Test Methods for Sampling and Testing Brick and Structural Clay Tile.

D. ASTM C 1088 - Standard Specification for Thin Veneer Brick Units Made From Clay or Shale.

E. ASTM D 256 - Standard Test Methods for Determining the Izod Pendulum Impact Resistance of Plastics

F. ASTM D 638 - Standard Test Method for Tensile Properties of Plastics

G. AWS D1.1 - Structural Welding Code - Steel.

H. AWS D1.4 - Structural Welding Code - Reinforcing Steel.

1.4 DESIGN / PERFORMANCE REQUIREMENTS

A. Design units to withstand design loads in accordance with applicable code, and erection forces. Calculate structural properties of units in accordance with ACI 318.

B. Design units to accommodate construction tolerances, deflection of building structural members and clearances of intended openings.

C. Design and size components to withstand seismic loads and sway displacement as calculated in accordance with the applicable code.

1.5 SUBMITTALS

A. Submit under provisions of Section 013000.

B. Product Data: Manufacturer's data sheets on each product to be used, including:

1. Preparation instructions and recommendations.

2. Storage and handling requirements and recommendations.

3. Installation methods.

C. Shop Drawings: Indicate layout and sizes, panel locations, configuration, joint locations, brick color and texture, brick coursing, brick coursing alignment across panel joints, dimensions, panel identification marks, reinforcement, connection details, support items, location of lifting devices, dimensions, openings, and relationship to adjacent components.

1. Drawings shall:

a. be to scale
b. include any adjustment to opening locations. Adjustments shall be clouded and noted for A/E approval.
c. Indicate cut or trimmed brick

D. Selection Samples: For each brick product specified, two complete sets of color chips representing manufacturer's full range of available colors and patterns.

E. Verification Samples: For each brick product specified, two samples, actual size, representing actual product, color, and patterns. Include form liner sample and bond breaker sample on brick chip representing bond breaker which will be used.

F. Manufacturer's Certificates: Certify products meet or exceed specified requirements.

1.6 QUALITY ASSURANCE

A. Fabricator: Qualifications: Company specializing in performing Work of this section with minimum five years documented experience.

B. Design: Design units under direct supervision of Professional Engineer experienced in design of this Work and licensed at Project location.

C. Mock-Up: Provide a minimum 4 foot by 4 foot mock-up for evaluation of surface finish and application workmanship.

1. Locate in areas designated by Architect.

2. Do not proceed with remaining work until workmanship and color are approved by Architect.

3. Rebuild mock-up as required to produce acceptable work.

4. Accepted mock-up shall be comparison standard for remaining Work

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store form liner in manufacturer's unopened packaging until ready for installation.
Form liner should not have prolonged exposure to direct sunlight that may damage the liner product. Avoid top loading or crushing liners in their packages.

B. Store thin brick in manufacturer's unopened packaging until ready for installation.
Protect the brick from extreme heat, over 120 degrees F, until it is installed and cast. Do not expose brick to excessive dust and dirt which may affect the brick's ability to bond to the concrete properly. Keep brick dry, covered and protected from the sun and rain prior to its installation.

C. Handling Tilt-up Units: Lift units to position, consistent with their shape and design.
Lift and support only from support points.

D. Blocking and Lateral Support During Erection: Clean and non-staining, without causing harm to exposed surfaces.

E. Protect panels from staining, chipping, or spalling.

F. Ensure that products of this section are supplied to affected trades in time to prevent interruption of construction progress.

1.8 PROJECT CONDITIONS

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

PART 2 PRODUCTS

2.2 MANUFACTURERS

A. Manufactures: Subject to compliance with requirements, available manufacturers offering products that may be incorporated in to the Work include, but not limited to, the following:

1. Innovative Brick Systems, LLC (Basis of Design)

2. Belden Brick Company

3. McNear

4. General Shale

5. Endicott

2.3 MATERIALS

A. Cast-In Place Concrete: Forms, concrete, reinforcement, admixtures as specified is Section 033000 – Cast-In-Place Concrete.

B. Brick Form Liner Sheets: single use form liner sheets with a seamless joint design that provides a realistic coved joint and fully embeds the thin brick into concrete walls for superior bonding, durability and weatherproofing. Each liner is designed with an indexing feature that makes setting up the panel easy and fast.

1. Physical properties:

   a. Thickness 20 MIL.
   b. Weight .142 LBS PER S.F.
   c. Tensile 4080 psi at yield when tested in accordance with ASTM D 636.

   d. Izod Impact 3.3 @73 degrees F when tested in accordance with ASTM D 256.
   e. Vicat Softening 220 degrees F
   f. Color White-primary; color can vary

2. Liner Sheet Size: Liners are provided in 27 inch by 32 inch panels and are manufactured with an EdgeLock quick connect feature for adjacent panels to lock and align efficiently with seamless panel construction.

3. Patterns and Sizes: (Generally available; Custom patterns made on order)

   a. ModulaR, Brick size: 2-1/4 inches by 7-5/8 inches. Sizes do not include overlap dimensions.

      1) Item Number 100 Modular Running Bond 32 inches wide, 26.66 inches high, 5.92 sf sheet area.
      2) Item Number 105, Modular Running Bond 3-5/8 inch coped return 3 5/8 inches wide, 26.66 inches high.
      3) Item Number 110, Modular Running Bond 7-5/8 inch coped return 7-5/8 inches wide, 26.66 inches high.
      4) Item Number 115, Modular Running Bond 7-5/8 inch by 7-5/8 inch folding return 16 inches wide, 26.66 inches high.
      5) Item Number 120, Modular Stack Bond 32 inches wide, 8 inches high.
      6) Item Number 125, Modular Soldier Course 32 inches wide, 8 inches high.
      7) Item Number 130, Modular 4-wide Stack Bond 32 inches wide, 26.66 inches high, 5.92 sf sheet area.
      8) Item Number 140, Modular Flemish Bond Strip 24 inches wide, 2-1/4 inches high.
      9) Item Number 150, Modular Rowlock Strip 32 inches wide, 3-5/8 inches high.

   b. Closure Brick size (often called Economy), 3-5/8 inches by 7-5/8 inches:

      1) Item Number 200, Closure Running Bond 32 inches wide, 24 inches high, 5.33 sf sheet area.
      2) Item Number 220, Closure Stack Bond (4 inch nesting pockets) 32 inches wide, 8 inches high.
      3) Item Number 225, Closure Soldier Bond (8 nesting pockets) 32 inches wide, 8 inches high.

   c. Utility Brick size (often called Jumbo), 3-5/8 inches by 11-5/8 inches.

1) Item Number 400, Utility 1/2 Bond 36 inches wide, 24 inches high, 6.0 sf sheet area.
2) Item Number 402, Utility 1/3 Running Bond 36 inches wide, 24 inches high, 6.0 sf sheet area.
3) Item Number 420, Utility Stack Bond 28 inches wide, 12 inches high.
4) Item Number 425, Utility Soldier Course 28 inches wide, 12 inches high.
5) Item Number 215, Utility Corner (8 inch return for Utility and Closure) 16 inches wide, 24 inches high.

d. Norman Brick size, 2-1/4 inch by 11-5/8 inch.

1) Item Number 300, Norman 1/3 Running Bond 36 inches wide, 26.66 inches high, 6.67 sf sheet area.
2) Item Number 320, Norman Soldier/Stack Bond 32 inches wide, 12 inches high.

4. Liner Sheet Indexing: VersaLiner sheets have embossed markings (plus and minus signs) around most perimeters that act as indicators for the molded mortar joints of each sheet. Joints near the minus signs are slightly smaller in order to nest properly underneath the larger joints and provide proper overlapping of each adjoining liner.

C. Brick Mat Form Liner Rolls:, single-use roll liner system that provides a seamless cove joint for the precise look of full laid-up brick with hand- struck and hand tooled appearances.

1. Patterns and Sizes:

a. Modular, Brick size: 2-1/4 inches by 7-5/8 inches.
b. Provided 34 inches wide with 32 inches of brick coursings, and a 2 inch nesting overlap flap.

2. Provided in 200 ft long rolls.

D. Thin Brick: ASTM C 1088, Type TBX, tested in accordance with ASTM C 67.

1. Size: Modular 2-1/4 inches (57.2 mm) high, 7-5/8 inches (193.7 mm) long, nominal 1/2 inch (12.7 mm) thick.

2. Size: Closure 3-5/8 inches (92.1 mm) high, 7-5/8 inches (193.7 mm) long, nominal 1/2 inch (12.7 mm) thick.

3. Size: Jumbo 7-5/8 inches (193.7 mm) high, 7-5/8 inches (193.7 mm) long, nominal 1/2 inch (12.7 mm) thick.

4. Size: Utility 3-5/8 inches (92.1 mm) high, 11-5/8 inches (295.3 mm) long, nominal 1/2 inch (12.7 mm) thick.

5. Size-Norman 2-1/4 inches (57.2 mm) high, 12 inches long (305.1mm) long, nominal 1/2 inch (12.7 mm) thick.

6. Trim Units: Matching thin brick.

7. Tolerance:

   a. Length: Plus 0, minus 1/16 inch (1.6 mm).
   b. Height: Plus 0, minus 1/16 inch (1.6 mm).
   c. Thickness: Plus or minus 1/16 inch (1.6 mm).

8. Texture: Smooth.

9. Texture: Wirecut.

10. Texture: Sand Finish.

11. Color: Match existing facilities.

12. Brick Coating: Wax, Face Off or NoxCrete brick coating shall be pre-applied to each brick face to facilitate the cleaning of the cast brick surface. Brick faces shall be coated with wax, an approved bond breaker to prevent grout staining.

PART 3 EXECUTION

3.1 EXAMINATION

A. Do not begin installation until substrates have been properly prepared.

B. Verify building structure, anchors, devices, and openings are ready to receive work of this Section.

C. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 PREPARATION

A. Clean form thoroughly prior to installation.

B. Provide for erection procedures and induced loads during erection. Maintain temporary bracing in place until final support is provided.

C. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.3 PANEL FABRICATION AND INSTALATION

A. Maintain environmental records and quality control program during production of tilt-up or precast units. Make records available upon request.

B. Use rigid forms constructed to maintain precast units uniform in shape, size and finish.

C. Utilize form liners specified.

D. Prepare, install, and finish form liners in accordance with current release of manufacturer’s Technical Design and Installation Guide.

E. Trim liner sheets as necessary prior to installation into the form.

F. Mark the side of the form approximately every 2 feet (610 mm) with course reference points for coursing control purposes.

G. Begin placing liner sheets in the form in accordance with the shop drawings. Note: The plus (+) edge joint secures over the minus (-) edge joint on the adjoining sheet. Place only one tier of sheets prior to placing the bricks, face down, in to the liner. Adjust coursing as needed while installation progresses.

H. Place Bricks face side down into the liner. Once fully bricked, check panel to ensure all bricks are fully nested and flat in the liner.

I. Install reinforcement and necessary devices to support reinforcement and proceed with the pour as specified in Section 033000.

J. Embed reinforcing steel, anchors, inserts plates, angles, and other cast-in items as indicated on Drawings.

K. Place recessed flashing reglets provided by Section 076200 continuous and straight.

L. Locate hoisting devices to permit removal after erection.

M. Cure units to develop concrete quality, and to minimize appearance blemishes including non-uniformity, staining, or surface cracking.

N. Remove liner sheets by peeling them off the cured panel.

O. Cleanup: Spray panel with a pressure washer delivering a minimum of 1000 PSI of water pressure and using hot (180 degrees F) water to remove concrete film from placed brick faces. Non-waxed bricks do not require hot water rinse

P. Erect units without damage to shape or finish. Replace or repair damaged panels.

Q. Erect members level and plumb within allowable tolerances.

R. Maintain uniform horizontal and vertical joint, alignment and spacing across construction joints as erection progresses.

S. When members require adjustment beyond design or tolerance criteria, discontinue affected work; advise Architect/Engineer.

T. Fasten units in place. Perform welding, including tack welds, in accordance with AWS D1.1 and AWS D1.4.

U. Seal perimeter and intermediate joints in accordance with Section 079200.

3.4 ERECTION TOLERANCES

A. Dimensions of the finished panel, at the time of erection in the structure, shall conform to the tolerances for precast, non-prestressed elements in ACI 117, unless otherwise specified by the Architect.

3.5 FIELD QUALITY CONTROL

A. Section 014000 - Quality Requirements: Testing and Inspection Services.

B. Field inspection and testing will be performed by Owner’s testing laboratory in accordance with applicable code.

3.6 PROTECTION

A. Protect installed products until completion of project.

B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION 03 45 00

SECTION 04 21 13.13 - BRICK VENEER MASONRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Concrete facing brick.
2. Face brick.
3. Stone trim units.
4. Mortar and grout.
5. Ties and anchors.
6. Embedded flashing.
7. Miscellaneous masonry accessories.

B. Related Sections:
1. Division 5 Section "Structural Steel" for installing anchor sections of adjustable masonry anchors for connecting to structural steel frame.
2. Division 5 Section "Metal Fabrications" for furnishing steel shelf angles for brick masonry.
3. Division 7 Section "Sheet Metal Flashing and Trim" for sheet metal flashing and for furnishing manufactured reglets installed in masonry joints.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: For the following:

1. Masonry Units: Show sizes, profiles, coursing, and locations of special shapes.
2. Stone Coursing Units: Show sizes, profiles, and locations of each stone trim unit required.
3. Fabricated Flashing: Detail corner units, end-dam units, and other special applications.

C. Samples for Initial Selection:

1. Concrete facing brick, in the form of small-scale units.
2. Face brick in the form of straps of five or more bricks.
3. Stone band course.
4. Colored mortar.
5. Weep holes/vents.

D. Samples for Verification: For each type and color of the following:

1. Concrete facing brick.
2. Face brick, in the form of straps of five or more bricks.
3. Special brick shapes.
4. Stone trim.
5. Pigmented mortar to match terminal building mortar color. Make Samples using same sand and mortar ingredients to be used on Project.
6. Weep holes
7. Accessories embedded in masonry.

E. List of Materials Used in Constructing Mockups: List generic product names together with manufacturers, manufacturers' product names, model numbers, lot numbers, batch numbers, source of supply, and other information as required to identify materials used. Include mix proportions for mortar and grout and source of aggregates.

1. Submittal is for information only. Neither receipt of list nor approval of mockup constitutes approval of deviations from the Contract Documents unless such deviations are specifically brought to the attention of Architect and approved in writing.

F. Material Certificates: For each type and size of the following:

1. Masonry units.

a. Include material test reports substantiating compliance with requirements.
b. For brick, include size-variation data verifying that actual range of sizes falls within specified tolerances.
c. For exposed brick, include test report for efflorescence according to ASTM C 67.
d. For surface-coated brick, include test report for durability of surface appearance after 50-cycles of freezing and thawing per ASTM C 67

2. Cementitious materials. Include brand, type, and name of manufacturer.
3. Preblended, dry mortar mixes. Include description of type and proportions of ingredients.
4. Grout mixes. Include description of type and proportions of ingredients.
5. Anchors, ties, and metal accessories.

G. Cold-Weather and Hot-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with requirements.

1.4 QUALITY ASSURANCE

A. Source Limitations for Masonry Units: Obtain exposed masonry units of a uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, from single source from single manufacturer for each product required.

B. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from single manufacturer for each cementitious component and from single source or producer for each aggregate.

C. Masonry Standard: Comply with ACI 530.1/ASCE 6/TMS 602 unless modified by requirements in the Contract Documents.

D. Sample Panels: Build sample panels to verify selections made under sample submittals and to demonstrate aesthetic effects. Comply with requirements in Division 1 Section "Quality Requirements" for mockups.

1. Build sample panels for each type of exposed unit masonry construction 48 inches long by 48 inches high.
2. Where masonry is to match existing, erect panels adjacent and parallel to existing surface.
3. Protect approved sample panels from the elements with weather-resistant membrane.
4. Approval of sample panels is for color, texture, and blending of masonry units; relationship of mortar and sealant colors to masonry unit colors; tooling of joints; aesthetic qualities of workmanship; and other material and construction qualities specifically approved by Architect in writing.

    a. Approval of sample panels does not constitute approval of deviations from the Contract Documents contained in sample panels unless such deviations are specifically approved by Architect in writing.

E. Store masonry units on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.

F. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.

G. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.

H. Deliver preblended, dry mortar mix in moisture-resistant containers designed for use with dispensing silos. Store preblended, dry mortar mix in delivery containers on elevated platforms, under cover, and in a dry location or in covered weatherproof dispensing silos.

I. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

1.5 PROJECT CONDITIONS

A. Protection of Masonry: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.

1. Extend cover a minimum of 24 inches (600 mm) down both sides of walls and hold cover securely in place.
2. Where one wythe of multiwythe masonry walls is completed in advance of other wythes, secure cover a minimum of 24 inches (600 mm) down face next to unconstructed wythe and hold cover in place.

B. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.

1. Protect base of walls from rain-splashed mud and from mortar splatter by spreading coverings on ground and over wall surface.
2. Protect sills, ledges, and projections from mortar droppings.
3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.
4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.

C. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.

1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F (4 deg C) and higher and will remain so until masonry has dried, but not less than seven days after completing cleaning.

D. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.

PART 2 - PRODUCTS

2.1 MASONRY UNITS, GENERAL

A. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits

stated in the standard. Do not use units where such defects will be exposed in the completed Work.

2.2 BRICK

A. General: Provide shapes indicated and as follows, with exposed surfaces matching finish and color of exposed faces of adjacent units.

1. For ends of sills and caps and for similar applications that would otherwise expose unfinished brick surfaces, provide units without cores or frogs and with exposed surfaces finished.
2. Provide special shapes for applications where stretcher units cannot accommodate special conditions, including those at corners, movement joints, bond beams, sashes, and lintels.
3. Provide special shapes for applications requiring brick of size, form, color, and texture on exposed surfaces that cannot be produced by sawing.
4. Provide special shapes for applications where shapes produced by sawing would result in sawed surfaces being exposed to view.

B. Face Brick: Facing brick complying with ASTM C 216

1. Products: Subject to compliance with requirements

2. Grade: SW
3. Type: FBX
4. Initial Rate of Absorption: Less than 30 g/30 sq. in. (30 g/194 sq. cm) per minute when tested per ASTM C 67.
5. Efflorescence: Provide brick that has been tested according to ASTM C 67 and is rated "not effloresced."
6. Surface Coating: Brick with colors or textures produced by application of coatings shall withstand 50 cycles of freezing and thawing per ASTM C 67 with no observable difference in the applied finish when viewed from 10 feet (3 m)
7. Size (Actual Dimensions): [3-1/2 inches (89 mm) wide by 2-3/4 inches (70 mm) high by 7-1/2 inches (190 mm) long] [or] [3-5/8 inches (92 mm) wide by 2-13/16 inches (71 mm) high by 7-5/8 inches (194 mm) long].
8. Application: Use where brick is exposed unless otherwise indicated.
9. Where shown to "match existing," provide face brick matching color range, texture, and size of existing adjacent brickwork.

2.3 STONE TRIM UNITS

2.4 MORTAR MATERIALS

A. Portland Cement: ASTM C 150, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.

B. Hydrated Lime: ASTM C 207, Type S.

C. Portland Cement-Lime Mix: Packaged blend of portland cement and hydrated lime containing no other ingredients.

D. Mortar Cement: ASTM C 1329.

1. Products: Subject to compliance with requirements,

E. Colored Cement Product: Packaged blend made from portland cement and hydrated lime and mortar pigments, all complying with specified requirements, and containing no other ingredients.

1. Products: Subject to compliance with requirements,

a. Colored Portland Cement-Lime Mix:

1) Capital Materials Corporation; Riverton Portland Cement Lime Custom Color.
2) Holcim (US) Inc.; Rainbow Mortamix Custom Color Cement/Lime.
3) Lafarge North America Inc.; Eaglebond Portland & Lime.
4) Lehigh Cement Company; Lehigh Custom Color Portland/Lime Cement.
5) Or approved equal

b. Colored Masonry Cement:

1) Capital Materials Corporation; Flamingo Color Masonry Cement.
2) Cemex S.A.B. de C.V.; Richcolor Masonry Cement.
3) Essroc, Italcementi Group; Brixment-in-Color.
4) Holcim (US) Inc.; Rainbow Mortamix Custom Color Masonry Cement.
5) Lafarge North America Inc.; U.S. Cement Custom Color Masonry Cement.
6) Lehigh Cement Company; Lehigh Custom Color Masonry Cement.
7) National Cement Company, Inc.; Coosa Masonry Cement.
8) Or approved equal

F. Aggregate for Mortar: ASTM C 144.

1. For mortar that is exposed to view, use washed aggregate consisting of natural sand or crushed stone.
2. For joints less than 1/4 inch (6 mm) thick, use aggregate graded with 100 percent passing the No. 16 (1.18-mm) sieve.
3. White-Mortar Aggregates: Natural white sand or crushed white stone.
4. Colored-Mortar Aggregates: Natural sand or crushed stone of color necessary to produce required mortar color.

G. Cold-Weather Admixture: Nonchloride, noncorrosive, accelerating admixture complying with ASTM C 494/C 494M, Type C, and recommended by manufacturer for use in masonry mortar of composition indicated.

H. Water-Repellent Admixture: Liquid water-repellent mortar admixture intended for use with concrete masonry units, containing integral water repellent by same manufacturer.

2.5 REINFORCEMENT

A. Masonry Joint Reinforcement, General: ASTM A 951/A 951M.

B. Masonry Joint Reinforcement for Veneers Anchored with Seismic Masonry-Veneer Anchors: Single 0.187-inch- (4.76-mm-) diameter, [**hot-dip galvanized, carbon**] [**stainless**]-steel continuous wire.

2.6 SEISMIC REINFORCEMENT

A. All fasteners in the connecting system such as bolts, inserts, welds, and dowels and the body of the connectors for brick veneer shall be designed for the allowable load, Fp=13PSF (applied horizontally).

2.7 TIES AND ANCHORS

A. Materials: Provide ties and anchors specified in this article that are made from materials that comply with the following unless otherwise indicated:

1. Mill-Galvanized, Carbon-Steel Wire: ASTM A 82/A 82M; with ASTM A 641/A 641M, Class 1 coating.
2. Hot-Dip Galvanized, Carbon-Steel Wire: ASTM A 82/A 82M; with ASTM A 153/A 153M, Class B-2 coating.

B. Corrugated Metal Ties: Metal strips not less than 7/8 inch (22 mm) wide with corrugations having a wavelength of 0.3 to 0.5 inch (7.6 to 12.7 mm) and an amplitude of 0.06 to 0.10 inch (1.5 to 2.5 mm) made from [0.030-inch- (0.76-mm-) thick, steel sheet, galvanized after fabrication]

C. Wire Ties, General: Unless otherwise indicated, size wire ties to extend at least halfway through veneer but with at least 5/8-inch (16-mm) cover on outside face. Outer ends of wires are bent 90 degrees and extend 2 inches (50 mm) parallel to face of veneer.

D. Adjustable Anchors for Connecting to Structural Steel Framing: Provide anchors that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall.

E. Adjustable Anchors for Connecting to Concrete: Provide anchors that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall.

1. General: Provide anchors that allow vertical adjustment but resist tension and compression forces perpendicular to plane of wall, for attachment over sheathing to wood or metal studs, and as follows:

   a. Structural Performance Characteristics: Capable of withstanding a 100-lbf (445-N) load in both tension and compression without deforming or developing play in excess of 0.05 inch (1.3 mm).

2. Contractor's Option: Unless otherwise indicated, provide any of the following types of anchors:
3. Screw-Attached, Masonry-Veneer Anchors: Units consisting of a wire tie and a metal anchor section.

   a. Products: Subject to compliance with requirements,

   1) Dayton Superior Corporation, Dur-O-Wal Division; D/A 213]
   2) Heckmann Building Products Inc.; 315-D with 316
   3) Hohmann & Barnard, Inc.; DW-10
   4) Wire-Bond; 1004, Type III

4. Seismic Masonry-Veneer Anchors: Units consisting of a metal anchor section and a connector section designed to engage a continuous wire embedded in the veneer mortar joint.

   a. Products: Subject to compliance with requirements**,**

   1) Dayton Superior Corporation, Dur-O-Wal Division; D/A 213S.
   2) Hohmann & Barnard, Inc.; DW-10-X-Seismiclip.
   3) Wire-Bond; RJ-711 with Wire-Bond clip.

2.8 MISCELLANEOUS ANCHORS

A. Unit Type Inserts in Concrete: Cast-iron or malleable-iron wedge-type inserts.

B. Dovetail Slots in Concrete: Furnish dovetail slots with filler strips, of slot size indicated, fabricated from 0.034-inch (0.86-mm), galvanized steel sheet.

2.9 EMBEDDED FLASHING MATERIALS

A. Metal Flashing: Provide metal flashing complying with Division 7 Section "Sheet Metal Flashing and Trim" and as follows:

   1. Stainless Steel: ASTM A 240/A 240M, Type 304, 0.016 inch (0.40 mm) thick.

   2. Fabricate through-wall flashing with snaplock receiver on exterior face where indicated to receive counterflashing.

3. Fabricate through-wall flashing with drip edge unless otherwise indicated. Fabricate by extending flashing 1/2 inch (13 mm) out from wall, with outer edge bent down 30 degrees
4. Fabricate through-wall flashing with sealant stop unless otherwise indicated. Fabricate by bending metal back on itself 3/4 inch (19 mm) at exterior face of wall and down into joint 1/4 inch (6 mm) to form a stop for retaining sealant backer rod.
5. Fabricate metal drip edges and sealant stops for ribbed metal flashing from plain metal flashing of same metal as ribbed flashing and extending at least 3 inches (76 mm) into wall with hemmed inner edge to receive ribbed flashing and form a hooked seam. Form hem on upper surface of metal so that completed seam will shed water.

2.10 MISCELLANEOUS MASONRY ACCESSORIES

A. Compressible Filler: Premolded filler strips complying with ASTM D 1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene

B. Bond-Breaker Strips: Asphalt-saturated, organic roofing felt complying with ASTM D 226, Type I (No. 15 asphalt felt).

C. Weep/Vent Products: Use the following unless otherwise indicated:
1. Round Plastic Weep/Vent Tubing: Medium-density polyethylene, 3/8-inch (9-mm) OD by 4 inches (100 mm) long.

2. Mesh Weep/Vent: Free-draining mesh; made from polyethylene strands, full height and width of head joint and depth 1/8 inch (3 mm) less than depth of outer wythe; in color selected from manufacturer's standard.

D. Cavity Drainage Material: Free-draining mesh, made from polymer strands that will not degrade within the wall cavity.

2.11 MASONRY CLEANERS

A. Proprietary Acidic Cleaner: Manufacturer's standard-strength cleaner designed for removing mortar/grout stains, efflorescence, and other new construction stains from new masonry without discoloring or damaging masonry surfaces. Use product expressly approved for intended use by cleaner manufacturer and manufacturer of masonry units being cleaned.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match the construction immediately adjacent to opening.

B. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.

C. Select and arrange units for exposed unit masonry to produce a uniform blend of colors and textures.

1. Mix units from several pallets or cubes as they are placed.

D. Matching Existing Masonry: Match coursing, bonding, color, and texture of existing masonry.

3.3 TOLERANCES

A. Dimensions and Locations of Elements:

1. For dimensions in cross section or elevation do not vary by more than plus 1/2 inch (12 mm) or minus 1/4 inch (6 mm).
2. For location of elements in plan do not vary from that indicated by more than plus or minus 1/2 inch (12 mm).
3. For location of elements in elevation do not vary from that indicated by more than plus or minus 1/4 inch (6 mm) in a story height or 1/2 inch (12 mm) total.

B. Lines and Levels:

1. For bed joints and top surfaces of bearing walls do not vary from level by more than 1/4 inch in 10 feet (6 mm in 3 m), or 1/2 inch (12 mm) maximum.

2. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 feet (3 mm in 3 m), 1/4 inch in 20 feet (6 mm in 6 m), or 1/2 inch (12 mm) maximum.
3. For vertical lines and surfaces do not vary from plumb by more than 1/4 inch in 10 feet (6 mm in 3 m), 3/8 inch in 20 feet (9 mm in 6 m), or 1/2 inch (12 mm) maximum.
4. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 feet (3 mm in 3 m), 1/4 inch in 20 feet (6 mm in 6 m), or 1/2 inch (12 mm) maximum.
5. For lines and surfaces do not vary from straight by more than 1/4 inch in 10 feet (6 mm in 3 m), 3/8 inch in 20 feet (9 mm in 6 m), or 1/2 inch (12 mm) maximum.
6. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4 inch in 10 feet (6 mm in 3 m), or 1/2 inch (12 mm) maximum.
7. For faces of adjacent exposed masonry units, do not vary from flush alignment by more than 1/16 inch (1.5 mm) except due to warpage of masonry units within tolerances specified for warpage of units.

C. Joints:

1. For bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch (3 mm), with a maximum thickness limited to 1/2 inch (12 mm); do not vary from bed-joint thickness of adjacent courses by more than 1/8 inch (3 mm).
2. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch (3 mm).[Do not vary from adjacent bed-joint and head-joint thicknesses by more than 1/8 inch (3 mm).]
3. For exposed bed joints and head joints of stacked bond, do not vary from a straight line by more than 1/16 inch (1.5 mm) from one masonry unit to the next.

3.4 LAYING MASONRY WALLS

A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.

PATTERN IS USUALLY RUNNING BOND. IF OTHER BOND PATTERNS ARE REQUIRED, SPECIFY IN FIRST PARAGRAPH BELOW OR INDICATE ON DRAWINGS.

B. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in patterns to match existing bond pattern in terminal building.

C. Stopping and Resuming Work: Stop work by racking back units in each course from those in course below; do not tooth. When resuming work, clean masonry

surfaces that are to receive mortar, remove loose masonry units and mortar, and wet brick if required before laying fresh masonry.

D. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.

E. Fill space between steel frames and masonry solidly with mortar unless otherwise indicated.

3.5 ANCHORING MASONRY TO STRUCTURAL STEEL AND CONCRETE

A. Anchor masonry to structural steel and concrete where masonry abuts or faces structural steel or concrete to comply with the following:

1. Provide an open space not less than [1/2 inch (13 mm)] wide between masonry and structural steel or concrete unless otherwise indicated. Keep open space free of mortar and other rigid materials.
2. Anchor masonry with anchors embedded in masonry joints and attached to structure.
3. Space anchors as indicated, but not more than 24 inches (610 mm) o.c. vertically and 36 inches (915 mm) o.c. horizontally.

3.6 ANCHORING MASONRY VENEERS

A. Anchor masonry veneers to [concrete backup] with[seismic] masonry-veneer anchors to comply with the following requirements:

1. Fasten anchors with metal fasteners of type indicated. Use two fasteners unless anchor design only uses one fastener.
2. Insert slip-in anchors in metal studs as sheathing is installed. Provide one anchor at each stud in each horizontal joint between sheathing boards.
3. Embed connector sections and continuous wire in masonry joints. Provide not less than 2 inches (50 mm) of air space between back of masonry veneer and face of sheathing.
4. Locate anchor sections to allow maximum vertical differential movement of ties up and down.
5. Space anchors as indicated, but not more than 18 inches (458 mm) o.c. vertically and 24 inches (610 mm) o.c. horizontally, with not less than 1 anchor for each 2 sq. ft. (0.2 sq. m) of wall area. Install additional anchors within 12 inches (305 mm) of openings and at intervals, not exceeding 8 inches (203 mm), around perimeter.
6. Space anchors as indicated, but not more than 16 inches (406 mm) o.c. vertically and [32 inches (813 mm)] [24 inches (610 mm)] o.c. horizontally with not less than 1 anchor for each [3.5 sq. ft. (0.33 sq. m)] [2.67 sq. ft. (0.25 sq. m)] of wall area. Install additional anchors within 12 inches (305 mm) of openings and at intervals, not exceeding 36 inches (914 mm), around perimeter.

3.7 EXPANSION JOINTS

A. General: Install expansion joint materials in unit masonry as masonry progresses. Do not allow materials to span expansion joints without provision to allow for in-plane wall or partition movement.

B. Form expansion joints in brick as follows:

1. Build flanges of metal expansion strips into masonry. Lap each joint 4 inches (100 mm) in direction of water flow. Seal joints below grade and at junctures with horizontal expansion joints if any.
2. Build flanges of factory-fabricated, expansion-joint units into masonry.
3. Build in compressible joint fillers where indicated.
4. Form open joint full depth of brick wythe and of width indicated, but not less than 3/8 inch (10 mm for installation of sealant and backer rod specified in Division 7 Section "Joint Sealants."

C. Provide horizontal, pressure-relieving joints by either leaving an air space or inserting a compressible filler of width required for installing sealant and backer rod specified in Division 7 Section "Joint Sealants," but not less than 3/8 inch (10 mm)

1. Locate horizontal, pressure-relieving joints beneath shelf angles supporting masonry.

3.8 LINTELS

A. Install steel lintels where indicated.

B. Provide minimum bearing of 8 inches (200 mm) at each jamb unless otherwise indicated.

3.9 FLASHING, WEEP HOLES, CAVITY DRAINAGE, AND VENTS

A. General: Install embedded flashing and weep holes in masonry at shelf angles, lintels, ledges, other obstructions to downward flow of water in wall, and where indicated. Install vents at shelf angles, ledges, and other obstructions to upward flow of air in cavities, and where indicated.

B. Install flashing as follows unless otherwise indicated:

1. Prepare masonry surfaces so they are smooth and free from projections that could puncture flashing. Where flashing is within mortar joint, place through-wall flashing on sloping bed of mortar and cover with mortar. Before covering with mortar, seal penetrations in flashing with adhesive, sealant, or tape as recommended by flashing manufacturer.
2. At masonry-veneer walls, extend flashing through veneer, across air space behind veneer, and up face of sheathing at least 8 inches (200

mm); with upper edge tucked under building paper or building wrap, lapping at least 4 inches (100 mm).

3. At lintels and shelf angles, extend flashing a minimum of 6 inches (150 mm) into masonry at each end. At heads and sills, extend flashing 6 inches (150 mm) at ends and turn up not less than 2 inches (50 mm) to form end dams.
4. Interlock end joints of ribbed sheet metal flashing by overlapping ribs not less than 1-1/2 inches (38 mm) or as recommended by flashing manufacturer, and seal lap with elastomeric sealant complying with requirements in Division 7 Section "Joint Sealants" for application indicated.
5. Install metal drip edges with ribbed sheet metal flashing by interlocking hemmed edges to form hooked seam. Seal seam with elastomeric sealant complying with requirements in Division 7 Section "Joint Sealants" for application indicated.

C. Install reglets and nailers for flashing and other related construction where they are shown to be built into masonry.

D. Place pea gravel in cavities as soon as practical to a height equal to height of first course above top of flashing, but not less than 2 inches (50 mm), to maintain drainage.

E. Place cavity drainage material in cavities to comply with configuration requirements for cavity drainage material in "Miscellaneous Masonry Accessories" Article..

3.10 FIELD QUALITY CONTROL

A. Testing and Inspecting: Owner will engage special inspectors to perform tests and inspections and prepare reports. Allow inspectors access to scaffolding and work areas, as needed to perform tests and inspections. Retesting of materials that fail to meet specified requirements shall be done at Contractor's expense.

B. Inspections: Level 1 special inspections according to the "International Building Code."

1. Begin masonry construction only after inspectors have verified proportions of site-prepared mortar.

3.11 REPAIRING, POINTING, AND CLEANING

A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.

B. Pointing: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for sealant application, where indicated.

C. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.

D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:

1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
2. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of masonry.
3. Protect adjacent stone and nonmasonry surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.
4. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
5. Clean brick by bucket-and-brush hand-cleaning method described in "BIA Technical Notes 20."
6. Clean concrete masonry by cleaning method indicated in NCMA TEK 8-2A applicable to type of stain on exposed surfaces.
7. Clean stone trim to comply with stone supplier's written instructions.
8. Clean limestone units to comply with recommendations in ILI's "Indiana Limestone Handbook."

3.12 MASONRY WASTE DISPOSAL

A. Salvageable Materials: Unless otherwise indicated, excess masonry materials are Contractor's property. At completion of unit masonry work, remove from Project site.

B. Waste Disposal as Fill Material: Dispose of clean masonry waste, including excess or soil-contaminated sand, waste mortar, and broken masonry units, by crushing and mixing with fill material as fill is placed.

1. Crush masonry waste to less than 4 inches (100 mm) in each dimension.
2. Mix masonry waste with at least two parts of specified fill material for each part of masonry waste. Fill material is specified in Division 2 Section "Earthwork."
3. Do not dispose of masonry waste as fill within 18 inches (450 mm) of finished grade.

C. Excess Masonry Waste: Remove excess clean masonry waste that cannot be used as fill, as described above, and other masonry waste, and legally dispose of off Owner's property.

END OF SECTION 04813

SECTION 042200 – CONCRETE UNIT MASONRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this section.

1.2 SUMMARY

A. General: Provide all labor, material, equipment, related services and supervision required, including manufacturing, erection and installation for unit masonry in accordance with the requirements of the Contract Documents.

B. The extent of unit masonry is shown on the drawings.

C. This section includes the following:
1. Concrete unit masonry.
2. Mortar and grout.
3. Masonry ties and accessories.

D. Related Sections: The following sections contain requirements that relate to this section:
1. Section 076200, Sheet Metal Flashing and Trim, for exposed sheet metal flashing installed in masonry.

E. Products installed but not furnished under this section include the following:
1. Steel lintels in unit masonry are specified in Section 055000, Metal Fabrications.
2. Joint sealants and backer-rods in unit masonry are specified in Section 079200, Joint Sealants.

1.3 SYSTEM PERFORMANCE REQUIREMENTS

A. Provide unit masonry that develops the following installed compressive strengths (F'm):
1. For concrete unit masonry:
a. F'm = 1500 psi.

1.4 SUBMITTALS

A. General: Submit the following in accordance with Section 013300, Submittal Procedures.

B. Product data for each different masonry unit, accessory, and other manufactured product indicated.

C. Shop drawings for reinforcing detailing fabrication, bending, and placement of unit masonry reinforcing bars. Comply with ACI 315 "Details and Detailing of Concrete Reinforcing" showing bar schedules, stirrup spacing, diagrams of bent bars, and arrangement of masonry reinforcement.

D. Samples for verification purposes of the following:
1. Full-size units for each different exposed masonry unit required showing full range of exposed color, texture, and dimensions to be expected in completed construction.
2. Colored masonry mortar samples for each color required showing the full range of colors expected in the finished construction. Label samples to indicate type and amount of colorant used.
3. Accessories embedded in the masonry.

E. Material certificates for the following signed by manufacturer and Contractor certifying that each material complies with requirements.
   1. Each different cement product required for mortar and grout including name of manufacturer, brand, type, and weight slips at time of delivery.
   2. Each material and grade indicated for reinforcing bars.
   3. Each type and size of joint reinforcement.
   4. Each type and size of anchors, ties, and metal accessories.

F. Material test reports from a qualified independent testing laboratory employed and paid by Contractor indicating and interpreting test results relative to compliance of the following proposed masonry materials with requirements indicated:
   1. Mortar complying with property requirements of ASTM C 270.
   2. Grout mixes. Include description of type and proportions of grout ingredients.
   3. Masonry units.

G. Cold-weather construction procedures evidencing compliance with requirements specified in referenced unit masonry standard.

H. Hot-weather construction procedures evidencing compliance with requirements specified in referenced unit masonry standard.

I. Qualification data for firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include list of completed projects with project names, addresses, telephone numbers, names of Architects and Owners, and other information specified.

J. Results from tests and inspections performed shall be reported promptly and in writing to Architect and Contractor.

1.5 QUALITY ASSURANCE

A. Unit Masonry Standard: Comply with ACI 530.1/ASCE 6 "Specifications for Masonry Structures," except as otherwise indicated.
   1. Revise ACI 530.1/ASCE 6 to exclude Sections 1.4 and 1.7; Parts 2.1.2, 3.1.2, and 4.1.2; and Articles 1.5.1.2, 1.5.1.3, 2.1.1.1, 2.1.1.2, and 2.3.3.9 and to modify Article 2.1.1.4 by deleting requirement for installing vent pipes and conduits built into masonry.

B. Inspecting Laboratory Qualifications: To qualify for employment in performing tests and inspection specified in this section, an independent testing laboratory must demonstrate to Architect's satisfaction, based on evaluation of laboratory-submitted criteria conforming to ASTM C 1093, that it has the experience and capability to conduct satisfactorily the testing indicated without delaying the progress of the work.

C. Preconstruction Testing: Employ and pay a qualified independent testing agency to perform the following preconstruction testing to establish compliance of proposed materials and construction with specified requirements:
   1. Test mortar properties per test methods of ASTM C270.

D. Fire Performance Characteristics: Where indicated, provide materials and construction identical to those of assemblies whose fire resistance has been determined per ASTM E 119 by a testing and inspecting organization, by equivalent concrete masonry thickness, or by another means, as acceptable to authorities having jurisdiction.

E. Single-Source Responsibility for Masonry Units: Obtain exposed masonry units of uniform texture and color, or a uniform blend within the ranges accepted for these characteristics,

from one manufacturer for each different product required for each continuous surface or visually related surfaces.

F. Single-Source Responsibility for Mortar Materials: Obtain mortar ingredients of uniform quality, including color for exposed masonry, from one manufacturer for each cementitious component and from one source and producer for each aggregate.

G. Qualifications of the Masonry Contractor

1. The masonry contractor shall be a licensed masonry firm that specializes in complete masonry construction of the type specified, indicated on the Drawings, and within the scope of this Project. The masonry contractor shall not function as a broker, and shall perform all masonry with its own workforce. The masonry contractor shall have a minimum of 10 years masonry experience operating as a sole masonry entity in commercial or industrial projects of comparable size and complexity. Joint ventures do not count as acceptable experience. Residential experience is not acceptable.
2. Quality Control Plan: The masonry contractor shall have an established formal and verifiable Quality Assurance/Control Program. Submit a copy of the manual and name of the program administrator with the bid. An unacceptable Quality Assurance/Control Plan, as determined by the Owner and Architect, is reason for disqualifying a masonry contractor. As an absolute minimum, the plan shall include the following provisions.
   a. Date program instituted.
   b. Printed Quality Assurance/Control manual.
   c. Formal training program for various skill levels and job classifications.
   d. Training schedule for various skill levels and job classifications.
   e. Non-conforming materials and construction policy.
   f. Site visit checklist.
   g. Job Visit Schedule
   h. Job Visit Log Book.
   i. Names and titles of individuals making job visits.
3. The masonry contractor shall be able to perform all work related to laying masonry, flashing, mortar mixing, grouting, and reinforcing, with his own mechanics who are qualified, experienced, skilled, and trained in their respective trades prior to beginning masonry work on this project. Trainees, apprentices, and helpers shall not perform these tasks on this project.
4. The masonry contractor shall not subcontract masonry work without the written permission of the Architect. If subcontracting masonry work is permitted, the masonry contractor will be fully responsible for the supervision, scheduling, and quality of each contractor. General contractors with a separate masonry subcontracting division will not automatically qualify as a masonry subcontractor.
5. The work of this section of the Specifications shall be provided as a single lump sum subcontract. Square foot/unit pricing of masonry labor and materials furnished by the general contractor are not permitted. The masonry subcontractor shall furnish all material, accessories, equipment, and labor to install all scheduled and required masonry in accordance with the Contract Documents.
6. The masonry contractor shall be fully bondable, where required by the General Conditions.
7. The General Contractor shall furnish a letter from its masonry contractor certifying that the masonry contractor meets and complies with these special requirements. If it is determined the masonry contractor does not meet the specified qualifications, even after contract execution, the General Contractor will be asked to replace the unqualified masonry contractor with one that meets the specified qualifications.

H. Masonry Contractor's Field Supervision: The masonry contractor shall maintain a full-time masonry superintendent on the job site at all times during masonry construction. The

masonry superintendent shall be experienced in masonry systems similar to the type, scope, and complexity required for this Project, and shall not actually perform masonry installation. The masonry contractor shall also employ, and have on site at all times, one qualified, full-time, and non-working masonry foreman for every 10 masons or fraction thereof. Prior to starting masonry work, the General Contractor's Project Manager shall review all masonry details and specifications with the General Contractor's Job Superintendent and the masonry foreman. The supervisor/foreman shall complete a daily activity report that includes the following items, and shall submit the report to the General Contractor weekly and to the Architect as requested:

1. Approximate quantity and type of masonry installed.
2. Noted defects, their location, and the action taken.
3. Quantity of incorrect and rejected work performed, the nature of the incorrect or rejected work, and its proportion as related to completed work.
4. Impact of defects on the Project.
5. If incorrect or rejected work will not be corrected by the end of the day that it was discovered, the time when the work will be corrected.

I. Quality Control Testing During Construction: Specified in PART 3.

1. The Contractor shall will employ and pay an independent testing laboratory acceptable to the Architect-Engineer to perform required tests during construction.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver masonry materials to project in undamaged condition.

B. Store and handle masonry units off the ground, under cover, and in a dry location to prevent their deterioration or damage due to moisture, temperature changes, contaminants, corrosion, and other causes. If units become wet, do not place until units are in an air-dried condition.

C. Store cementitious materials off the ground, under cover, and in dry location.

D. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.

E. Store masonry accessories including metal items to prevent corrosion and accumulation of dirt and oil.

1.7 PROJECT CONDITIONS

A. Protection of Masonry: During erection, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.

1. Extend cover a minimum of 24 inches down both sides and hold cover securely in place.

B. Do not apply uniform floor or roof loads for at least 12 hours and concentrated loads for at least 3 days after building masonry walls or columns.

C. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Remove immediately any grout, mortar and soil that come in contact with such masonry.

1. Protect base of walls from rain-splashed mud and mortar splatter by means of coverings spread on ground and over wall surface.
2. Protect sills, ledges, and projections from mortar droppings.

3. Protect surfaces of window and doorframes, as well as similar products with painted and integral finishes from mortar droppings.

D. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen subgrade or setting beds. Remove and replace unit masonry damaged by frost or freezing conditions. Comply with the cold weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.
   1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 degrees F and above and will remain so until masonry has dried, but not less than 7 days after completing cleaning.

E. Hot-Weather Requirements: Protect unit masonry work when temperature and humidity conditions produce excessive evaporation of water from mortar and grout. Provide artificial shade and wind breaks and use cooled materials as required. Do not apply mortar to substrates with temperatures of 100 degrees F and above.

F. Do not proceed with the work during inclement weather or when weather forecasts are unfavorable, unless the work will proceed in accordance with the manufacturer's requirements and instructions and any agreements or restrictions of the Pre-Installation Conference.

1.8 MAINTENANCE

A. Maintenance Manuals: Furnish complete manuals describing the materials and procedures to be followed in cleaning and maintaining the work. Include manufacturer's brochures describing the actual materials used in the work. Assemble manuals into single binders.

1.9 WARRANTY

A. General: Warranties shall be in addition to, and not a limitation of, other rights the Owner may have under the Contract Documents.

B. Warranty for Rigid Plastic Cavity Wall Insulation: Submit for the Owner's documentation. Furnish 15 year written warranty, signed by the manufacturer, agreeing to replace defective insulation. Upon notification of such defects, within the warranty period, make necessary replacement at the convenience of the Owner.

PART 2 - PRODUCTS

2.1 GENERAL

A. Comply with referenced unit masonry standard and other requirements specified in this section applicable to each material indicated.

2.2 CONCRETE MASONRY UNITS

A. General: Comply with requirements indicated below applicable to each type of concrete masonry unit required.
   1. Provide special shapes where indicated and as follows:
      a. For lintels, corners, jambs, sash, control joints, headers, bonding, and other special conditions.
      b. Square-edged units for outside corners, except where indicated as bullnose.
   2. Size: Provide concrete masonry units complying with requirements indicated below for size that are manufactured to specified face dimensions within tolerances

specified in the applicable referenced ASTM specification for concrete masonry units.

a. Concrete Masonry Units: Manufactured to specified dimensions of 3/8 inch less than nominal widths by nominal heights by nominal lengths indicated on drawings.

3. Exposed Faces: Manufacturer's standard color and texture, unless otherwise indicated.
4. CMU shall be free of pumice, scoria, cinder, bottom ash, and tuff.
5. Integral Water Repellant: Manufacture all exterior concrete block that will be directly exposed to weather with one of the following water repellants integrally blended into the mix: Dry-Block Mortar Admixture by W.R. Grace & Co or RainBloc by ACM Chemistries, or Acme Ultra by Acme-Hardesty.
6. All materials and mixes shall have minimum proportions of alkali, sulfates, and free salts so as to prevent or minimize efflorescence after installation.
7. Ocean sand is not acceptable for fine aggregate.

B. Concrete Masonry Units: ASTM C 90, Grade N and as follows:

1. Unit Compressive Strength: Provide units with minimum average net area compressive strength indicated below:

a. As indicated on the drawings. If not indicated, provide units with a minimum F'm=1,500 psi

b. Not less than the unit compressive strengths required to produce concrete unit masonry construction of compressive strength indicated.

2. Weight Classification: Normal weight, 125 pcf, ASTM C331.
3. All materials and mixes shall have minimum proportions of alkali, sulfates, and free salts so as to prevent or minimize efflorescence after installation.

2.3 MORTAR AND GROUT MATERIALS

A. General Material requirements for aggregate and Portland cement shall apply to all mixes and sources whether pre-mixed or site mixed. All materials and mortar mixtures shall have minimum proportions of alkali, sulfates, and free salts so as to prevent or minimize efflorescence after installation.

B. Portland Cement: ASTM C 150, Type I, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce required mortar color.

C. Masonry Cement: ASTM C 91.

1. For colored pigmented mortars use premixed colored masonry cements of formulation required to produce color indicated, or if not indicated, as selected from manufacturer's standard formulations.

D. Ready-Mixed Mortar: Cementitious materials, water, and aggregate complying with requirements specified in this article, combined with set-controlling admixtures to produce a ready-mixed mortar complying with ASTM C 1142 and ASTM C 1384.

E. Hydrated Lime: ASTM C 207, Type S.

F. Aggregate for Mortar: ASTM C 144, except for joints less than 1/4 inch use aggregate graded with 100% passing the No. 16 sieve. Ocean sand is not acceptable. Use clean, Mason sand.

G. Aggregate for Grout: ASTM C404. Ocean sand is not acceptable for fine aggregate. Use clean, Mason sand.

H. Water: Clean and potable.

I. Water-Repellent Admixture:
   1 RainBloc by ACM Chemistries or a reviewed substitute
   2. Dry-Block Mortar Admixture; Grace: W.R. Grace & Co.
   3. Acme Ultra Mortar Admixture by Acme-Hardesty

2.4 TIES, ANCHORS AND REINFORCEMENTS

A. Reinforcing Bars: Deformed steel reinforcing bars, free from mill scale and loose rust on other deleterious matter. Sizes and locations as indicated on the drawings. Material and grade as follows:
   1. Billet steel complying with ASTM A 615, Grade 60.

B. Joint Reinforcement: For all exterior walls and interior walls (interior walls as scheduled or as detailed) use hot-dipped galvanized carbon-steel wire, ASTM A153, Class B-2. Welded-wire units prefabricated with deformed continuous side rods and plain cross rods into straight lengths of not less than 10 feet, with prefabricated corner and tee units, cross-rod spacing at 16 inches o.c. for core clearance and complying with requirements indicated below:
   1. Wire Diameter for Side Rods: 0.1483 inch, (9 gage).
   2. Wire Diameter for Cross Rods: 0.1483 inch (9 gage).
   3. For single-wythe concrete masonry provide type as follows with single pair of side rods.
      a. Ladder design with perpendicular cross rods spaced not more than 16 inches on center.
         1) Masonry Reinforcing Corporation of America “Wire-Bond,” ladder type series 200, 2-wire system single-wythe type.
         2) Dur-O-Wal Inc. “Ladder Type” D/A 320 LADUR (2 wire).
         3) Hohmann and Barnard Inc. single-wythe wall with No. 220 ladder mesh.

C. Steel Column Anchors: Use minimum 2 inch long hooked ends. Minimum strap thickness of 1/4 inches with corrugated straps at the embedment into the CMU; at the end of the corrugated portion drill holes for 8 inch long 3/16 inch diameter dowels; the dowels will project 4 inches above and below the strap for embedment into the filled cells. The CMU cells at each anchor must be filled solid with grout. At the lowest filled cell, use the fabric mortar/grout screen to hold the grout in place. Coordinate thickness of slot with column flange thickness. Hooked end of straps to fit snug to column flanges. Spray-on fireproofing must be repaired and/or replaced after the anchors have been installed. For column anchors located in exterior walls or interior walls exposed to water or moist air, use stainless steel, ASTM A167, ASTM A240, Type 316, 2B finish. For other interior walls, use mill galvanized finish, ASTM A525 Class G60 (0.6 oz zinc coating per square foot). Provide lock rod and bolts to mechanically engage both sides of column flanges. Columns must be designed and engineered to resist positive and negative wind loads on exterior walls.
   1. Hohmann and Barnard Inc. Column anchors No. 353-L and No. 355-L.
   2. Heckmann Column anchors No. 190 and No. 193.

D. Corrugated Buck Anchors: 2 inch wide, 12 gage; length as required; 2-inch bend with nail holes. For anchors located in exterior walls or interior walls exposed to water or moist air, use stainless steel, ASTM A167, ASTM A240, Type 316, 2B finish. For other interior walls, use mill galvanized finish, ASTM A525 Class G60 (0.6 oz zinc coating per square foot).
   1. Hohmann and Barnard Inc. No. 345.
   2. Heckmann No. 200.

E. Rigid Partition Anchors: “Zee” type rigid steel anchor, 24 inches long by 1-1/2 inches wide by 1/4 inches thick with 2 inch bends. For anchors located in exterior walls or interior walls

exposed to water or moist air, use stainless steel, ASTM A167, ASTM A240, Type 316, 2B finish. For other interior walls, use mill galvanized finish, ASTM A525 Class G60 (0.6 oz. zinc coating per square foot).
1. Heckmann No. 272-Z type rigid steel.
2. Hohmann and Barnard Inc. No. 344 rigid partition anchors.

F. Rebar Positioners: For positioning vertical reinforcing in the center of cmu. Provide single or double loops as required with 3/16 inch diameter wire. For rebar positioners in exterior walls or interior walls exposed to moist environment use hot-dipped galvanized coating, ASTM A 153 Class B2 (1.5 oz/sq. ft). For all other locations coating requirements are ASTM A525 Class G60(.60/oz/sq. ft).
1. Hohmann and Barnard Inc. No. RB and No. RB Twin Rebar Positioners.
2. Heckmann No. 376 rebar positioners.
3. Masonry Reinforcing Corporation of America Wire-Bond Nos. 3401 and 3402.
4. Dur-O-Wal Inc. Vertical Bar Positioners D/A 811 or D/A 816.

G. Mortar/Grout Screen: 1/4-inch square monofilament screen, fabricated from high strength non-corrosive polypropylene polymers.
1. Hohmann and Barnard “MGS-Mortar/Grout Screen.”
2. Dur-O-Wal, Inc. Dur-O-Stop D/A 1015-1017.
3. Masonry Reinforcing Corporation of America; Wire-Bond, “Grout Stop.”

H. Control Joints: Designed for use with standard sash block. Factory extruded rubber conforming to ASTM D-2000 2AA-805, durometer hardness of 80 when tested in accordance with ASTM D2240. Provide regular and tee shapes.
1. Dur-O-Wal Inc. “Rapid Control Joint Rubber Compound.”
2. Hohmann and Barnard Inc., No. RS-Standard, No. RS-Tee.
3. Masonry Corporation of America Wire-Bond No. 2900, No. 2900, and No. 2901.

I. Insulation Retainer Clips: One piece corrosion resistant insulation retainer clip; stainless steel plate fits over masonry ties and clamps the insulation to the back-up construction.
1. Dur-O-Wal, Inc.: “Fur-Clip.”

J. Channel Slot Anchors with Triangular Tie Anchors: Channel-slot anchors with welded straps for embedment into cmu; standard length; stainless-steel ASTM A167, ASTM A240, Type 316, 2B finish. Triangular Tie Anchors; 12 gage end, ties 3/16 inch diameter, length as required to provide a minimum 3 inch bearing into the block wythe. Stainless steel ASTM A580, Type 316.
1. Hohmann and Barnard Inc. “Gripstay Channel No. 361,” “Flexible Gripstay Anchor No. 363.”
2. Heckmann “Built-In Channel Slot No. 131,” “Channel Slot Triangular Tie No. 129,”
3. Dur-O-Wal, Inc. “Channel Slot No. D/A 902,” “Triangular Tie No. D/A 918-922.”

K. Triangular Flexible Tie Anchors: Strap and tie material stainless steel ASTM A580, Type 316. Strap 3/4 inches wide by 12 gage thick; 3/16-inch diameter triangular ties, length as required. Minimum tie embedment 1/2 (one-half) nominal width of CMU wythes.
1. Hohmann and Barnard Inc. No. 345-BT Flexible Tie.
2. Heckmann No. 316 Triangular Ties and No. 310 Hitclip Anchor.
3. Dur-O-Wal, Inc. (equivalent).

2.5 EMBEDDED FLASHING MATERIALS

A. Drip Edge Flashing: Stainless steel 22ga., Type 2B, full depth leg with turned down edge at drip and turned-up edge at back of cavity. Use at cmu starter course and at lintels. Place the flashing and secure in place, then place on top the flexible flashing specified below.
1. Dur-O-Wal, Inc. “Drip Edge Flashing.”

2. Hohmann and Barnard “Type MFL,” profile to match details.
3. Heckmann “Type 1008(similar).”

B. Flexible Flashing: Self-sealing, self-healing, fully adhered, composite flexible flashing. Combination rubberized asphalt and laminated polyethylene film, total minimum thickness 40 mils.
1. Dur-O-Wal, Inc. “Dur-O-Barrier.”
2. Hohmann and Barnard Inc. “Textroflash.”

C. Termination Bars: Type 304 stainless steel, flat profile with holes spaced at 16@ o.c.. Use at top of flexible flashing.
1. Hohmann and Barnard, Inc. “Type T1.”
2. Heckmann “T-Bar.”

D. End Dams and Corners: Preformed of same material as used for through wall flashing.

E. Flashing Terminations: The preferred method to terminate through wall flashing is in the masonry joints. Where joint termination is not possible, provide required termination bar recommended by the flashing manufacturer for the particular application to fasten flashing to the interior backing with stainless steel termination bars and sealed with silicone sealant tooled to a smooth depression and cavity free surface that will not collect and water and will shed water away from the backup and toward the cavity.

2.6 MORTAR AND GROUT MIXES

A. General: Do not add admixtures including coloring pigments, air-entraining agents, accelerators, retarders, water repellent agents, antifreeze compounds, or other admixtures, unless otherwise indicated.
1. Do not use calcium chloride in mortar or grout.

B. Mortar for Unit Masonry: Comply with ASTM C 270, Property Specification for job-mixed mortar and ASTM C 1142 for ready-mixed mortar, of types indicated below:
1. Limit cementitious materials in mortar to Portland cement-lime.
2. For masonry below grade and in contact with earth, and where indicated, use type indicated below:
   a. Type S.
3. For reinforced masonry and where indicated, use type indicated below:
   a. Type S.
   b. Type S or RS.
4. For exterior, above-grade loadbearing and nonloadbearing walls and parapet walls; for interior loadbearing walls; for interior nonloadbearing partitions, and for other applications where another type is not indicated, use type indicated below:
   a. Type N.
   b. Type N or RN.

C. Grout for Unit Masonry: Comply with requirements of Section 033000, Cast-In-Place Concrete.

D. Cold-Weather Admixture: When permitted by the Architect, Non-chloride, non-corrosive, accelerating admixture complying with ASTM C 494, Type C, and recommended by the manufacturer for use in masonry mortar of composition indicated.

2.7 INSULATION

A. Extruded Polystyrene Board Insulation: Provide rigid cellular polystyrene thermal insulation with closed cells and integral high-density skin, formed by the expansion of polystyrene base resin in an extrusion process to comply with ASTM C578, Type IV;

in manufacturer's standard lengths and widths; thickness as indicated on the drawings. Square edge, minimum 25 psi compressive strength; 15-year manufacturer's warranty. "Cavitymate-Plus," Dow Chemical Company, or approved equal.

B. Cell Fill For Sound Attenuation: Comply with ASTM E119. Amino-Plast resin and catalyst forming agent. Mix shall provide an aged and advertised R-value of 14 in an 8-inch block having a compressive strength of 60 psi. Insulation shall be of the type that is foamed in place and can be use on new or existing construction. Acceptable Manufacturers are:
   1. Core-Fill-500 by Tailored Chemical Products
   2. Tripolmer by C.P. Chemical
   3. Thermco by Thermal Corporation of America

2.8 SOURCE QUALITY CONTROL

A. Concrete Masonry Unit Tests: For each type, class, and grade of concrete masonry unit indicated (including ground face masonry), units will be tested by qualified independent testing laboratory for strength, absorption, and moisture content per ASTM C 140.

2.9 MISCELLANEOUS MATERIALS

A. Steel Corner Angles: Minimum 6 inches by 6 inches by 1/4 inches (thick) length as specified with hooked dowel anchor bolts; finish hot-dipped galvanized, ASTM A153, Class B-2 (1.5 oz/sq. ft).
   1. Heckmann No. 725.

2.10 MASONRY CLEANERS

A. Manufacturers: Subject to compliance with requirements, provide suitable complying with the specified requirements, by one of the following manufacturers:
   1. Diedrich Technologies, Inc.
   2. ProSoCo, Inc.
   3. Sure Klean

B. Proprietary Cleaner: Comply with the following masonry cleaning requirements:
   1. Based on the type, color, texture, and composition of the masonry to be cleaned and the type foreign material (mortar, grout, mud stains, soot, mold, efflorescence, etc.) to be removed, provide products expressly approved for the intended use by the chemical manufacturer and the manufacturer of the masonry units.
   2. Use manufacturer's standard-strength, general-purpose cleaner designed for removing mortar/grout stains, efflorescence, and other new construction stains from new masonry surfaces of type indicated below without discoloring or damaging masonry surfaces or mortar joints;
   3. Use only materials expressly approved for intended use by manufacturer of masonry units being cleaned and by the Brick Institute of America.
   4. Do not use mixtures containing Muriatic acid.
      a. For masonry not subject to metallic oxidation stains, use formulation consisting of a concentrated blend of surface-acting acids, chelating, and wetting agents.
      b. For dark-colored masonry not subject to metallic oxidation stains, use formulation consisting of a liquid blend of surface-acting acids and special inhibitors.
      c. For masonry subject to metallic oxidation stains, use formulation consisting of a liquid blend of organic and inorganic acids and special inhibitors.

d. For split-faced or ground-faced architectural CMU use a formulation consisting of a liquid blend surface acting acids, inhibitors and special wetting agents designed specifically for cleaning Architectural CMU.

e. For prefaced concrete units, verify that masonry cleaners will not damage facings.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions, with installer present, for compliance with requirements for installation tolerances and other specific conditions, and other conditions affecting performance of unit masonry.

1. For the record, prepare written report, endorsed by installer, listing conditions detrimental to performance of unit masonry.

B. Examine rough-in and built-in construction to verify actual locations of piping connections prior to installation.

C. Do not proceed until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with referenced unit masonry standard and other requirements indicated applicable to each type of installation included in Project.

B. Thickness: Build cavity and composite walls and other masonry construction to the full thickness shown. Build single-wythe walls to the actual thickness of the masonry units, using units of nominal thickness indicated.

C. Build chases and recesses as shown or required to accommodate items specified in this and other sections of the Specifications. Provide not less than 8 inches of masonry between chase or recess and jamb of openings and between adjacent chases and recesses.

D. Leave openings for equipment to be installed before completion of masonry. After installation of equipment, complete masonry to match construction immediately adjacent to the opening.

E. Cut masonry units with motor-driven saws to provide clean, sharp, unchipped edges. Do not use cut masonry units in locations exposed to view. Cut units as required to provide continuous pattern and to fit adjoining construction. Use full-size units without cutting where possible.

F. Matching Existing Masonry: Match coursing, bonding, color, and texture of new masonry with existing materials.

G. Do not use CMU that have 50 percent or more excessive wet surface area or wet the CMU prior to laying. Damp surfaces are acceptable. Damp and excessive wet surfaces areas are defined as follows.

1. Damp Surface: A dark surface that gets darker when additional potable water is added to the dark surface. This indicates the unit has moisture but it is not excessive.

2. Excessive Wet Surface: A dark surface that does not get darker when additional potable water is added to the dark surface. This indicates the unit has excessive moisture.

3.3 CONSTRUCTION TOLERANCES

A. Comply with construction tolerances of referenced unit masonry standard.

3.4 LAYING MASONRY WALLS

A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint widths and for accurate locating of openings, movement-type joints, returns, and offsets. Avoid the use of less-than-half-size units at corners, jambs, and where possible at other locations.

B. Lay up walls to comply with specified construction tolerances, with courses accurately spaced and coordinated with other construction.

C. Bond Pattern for Exposed Masonry: Lay exposed masonry in a running bond pattern; do not use units with less that nominal 4 inch horizontal face dimensions at corners or jambs.

D. Lay concealed masonry with all units in a wythe in running bond. Bond and interlock each course of each wythe at corners. Do not use units with less than nominal 4-inch horizontal face dimensions at corners or jambs.

E. Stopping and Resuming Work: In each course, rack back 1/2 unit length for one-half running bond; do not tooth. Clean exposed surfaces of set masonry, wet clay masonry units lightly (if required), and remove loose masonry units and mortar prior to laying fresh masonry.

F. Built-In Work: As construction progresses, build-in items specified under this and other sections of the Specifications. Fill in solidly with masonry around built-in items.
   1. Fill space between hollow metal frames and masonry solidly with mortar, unless otherwise indicated.
   2. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath in the joint below and rod mortar or grout into core.
   3. Fill cores in hollow concrete masonry units with grout 3 courses (24 inches) under bearing plates, beams, lintels, posts, and similar items, unless otherwise indicated.

3.5 MORTAR BEDDING AND JOINTING

A. Lay hollow concrete masonry units as follows:
   1. With full mortar coverage on horizontal and vertical face shells.
   2. Bed webs in mortar in starting course on footings and in all courses of piers, columns, and pilasters, and where adjacent to cells or cavities to be filled with grout.
   3. For starting course on footings where cells are not grouted, spread out full mortar bed including areas under cells.
   4. Maintain joint widths indicated, except for minor variations required to maintain bond alignment. If not indicated, lay walls with 3/8-inch joints.

B. Tool exposed joints of exterior concrete masonry units where indicated, when thumbprint hard, by tooling out setting mortar to a uniform depth of $\pm$1/4 inch in a raked pattern to match manufactured scored joints in concrete masonry units.

C. Tuck-point all joints of scored units for proper appearance. All exterior scored units must be tuck-pointed. Do not rake joints.

D. Cut joints flush for masonry walls to be concealed or to be covered by other materials, unless otherwise indicated.

3.6 STRUCTURAL BONDING OF MULTIWYTHE MASONRY

A. Use continuous horizontal joint reinforcement installed in horizontal mortar joints for bond tie between wythes.

B. Corners: Provide interlocking masonry unit bond in each course at corners, unless otherwise shown.
   1. Provide continuity with horizontal joint reinforcement at corners using prefabricated "L" units, in addition to masonry bonding.

C. Intersecting and Abutting Walls: Unless vertical expansion or control joints are shown at juncture, provide same type of bonding specified for structural bonding between wythes and space as follows:
   1. Provide continuity with horizontal joint reinforcement using prefabricated "T" units.

D. Nonbearing Interior Partitions: Build full height of story to underside of solid floor or roof structure above and as follows:
   1. Install pressure-relieving joint filler in joint between top of partition and underside of structure above and lateral wall brace connection as indicated on the drawings.

3.7 CAVITIES AND AIR SPACES

A. Keep cavities/air spaces clean of mortar droppings and other materials during construction. Strike joints facing cavities/air spaces flush.

B. Tie exterior wythe to backup with continuous horizontal joint reinforcing.

C. Install vents in vertical head joints at the top of each continuous cavity/air space. Space vents and close off cavities/air spaces vertically and horizontally with blocking in manner indicated.

3.8 CAVITY WALL AND MASONRY-CELL INSULATION

A. Insulation type and extent is indicated on the drawings.

B. Fit courses of insulation between wall ties and other confining obstructions in cavity, with edges butted tightly both ways. Press units firmly against inside wythe of masonry or other construction as shown.
   1. Apply adhesive in full coverage edge-to-edge and corner-to-corner over entire surface of insulation in thickness recommended by the insulation manufacturer to ensure a permanent bond to the substrate. Do not apply adhesive in dabs or strips.
   2. Fill all cracks and open gaps in insulation with crack sealer compatible with insulation and masonry.

C. Foam Insulation Fill in Cells
   1. Pump insulation in to masonry cells according to manufacturer's instructions. Ensure that each cell is filled solid, from the bottom of the wall to the top of the wall, with foam. Use caution to prevent damage to CMU during filling.
   2. If the Owner or the Architect suspect that the cells are not completely or properly filled, the Owner may hire an independent testing agency to core the masonry. If tests indicate that the cells are not properly filled with foam, the contractor shall be responsible for all costs to fill or refill cells and for all previous testing that was paid for by the Owner and for all future testing.

3.9 HORIZONTAL JOINT REINFORCEMENT

A. General: Provide continuous horizontal joint reinforcement as indicated. Install longitudinal side rods in mortar for their entire length with a minimum cover of 5/8 inch on exterior side of walls, 1/2 inch elsewhere. Lap reinforcing a minimum of 6 inches.

B. Cut or interrupt joint reinforcement at control and expansion joints, unless otherwise indicated.

C. Provide continuity at corners and wall intersections by use of prefabricated "L" and "T" sections. Cut and bend reinforcement units as directed by manufacturer for continuity at returns, offsets, column fireproofing, pipe enclosures, and other special conditions.

D. Space reinforcement at a maximum 8-inch O.C. in foundation walls and parapet walls and 16-inch O.C. for all other conditions.

3.10 ANCHORING MASONRY TO STRUCTURAL MEMBERS

A. Anchor masonry to structural members where masonry abuts or faces structural members to comply with the following:
   1. Provide an open space not less than 1 inch in width between masonry and structural member, unless otherwise indicated. Keep open space free of mortar or other rigid materials.
   2. Anchor masonry to structural members with anchors as detailed and scheduled.
   3. Space anchors as indicated, but not more than 24 inches o.c. vertically and 24 inches o.c. horizontally.

3.11 CONTROL AND EXPANSION JOINTS

A. General: Install control and expansion joints in unit masonry where indicated. Provide vertical control joints at 20 feet, 0 inches on center, unless otherwise shown or noted. Built-in related items as the masonry progresses. Do not form a continuous span through movement joints unless provisions are made to prevent in-plane restraint of wall or partition movement.

B. Build flanges of metal expansions trips into masonry. Lap each joint 4 inches in direction of water flow. Seal joints below grade and at junctures with horizontal expansion joints, if any.

C. Build flanges of factory-fabricated expansion joint units into masonry.

D. Build-in nonmetallic joint fillers where indicated.

E. Build-in horizontal pressure-relieving joints where indicated; construct joints by either leaving an air space or inserting a compressible filler of width required for installing sealant and backer rod specified in 07920, Sealants and Caulking.
   1. Locate horizontal pressure-relieving joints beneath shelf angles supporting masonry veneer and attached to structure behind masonry veneer.
   2. Interrupt steel lintel support angles on either side of control joints leaving gap equal to width of control joint.

3.12 LINTELS

A. Install steel lintels where indicated.

B. Provide masonry lintels where shown and wherever openings of more than 1 foot - 0 inches for brick size units and 2 feet - 0 inches for block size units are shown without structural steel or other supporting lintels. Provide precast or formed-in-place masonry lintels. Cure precast lintels before handling and installation. Temporarily support formed-in-place lintels.

1. For hollow concrete masonry unit walls, use specially formed bond beam units with reinforcement bars placed as indicated and filled with coarse grout.

C. Provide minimum bearing of 8 inches at each jamb, unless otherwise indicated.

3.13 FLASHING AND WEEP HOLES

A. General: Install embedded flashing and weep holes in masonry at shelf angles, lintels, ledges, other obstructions to the downward flow of water in the wall, and where indicated.
   1. All flashing shall be installed by the masonry contractor and only by skilled flashing installation specialists who are thoroughly trained and experienced in installing the type flashing specified. No exceptions.

B. Prepare masonry surfaces so that they are smooth and free from projections that could puncture flashing. Place through-wall flashing on sloping bed of mortar and cover with mortar. Seal penetrations in flashing with adhesive/sealant/tape as recommended by flashing manufacturer before covering with mortar.

C. Install flashings as follows:
   1. At lintels and shelf angles, extend flashing a minimum of 4 inches into masonry at each end. Extend flashing from exterior face of outer wythe of masonry, through the outer wythe, turned up a minimum of 4 inches, and through the inner wythe to within 1/2 inches of the interior face of the wall in exposed masonry. Where interior surface of inner wythe is concealed by furring, carry flashing completely through the inner wythe and turn up approximately 2 inches, unless otherwise indicated.
   2. At heads and sills, extend flashing as specified above unless otherwise indicated but turn up ends not less than 2 inches to form a pan.
   3. Turn down sheet metal flashings at exterior face of masonry to form drip.
   4. Cut off flexible flashing flush with face of wall after masonry wall construction is completed.

D. Install weep holes in the head joints in exterior wythes of the first course of masonry at ledges and lintels immediately above embedded flashings and as follows:
   1. Form weep holes by keeping head joints free and clear of mortar.
   2. Space weep holes 24 inches o.c. horizontally.

E. Install reglets and nailers for flashing and other related construction where shown to be built into masonry.

F. All installed though wall flashing including inside and outside corners shall be inspected and photographed, by the third party inspector, for proper location, installation, and compliance with the Contract Documents prior to covering. Documentation shall include date, time, location, masonry contractor, and inspector and shall be maintained at the project site for record. This documentation shall be included with the operation and maintenance information and manuals submitted at project closeout.
   1. Questionable materials and installation, before or after project completion, may be subject to review by a third party inspector or consultant as selected by the Owner. Where questionable materials and installation are found to be non-compliant with the Contract Documents, the Contractor shall be responsible for all costs, fees, and expenses related to removing noncompliant work and materials and replacing with compliant work and materials. These costs, fees, and expenses include, but are not limited to those of or pertaining to consultants, Architects, tradesmen, inspections, testing, equipment, rentals, materials, storage, etc. Where Questionable materials and installation are found to be compliant with the Contract Documents, the Owner will be responsible for all applicable costs.

3.14 INSTALLATION OF REINFORCED UNIT MASONRY

A. General: Install reinforced unit masonry to comply with requirements of referenced unit masonry standard.

B. Temporary Formwork: Construct formwork and shores to support reinforced masonry elements during construction.
   1. Construct formwork to conform to shape, line, and dimensions shown. Make sufficiently tight to prevent leakage of mortar and grout. Brace, tie, and support forms to maintain position and shape during construction and curing of reinforced masonry.

C. Grouting: Do not place grout until entire height of masonry to be grouted has attained sufficient strength to resist grout pressure. Maximum pour heights are as follows:
   1. For exposed to view masonry walls, pour height shall not exceed 5 feet. No cleanout holes shall be allowed.
      a. For other than final lifts or at poured-in-place concrete beams or lintels, grout in top cell shall be placed only to 1/2 height. At final lift, fill top cell flush.
   2. For concealed masonry walls, pour height can be increased to 8 feet. Where pour height exceeds 5 feet, cleanout holes shall be provided.
      a. Cleanout holes shall be at least 3 inches in least dimension. Provide cleanout hole at each vertical reinforcing bar. Where masonry is grouted solid, provide cleanout holes at not less than 32 inches o.c.
      b. For other than final lifts or at poured-in-place concrete beams or lintels, grout in top cell shall be placed only to 1/2 height. At final lift, fill top cell flush.
   3. No pour height shall exceed 8 feet.

3.15 FIELD QUALITY CONTROL

A. Testing Frequency: Tests and evaluations listed in this article will be performed during construction for each 5000 square feet of wall area or portion thereof.
   1. Mortar properties will be tested per property specification of ASTM C 270.
   2. Mortar composition and properties will be evaluated per ASTM C 780.
   3. Grout compressive strength will be sampled and tested per ASTM C 1019.

B. Prism Test Method: For each type of wall construction indicated, masonry prisms will be tested per ASTM E 447, Method B, and as follows:
   1. Prepare one set of prisms for testing at 7 days and one set for testing at 28 days.

C. Evaluation of Quality Control Tests: In absence of other indications of noncompliance with requirements, masonry will be considered satisfactory if results from construction quality control tests comply with minimum requirements indicated.

3.16 REPAIRING, POINTING, AND CLEANING

A. Repairing: Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or if units do not match adjoining units. Install new units to match adjoining units and in fresh mortar or grout, pointed to eliminate evidence of replacement.

B. Pointing: During the tooling of joints, enlarge any voids or holes, except weep holes, and completely fill with mortar. Point-up all joints including corners, openings, and adjacent construction to provide a neat, uniform appearance, prepared for application of sealants.

C. Cleaning

1. General
   a. Clean carefully and regularly.
   b. During and after any cleaning, if any the cleaned masonry units or joints show any sign of damage or discoloration, including joints with the mortar matrix removed leaving sandy joints, all affected units, will be removed and replaced with acceptable units, and defective joints will be repointed.
2. In-Progress Cleaning: Clean unit masonry as work progresses and at the end of each day by dry brushing to remove mortar fins and smears prior to tooling joints. Perform in-process cleaning so as to minimize the use of harsh cleaning chemicals and hand cleaning during final cleaning at the end of the masonry work..
3. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:
   a. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
   b. Test cleaning materials and methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of masonry.
   c. Protect adjacent stone and nonmasonry surfaces from contact with cleaner by covering them with liquid strippable masking agent, polyethylene film, or waterproof masking tape.
   d. Wet wall surfaces with water prior to application of cleaners; remove cleaners promptly by rinsing thoroughly with clear water. Do not allow cleaning solutions to dry on the wall.
   e. Clean concrete masonry by cleaning method indicated in NCMA TEK 45 applicable to type of stain present on exposed surfaces.
   f. Clean prefaced units carefully to prevent damage to facings.
   g. Clean from the top down.
4. Pressure Washing:
   a. Power washing is to be used only if hand washing produces unacceptable results.
   b. Pressure washing is not a substitute for poor in-progress cleaning.
   c. Power washing is to be used only with the Architects permission.
   e. Follow cleaning solution manufacturer’s instructions.
   f. If power washing is permitted, comply with the following:

D. Protection: Provide final protection and maintain conditions, in a manner acceptable to installer, that ensure unit masonry is without damage and deterioration at time of Substantial Completion.

0.7 SPECIAL INSPECTIONS

A. General: Special inspection and verification of masonry construction shall conform to the requirements of Section 014500 – Statement of Special Inspections. Refer to Section 3.15 – FIELD QUALITY CONTROL for additional requirements.

END OF SECTION 042000

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SECTION 051200 – STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this section.

1.2 SUMMARY

A. The work includes all structural steel shown, scheduled or otherwise required to complete the work, and all necessary connectors and accessories.

B. Related Sections: The following sections contain requirements that relate to this section:

1. Division 3, Section 033000 – CAST-IN-PLACE CONCRETE
2. Division 5, Section 053100 - STEEL DECKING
3. Division 5, Section 055000 - METAL FABRICATIONS.

1.3 SUBMITTALS

A. Shop Drawings: Furnish for approval. Fabrication shall not begin prior to approval of the shop drawings. The Contractor shall prepare the shop drawings. Reproduction of the Architect-Engineer's drawings is not permitted.

B. Substitutions: Make requests for substitutions of sections and modifications to details by obvious notations on shop drawings. Do not proceed with the substitution until specific approval has been granted by Architect-Engineer. No spliced members will be accepted unless splices are clearly shown on the shop drawings and approved by the Architect-Engineer.

C. Grout: Submit manufacturer's data and printed instructions, proposed mix proportions and resulting consistency and strength. When requested by the Architect-Engineer, submit independent testing lab reports verifying all specified requirements.

D. Inspection and Testing Reports: Submit two copies directly from the laboratory, one to the Owner and one to the Architect-Engineer.

E. Independent Testing Laboratory Certification: The independent testing laboratory shall provide a letter, signed and sealed by a registered professional engineer, legally authorized to practice in the jurisdiction where the project is located, stating that, to the best of his knowledge, based on an acceptable testing program, all fasteners and welds are installed in accordance with the drawings, specifications and applicable codes and standards.

F. Welders' Certificates: When requested by the Architect-Engineer, submit current AWS certificates for each welding operator for each type of welding performed.

G. Mill Reports: When requested by the Architect-Engineer, furnish 2 copies, specifying chemical and physical properties of steel to be used on this project.

H. Calculations: Submit structural calculations for the pre-engineered canopy system signed and sealed by a structural engineer registered in the state where the project is located. Indicate all member sizes, spacings, connections and other pertinent design information for all components of the system.

1. The following codes and publications, of the latest edition adopted, govern this work unless indicated or specified otherwise.

a. Aluminum Design Manual

b. “Manual of Steel Construction – Allowable Stress Design, Ninth Edition” or “Manual of Steel Construction – Load and Resistance Factor Design, Third Edition” both publications of AISC.

c. 2012 Virginia Construction Code

2. Design Loads: As indicated in this Section and on the Drawings.

3. Live Loads: The structure shall be designed to withstand a roof live load of 20 PSF in accordance with applicable code requirements.

4. Wind Loads: As indicated on the Drawings.

5. Load Combinations: Per applicable codes.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experienced Installer who has completed structural steel work similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance.

B. Fabricator Qualifications: Engage a firm experienced in fabricating structural steel similar to that indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to fabricate structural steel without delaying the work.

1. Fabricator must participate in the AISC Quality Certification Program and be designated an AISC-Certified Plant as follows:

a. Category: Standard for Steel Building Structures (STD).

C. The following codes and publications, of the latest edition, govern this work unless indicated or specified otherwise. References in these codes and publications to inspection by the Architect-Engineer shall be deleted. The Architect-Engineer's job administration is defined in the General Conditions of the Construction Contract.

1. "Code of Standard Practice for Steel Buildings and Bridges": A publication of AISC.
2. "Specification for Structural Steel Buildings": A publication of AISC.
3. AWS D1.1 "Structural Welding Code": A publication of American Welding Society.
4. "Specifications for Structural Joints using ASTM A325 or A490 Bolts": A publication of AISC.
5. Surface Preparation Specifications of the Steel Structures Painting Council. References appear as the specification number preceded by the initials SSPC.
6. American Society for Testing and Materials: ASTM.

D. Certification of Welders: Welding of all structural steel shall be limited to welding operators whose competency has been tested and certified in accordance with the Structural Welding Code of American Welding Society.

E. Inspection and Testing: The Contractor will employ and pay an independent testing laboratory to insure that all fasteners and welds are installed in accordance with the drawings, specifications, and approved shop drawings. The inspection and testing includes items covered in related sections. The inspection shall be performed under the supervision of a registered professional engineer, legally authorized to practice in the jurisdiction where the project is located.

F. Marking: Shop mark each piece of steel, plainly in a protected location in accordance with reference numbers on the shop drawings.

G. Coordination with Existing Conditions: The Fabricator shall be responsible for providing steel that has been fabricated to accommodate existing conditions as directed by the Architect-Engineer. The Architect-Engineer will provide the Fabricator with a certified survey of existing conditions affecting structural steel on this Project.

H. Quality Control Testing During Construction: Specified in PART 3.

1. The Contractor shall will employ and pay an independent testing laboratory acceptable to the Architect-Engineer to perform required tests during construction.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Structural Steel: ASTM A36 and ASTM A992, Grade 50, see drawings.

B. Cold-Formed Structural Steel Tubing: ASTM A500, Grade B, F_y = 46 KSI.

C. Steel Pipe: ASTM A53, Type S, Grade B or API Standard 5L, Grade B.

D. Shear Connectors: ASTM A108, Grade 1015 through 1020, headed-stud type, cold-finished carbon steel, AWS D1.1, Type B.

1. Minimum Tensile Stress = 60000 psi
2. Minimum Yield Stress = 50000 psi (.2% offset)

E. Anchor Rods, Nuts, and Washers: As follows:

1. Headed Rods: ASTM F1554, unless otherwise noted. See drawings for grade of material.

F. High-Strength Bolts, Nuts, and Washers: ASTM A325, Type 1, heavy hex steel structural bolts, heavy hex carbon-steel nuts, and hardened carbon-steel washers.

G. Welding Electrodes: Comply with AWS requirements.

1. Bare Steel: E70.
2. Galvanized Steel: E60 specifically applicable to galvanized surfaces.

2.2 PRIMER

A. Provide Tnemic Inc. "No. 10-99 Red", ICI Devoe Coatings "Devguard 4100" or Sherwin Williams "Kem Kromik".

2.3 GROUT

A. Materials: Grouting shall be performed with a material meeting the performance requirements that follow. Cement-based grouts shall have a minimum 5-year history of use and meet the following performance requirements at maximum water. They shall not contain expansive cement or metallic particles such as aluminum powder or iron filings.

1. Plastic Volume Change: The grout shall have no shrinkage (0.0 percent) and a maximum of 4.0 percent expansion from time of placement until final set when tested according to ASTM C827.
2. Hardened Volume Change: The grout shall have no shrinkage (0.0 percent) and a maximum of 0.2 percent expansion in the hardened state when tested according to CRD C-621.
3. Compressive Strength: The grout shall have a minimum 28-day compressive strength of 5,000 psi when tested according to ASTM C109, restrained.
4. Creep: The grout shall have creep characteristics equal to or less than the concrete on which it is bearing.
5. Working Time: The grout for anchor bolt sleeves shall have a fluid consistency with a time of efflux of less than 30 seconds and all other grout shall have a flow consistency greater than 125 percent for a minimum of 45 minutes when tested according to applicable consistency sections of ASTM C827 at 15 minute intervals.

B. Approved Manufacturers:

1. Master Builders, Inc., Cleveland, Ohio.
2. Sika Corporation, Lyndhurst, New Jersey.
3. Five Star Products, Inc.; U.S. Grout Corporation, Fairfield, Connecticut.
4. Lambert Corporation, Orlando, Florida.

2.4 GALVANIZING

A. Conform to ASTM Standards A123, A386 and A153 as applicable. Galvanizing Repair Compound shall conform to Mil. Spec. MIL-P-21035. Provide "ZRC" by ZRC Chemical Products Co. or "Zinc Clad 5" by Sherwin Williams.

2.5 CATWALK RAILINGS

A. Structural Performance of Railings: Provide railings capable of withstanding the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

1. Handrails:

a. Uniform load of 50 lbf/ ft. applied in any direction.
b. Concentrated load of 200 lbf Applied in any direction.
c. Uniform and concentrated loads need not be assumed to act concurrently.

2. Top Rails of Guards:

a. Uniform load of 50 lbf/ ft. applied in any direction.
b. Concentrated load of 200 lbf applied in any direction.
c. Uniform and concentrated loads need not be assumed to act concurrently.

3. Infill of Guards:

a. Concentrated load of 50 lbf applied horizontally on an area of 1 sq. ft..
b. Infill load and other loads need not be assumed to act concurrently.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Before erection proceeds, and with the steel erector present, verify elevations of concrete and masonry bearing surfaces and locations of anchorages for compliance with requirements.

B. Do not proceed with erection until unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place, unless otherwise indicated.

3.3 FABRICATION

A. General: Comply with the applicable portions of the publications referenced in PART 1.

B. Steel Connections: One sided or other eccentric connections not permitted unless specifically shown. No combination of fasteners such as bolts and welds are permitted in the same face of any connection. Furnish the type connections shown or noted; where not shown or noted, use either high strength bolting or welding. Where welding is used, apply heat symmetrically to minimize distortion or misalignment.

C. Concrete Connections:

1. Bearing Plates: Following grout manufacturer's written instructions, set in grout to elevations required or as shown on drawings.
2. Leveling: Use steel wedges for leveling members and plates on masonry and concrete; remove the wedges after grouting and grout the resulting holes. Leveling nuts are not permitted.
3. Anchor Bolt Pipe Sleeves: Prior to grouting anchor bolt pipe sleeves, remove debris and standing water from pipe sleeves. After anchor bolts have been aligned with members and/or base plates, and prior to erection of the member and/or plate, fill pipe sleeves with grout of a fluid consistency per manufacturer's written instructions.

D. Temporary Bracing: Furnish as necessary until permanent bracing is installed.

E. Nuts: Where machine bolts are shown, provide approved, self-locking type nuts, or upset the threads to prevent back-off.

F. Machine Bolts: Install so that threads are not in bearing.

G. Fabricate and assemble structural steel in shop to greatest extent possible. Fabricate structural steel according to AISC specifications referenced in this section and in Shop Drawings.

1. Camber structural steel members where indicated.
2. Identify high-strength structural steel according to ASTM A6 (ASTM A6M) and maintain markings until steel has been erected.
3. Mark and match-mark materials for field assembly.
4. Fabricate for delivery a sequence that will expedite erection and minimize field handling of structural steel.
5. Complete structural steel assemblies, including welding of units, before starting shop-priming operations.
6. Comply with fabrication tolerance limits of AISC's "Code of Standard Practice for Steel Buildings and Bridges" for structural steel.

H. Fabricate architecturally exposed structural steel with exposed surfaces smooth, square, and free of surface blemishes, including pitting, rust and scale seam marks, roller marks, rolled trade names, and roughness.

1. Remove blemishes by filling, grinding, or by welding and grinding, prior to cleaning, treating, and shop priming.
2. Comply with fabrication requirements, including tolerance limits, of AISC's "Code of Standard Practice for Steel Buildings and Bridges" for architecturally exposed structural steel.

I. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.

1. Plane thermally cut edges to be welded.

J. Finishing: Accurately mill ends of columns and other members transmitting loads in bearing.

K. Holes: Provide holes required for securing other work to structural steel framing and for passage of other work through steel framing members, as shown on Shop Drawings.

1. Cut, drill, or punch holes perpendicular to metal surfaces. Do not flame-cut holes or enlarge holes by burning. Drill holes in bearing plates.
2. Weld threaded nuts to framing and other specialty items as indicated to receive other work.

3.4 ERECTION

A. General: Comply with the applicable portions of the referenced publications.

B. Beams, Girders, Purlins, Columns, Trusses: Use steel wedges for leveling on masonry and concrete; remove the wedges after grouting and grout the resulting holes. Anchor to steel supports as shown.

C. Field Connections: Furnish the type connections shown or noted. Where not shown or noted, use either high strength bolting or welding. Where welding is used,

symmetrical application of welding heat shall be used at all connections and symmetrical application with reference to the overall dimensions of the building to minimize distortion or misalignment.

D. Base Plates: Following grout manufacturer's written instructions, set base plates in grout to elevations required or as shown on drawings.

E. Anchor Bolt Pipe Sleeves: Prior to grouting anchor bolt pipe sleeves, remove debris and standing water from pipe sleeves. After anchor bolts have been aligned with column base plates, fill pipe sleeves with grout of a fluid consistency per manufacturer's written instructions.

F. Temporary Bracing: Furnish as necessary until permanent bracing is installed.

G. Set structural steel accurately in locations and to elevations indicated and according to AISC specifications referenced in this section.

H. Base and Bearing Plates: Clean concrete and masonry bearing surfaces of bond-reducing materials and roughen surfaces prior to setting base and bearing plates. Clean bottom surface of base and bearing plates.

1. Set base and bearing plates for structural members on wedges, shims, or setting nuts as required.
2. Tighten anchor bolts after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of base or bearing plate prior to packing with grout.
3. Pack grout solidly between bearing surfaces and plates so no voids remain. Finish exposed surfaces, protect installed materials, and allow to cure.

a. Comply with manufacturer's instructions for proprietary grout materials.

I. Maintain erection tolerances of structural steel within AISC's "Code of Standard Practice for Steel Buildings and Bridges."

1. Maintain erection tolerances of architecturally exposed structural steel within AISC's "Code of Standard Practice for Steel Buildings and Bridges."

J. Align and adjust various members forming part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that will be in permanent contact. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.

1. Level and plumb individual members of structure.

K. Splice members only where indicated.

L. Remove erection bolts on welded, architecturally exposed structural steel; fill holes with plug welds; and grind smooth at exposed surfaces.

M. Finish sections thermally cut during erection equal to a sheared appearance.

N. Do not enlarge unfair holes in members by burning or by using drift pins. Ream holes that must be enlarged to admit bolts.

3.5 SHOP AND FIELD CONNECTIONS

A. Install and tighten nonhigh-strength bolts, except where high-strength bolts are indicated.

B. Install and tighten high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A325 or A490 Bolts."

1. Connection Type: Snug tightened, unless indicated as slip-critical, direct-tension, or tensioned shear/bearing connections.

C. Weld Connections: Comply with AWS D1.1 for procedures, appearance and quality of welds, and methods used in correcting welding work.

1. Comply with AISC specifications referenced in this section for bearing, adequacy of temporary connections, alignment, and removal of paint on surfaces adjacent to field welds.
2. Assemble and weld built-up sections by methods that will maintain true alignment of axes without warp.
3. Verify that weld sizes, fabrication sequence, and equipment used for architecturally exposed structural steel will limit distortions to allowable tolerances. Prevent surface bleeding of back-side welding on exposed steel surfaces. Grind smooth exposed fillet welds 1/2 inch and larger. Grind flush butt welds. Dress exposed welds.

3.6 SHOP PRIMING

A. Surfaces to be Encased in Concrete: Shop clean in accordance with SSPC-SP 3 "Power Tool Cleaning". Ship to the job site bare. Extend priming of partially embedded members to a depth of 3 inches.

B. Surfaces to Receive Welds: Where specified welding requirements (AWS) do not allow, or recommend against, welding on or through the required primer, provide surface preparation as required for the component but leave the specific area to receive the weld bare for field touch-up after welding.

C. All Other Surfaces Except Galvanized: Clean in accordance with SSPC-SP 3. Prime surfaces and work the paint well into all angles and crevices. Apply uniformly and free from holidays and bare spots. Shop primer shall be 2.0 mils (0.05 mm) minimum total dry film thickness.

D. Do not shop prime galvanized surfaces or surfaces to be high-strength bolted with slip-critical connections.

3.7 GALVANIZING

A. General: Conform to ASTM Standards A123, A386 and A153 as applicable whenever surfaces are indicated or specified to be galvanized. Galvanize after fabrication unless otherwise indicated or specified.

B. Repair: Repair all galvanized coatings that become damaged in handling, transporting, welding and bolting. Make the repairs by application of a galvanizing repair compound. Clean all areas that are to be repaired; remove slag from welds. Apply repair compound to cold surfaces.

3.8 CLEANING

A. Field Touch-Up: Touch-up all primer coated surfaces with same material as the primer coat. Field paint all unprimed bolts and accessories. Clean all welds and adjacent surfaces and touch-up with one coat of primer. Clean and touch-up all rusted areas with one coat of primer. Clean and touch-up all rusted areas resulting from long exposure during storage or after erection. The prime coat over which succeeding coats are applied shall be sound and well bonded.

3.9 FIELD QUALITY CONTROL

A. General: In addition to what is required herein, contractor shall be responsible for providing Quality Control, as defined in Chapter N of AISC 360-10, for structural steel framing.

B. Inspection of High-Strength Bolting:

1. Perform periodic inspection of bearing-type and slip-critical connections.
2. Perform continuous inspection of slip-critical connections.

C. Inspection of Welding:

1. Perform periodic inspection of single-pass fillet welds less that or equal to 5/16” as well as floor and deck welds.
2. Perform continuous inspection of all complete and partial penetration groove welds as well as all fillet welds greater than 5/16”.

D. Bolted and Welded Connections:

1. Procedure: A visual check shall be made of all bolted connections. In addition, all high strength bolts shall be checked for proper tension to verify compliance with specified requirements. Additional bolts may be tested at the option of the independent testing laboratory. Defective bolts shall be removed and replaced without cost to the Owner.
2. Exposure for Inspection: The visual check and testing procedure applies to both shop and field connections. No painting or galvanizing of the connections shall be performed prior to acceptance by the independent testing laboratory.

E. Welded Connections:

1. Procedure: A visual check shall be made of all welded connections. In addition, all full penetration welds shall be checked by ultrasonic testing or other test methods as necessary to verify compliance with specified requirements. Additional welds may be tested at the option of the independent testing laboratory. Defective welds shall be removed and replaced without cost to the Owner.
2. Exposure for Inspection: The visual check and testing procedure applies to both shop and field connections. No painting or galvanizing of the connections shall be performed prior to acceptance by the independent testing laboratory.
3. Testing of Welds: No testing shall be started until the weld is cool to the touch or a minimum time of 24 hours has elapsed after completion of welding.

F. Welded Studs on Composite Beams: Establish settings and procedures prior to starting stud welding. The first two studs on each beam will be tested by striking with a hammer until bent 30 degrees from vertical. In addition, all questionable studs will

be tested by striking with a hammer to a minimum bend of 15 degrees from vertical. A minimum of 5 percent of all studs will be tested. Following evaluation, replace all studs that do not meet acceptance criteria. Tested studs that show no signs of failure are satisfactory and may be left in the bent position.

G. Injection Adhesive Anchors: A visual check will be made of all injection adhesive anchor rods and fasteners. In addition, a minimum of 5 percent of all injection adhesive anchors will be tested for compliance with manufacturers recommended maximum allowable tension capacities. The independent testing laboratory will perform this testing. Anchors to be tested will be chosen by the Architect-Engineer. Additional injection adhesive anchors may be tested at the option of the independent testing laboratory. Following evaluation, replace and re-test all anchors that do not meet the acceptance criteria.

3.10 SPECIAL INSPECTIONS

A. General: Special inspection and verification of structural steel framing construction shall conform to the requirements of Section 014500 – Statement of Special Inspections. Refer to Section 3.9 – FIELD QUALITY CONTROL for additional requirements.

END OF SECTION 051200

SECTION 053100 – STEEL DECKING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes steel deck units, accessories and attachments for floor and roof application.

1.3 SUBMITTALS

A. General: Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections.

B. Product data including manufacturer's specifications and installation instructions for each type of deck, accessory, and product specified, with proposed products plainly marked.

C. Shop drawings showing layout and types of deck units, anchorage details, and conditions requiring closure strips, supplementary framing, sump pans, cant strips, cut openings, special jointing and other accessories.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experienced Installer who has completed steel deck similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance.

B. Codes and Standards: Comply with provisions of the following codes and standards, except as otherwise indicated:

1. American Iron and Steel Institute (AISI), "Specification for the Design of Cold-Formed Steel Structural Members."
2. AWS, D1.3 "Structural Welding Code - Sheet Steel."
3. Steel Deck Institute (SDI), "Design Manual for Composite Decks, Form Decks and Roof Decks."

C. Qualification of Field Welding: Use qualified welding processes and welding operators in accordance with "Welder Qualification" procedures of AWS.

1. Welded decking in place is subject to inspection and testing. Owner will bear expense of removing and replacing portions of decking for testing purposes if welds are found to be satisfactory. Remove work found to be defective and replace with new acceptable work.

D. Underwriters' Label: Provide metal floor deck units listed in UL "Fire Resistance Directory," with each deck unit bearing the UL label and marking for specific system detailed.

E. FM Listing: Provide steel roof deck evaluated by Factory Mutual and listed in Factory Mutual "Approval Guide" for Class 1 fire rating.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Protect steel deck from corrosion, deformation, and other damage during delivery, storage, and handling.

B. Stack steel deck on platforms or pallets and slope to provide drainage. Protect with a waterproof covering and ventilate to avoid condensation.

C. Do not store materials on the structure in a manner that might cause distortion or damage to the supporting structure. Repair or replace damaged materials in an approved manner without additional cost to the Owner.

D. Corrosion Repair: Finish of decking units shall be maintained at all times using touch-up paint whenever necessary to prevent the formation of rust. Touch-up paint for shop painted units shall be of the same type sued for the shop painting. Touch-up paint for zinc coated units shall be a high zinc content, galvanizing repair paint.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Bowman Metal Deck Armco, Inc.
2. Consolidated Systems, Inc.
3. Epic Metals Corp.
4. Marlyn Steel Products, Inc.
5. Robertson A United Dominion Co.
6. Roof Deck, Inc.
7. United Steel Deck, Inc.
8. Vulcraft Div. of Nucor Corp.
9. Wheeling Corrugating Co., Div. of Wheeling-Pittsburgh Steel Corp.

2.2 MATERIALS

A. Steel for Metal Deck Units: ASTM A653 (galvanized), grade as required to comply with SDI specifications.

B. Miscellaneous Steel Shapes: ASTM A36 (ASTM A36M).

C. Sheet Metal Accessories: ASTM A653, commercial quality, galvanized.

D. Galvanizing: ASTM A653, G90.

E. Galvanizing Repair: At welds and where galvanized surfaces are damaged and not encased in structural concrete, prepare surfaces and repair in accordance with procedures specified in ASTM A780.

F. Flexible Closure Strips: Manufacturer’s standard vulcanized, closed cell, synthetic rubber.

G. Screws: AISI 1019, minimum size No. 12, cadmium-plated or stalgard coated.

2.3 FABRICATION

A. General: Form deck units in lengths to span three or more supports, with flush, telescoped or nested 2 inch laps at ends and interlocking or nested side laps, of metal thickness, section modulus and rib depth as specified.

B. Roof Deck Units: Provide deck configurations that comply with SDI "Specifications and Commentary for Steel Roof Deck." Refer to drawings for minimum requirements.

C. Composite Steel Floor Deck: Fabricate deck units with integral embossing or raised pattern to furnish mechanical bond with concrete slabs. Fabricate open-beam deck unit with fluted sections having interlocking side laps. Refer to drawings for minimum requirements.

D. Non-Composite Steel Form Floor Deck: Provide deck configurations that comply with SDI "Specifications and Commentary for Non-Composite Steel Form Deck." Refer to drawings for minimum requirements.

2.4 ACCESSORIES

A. General: Provide accessory materials for steel deck that comply with requirements indicated and recommendations of the steel deck manufacturer.

B. Metal Closure Strips: Fabricate metal closure strips, for openings between decking and other construction and at ridges and valleys, of not less than 0.045-inch minimum (18 gauge) sheet metal. Form to provide tight-fitting closures at open ends of flutes and sides of decking.

C. Roof Sump Pans: Fabricate from single piece of 0.071-inch minimum (14 gauge) galvanized sheet steel. Provide sump pans of adequate size to receive roof drains and with bearing flanges not less than 3 inches wide. Recess pans not less than 1-1/2 inches below roof deck surface unless otherwise shown or required by deck configuration.

D. Mechanical Fasteners: Manufacturer's standard, corrosion-resistant, low-velocity, powder-actuated or pneumatically driven carbon steel fasteners; or self-drilling, self-threading screws. The Contractor bears the responsibility of providing mechanical fasteners in an arrangement acceptable to the Architect-Enigneer as a substitution to the fasteners required on the drawings.

E. Side Lap Fasteners: Unless noted otherwise, provide manufacturer's standard, corrosion-resistant, hexagonal washer head; self-drilling, carbon steel screws, No. 10 minimum diameter.

F. Miscellaneous Roof Deck Accessories: Steel sheet, 0.0359-inch- thick minimum ridge and valley plates, finish strips, and reinforcing channels, of same material as roof deck.

G. Pour Stops and Girder Fillers: Steel sheet, of same material as deck panels, and of thickness and profiles required per SDI Publication No. 28.

H. Column Closures, End Closures, Z-Closures, and Cover Plates: Steel sheet, of same material and thickness as deck panels, unless otherwise indicated.

I. Weld Washers: Manufacturer's standard uncoated-steel sheet weld washers, shaped to fit deck rib, 0.0598 inch thick with 3/8-inch minimum diameter prepunched hole.

J. Steel Sheet Accessories: ASTM A653, G 90 coating class.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine supporting framing and field conditions for compliance with requirements for installation tolerances and other conditions affecting performance of steel deck.

3.2 PREPARATION

A. Do not place deck panels on concrete supporting structure until concrete has cured and is dry.

B. Locate decking bundles to prevent overloading of supporting members.

3.3 INSTALLATION, GENERAL

A. General: Install deck and accessories in accordance with SDI and the manufacturer's recommendations, shop drawings, and as specified herein.

1. Place deck units on supporting steel framework and adjust to final position with ends accurately aligned and bearing on supporting members before being permanently fastened. Do not stretch or contract side lap interlocks.
2. Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used in correcting welding work. Care shall be exercised in the selection of the electrodes and amperage to provide positive weld and to prevent high amperage blow holes. Use welding washers for steel deck thickness less than 0.028 inch and where recommended by deck manufacturer. Welding washers shall have a minimum thickness of 0.0568 inch (16 gauge) and have a nominal 3/8-inch diameter hole.
3. Mechanical fasteners, either powder-actuated or pneumatically driven, may be used in lieu of welding when suitable test data verifying strength and stiffness equal to the specified welding is approved. Submit manufacturer's data and tests.

B. Anchorage and Attachment of Deck Units: Shall be in accordance with the following minimums and additional shall be provided where shown or scheduled on the drawings.

1. Steel Roof Deck: Puddle welds shall be at least 5/8-inch diameter or elongated welds with an equal perimeter. Fillet welds when used, shall be at least 1-inch long. Weld metal shall penetrate all layers of deck material at end laps and side joints and shall have good fusion to the supporting members. The location and number of welds to the supportive structural members shall be a minimum of the following: All side laps plus a sufficient number of interior ribs to limit the spacing between adjacent points of attachment to 12 inches at all diaphragm perimeter members, shear walls, braced frames and rigid frames and 18 inches at all other supports. For spans 5 feet and greater, the side laps shall be fastened together with a minimum of No. 12 screws at a maximum spacing of 36 inches.

2. Composite Steel Floor Deck: Units shall be anchored to supporting members, including bearing walls, with nominal 5/8-inch diameter puddle welds or equivalent at all edge ribs plus a sufficient number of interior ribs to provide a maximum average spacing of 12 inches. The maximum spacing between adjacent points of attachments shall not exceed 18 inches. Differential deflection shall be controlled by fastening together sidelaps of floor deck units as recommended by the steel deck manufacturer.
3. Non-Composite Steel Form Floor Deck: Units shall be anchored to supporting members, including bearing walls, with nominal welding washers at all edge ribs plus a sufficient number of interior ribs to provide a maximum average spacing of 12 inches. The maximum spacing between adjacent points of attachments shall not exceed 18 inches. Differential deflection shall be controlled by fastening together sidelaps of floor deck units as recommended by the steel deck manufacturer.

C. Cutting and Fitting: Cut and neatly fit deck units and accessories around other work projecting through or adjacent to the decking, as shown.

D. Reinforcement at Openings: Provide additional metal reinforcement and closure pieces as required for strength, continuity of decking, and support of other work shown.

E. Hanger Slots or Clips: Provide UL-approved punched hanger slots between cells or flutes of lower element where floor deck units are to receive hangers for support of ceiling construction, air ducts, diffusers, lighting fixtures, or other items.

1. Hanger clips designed to clip over male side lap joints of floor deck units may be used instead of hanger slots.
2. Locate slots or clips at not more than 14 inches o.c. in both directions, not over 9 inches from walls at ends, and not more than 12 inches from walls at sides, unless otherwise indicated.
3. Provide manufacturer's standard hanger attachment devices.

F. Roof Sump Pans: Place over openings provided in roof decking and weld flanges to top decking surface. Space welds not more than 12 inches o.c. with at least one weld at each corner.

G. Closure Strips: Provide metal closure strips at open uncovered ends and edges of roof decking and in voids between decking and other construction. Weld into position to provide a complete decking installation.

3.4 REPAIRS AND PROTECTION

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on both surfaces with galvanized repair paint according to ASTM A 780 and the manufacturer's instructions.

B. Provide final protection and maintain conditions to ensure steel decking is without damage or deterioration at time of Substantial Completion.

3.5 SPECIAL INSPECTIONS

A. General: Special inspection and verification of steel decking construction shall conform to the requirements of Section 014500 – Statement of Special Inspections.

END OF SECTION 053100

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SECTION 054000 – COLD-FORMED METAL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Exterior load-bearing wall framing.
2. Interior load-bearing wall framing.
3. Exterior non-load-bearing wall framing.

B. Related Sections include the following:

1. Division 9 Section "Gypsum Board Assemblies" for interior non-load-bearing, metal-stud-framed, shaft-wall assemblies and metal-stud framing and ceiling-suspension assemblies.

1.2 PERFORMANCE REQUIREMENTS

A. The manufacturer of the cold-formed metal framing system shall assume undivided responsibility for design of the system including size, gauge, strength, spacing of members, anchorage to structure, connections, angles, clips, bracing, strapping, bridging, supplementary framing, framing at openings, corners and at control and expansion joints.

B. Structural Performance: Provide cold-formed metal framing capable of withstanding design loads within limits and under conditions indicated.

1. Design Loads: As indicated.
2. Deflection Limits: Design framing systems to withstand design loads without deflections greater than the following:

   a. Exterior Load-Bearing Wall Framing: Horizontal deflection of 1/720 of the wall height.
   b. Interior Load-Bearing Wall Framing: Horizontal deflection of 1/360 of the wall height under a horizontal load of 5 lbf/sq. ft.
   c. Exterior Non-Load-Bearing Framing: Horizontal deflection of 1/720 of the wall height.
   d. All framing supporting tile finishes shall have a horizontal deflection of 1/720 of the wall height.

3. Design framing systems to provide for movement of framing members without damage or overstressing, sheathing failure, connection failure, undue strain on fasteners and anchors, or other detrimental effects when subject to a maximum ambient temperature change of 120 deg F.
4. Design framing system to maintain clearances at openings, to allow for construction tolerances, and to accommodate live load deflection of primary building structure as follows:

   a. Upward and downward movement of 1/2 inch.

C. Cold-Formed Steel Framing, General: Design according to AISI's "Standard for Cold-Formed Steel Framing - General Provisions."

1. Headers: Design according to AISI's "Standard for Cold-Formed Steel Framing - Header Design."
2. Design exterior non-load-bearing wall framing to accommodate horizontal deflection without regard for contribution of sheathing materials.

1.3 SUBMITTALS

A. Product Data: For each type of cold-formed metal framing product and accessory indicated.

B. Shop Drawings: Show layout, spacings, sizes, thicknesses, and types of cold-formed metal framing; fabrication; and fastening and anchorage details, including mechanical fasteners. Show reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, connection details, and attachment to adjoining work.

1. For cold-formed metal framing indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

C. Welding certificates.

D. Qualification Data: For professional engineer.

E. Product Test Reports: From a qualified testing agency, unless otherwise stated, indicating that each of the following complies with requirements, based on evaluation of comprehensive tests for current products:

1. Steel sheet.
2. Expansion anchors.
3. Power-actuated anchors.
4. Mechanical fasteners.
5. Vertical deflection clips.
6. Horizontal drift deflection clips
7. Miscellaneous structural clips and accessories.

F. Research/Evaluation Reports: For cold-formed metal framing.

1.4 QUALITY ASSURANCE

A. Engineering Responsibility: Preparation of Shop Drawings, design calculations, and other structural data by a qualified professional engineer.

B. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of cold-formed metal framing that are similar to those indicated for this Project in material, design, and extent.

C. Testing Agency Qualifications: An independent testing agency, acceptable to authorities having jurisdiction, qualified according to ASTM E 329 to conduct the testing indicated.

D. Product Tests: Mill certificates or data from a qualified independent testing agency, or in-house testing with calibrated test equipment indicating steel sheet complies with requirements, including base-metal thickness, yield strength, tensile strength, total elongation, chemical requirements and metallic-coating thickness.

E. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code--Steel," and AWS D1.3, "Structural Welding Code--Sheet Steel."

F. Fire-Test-Response Characteristics: Where indicated, provide cold-formed metal framing identical to that of assemblies tested for fire resistance per ASTM E 119 by a testing and inspecting agency acceptable to authorities having jurisdiction.

G. AISI Specifications and Standards: Comply with AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members" and its "Standard for Cold-Formed Steel Framing - General Provisions."

1.5 DELIVERY, STORAGE, AND HANDLING

A. Protect cold-formed metal framing from corrosion, deformation, and other damage during delivery, storage, and handling.

B. Store cold-formed metal framing, protect with a waterproof covering, and ventilate to avoid condensation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering cold-formed metal framing that may be incorporated into the Work include, but are not limited to, the following:

1. AllSteel Products, Inc.
2. Clark Steel Framing.
3. Consolidated Fabricators Corp.; Building Products Division.
4. Dale/Incor.
5. Dietrich Metal Framing; a Worthington Industries Company.
6. Formetal Co. Inc. (The).

2.2 MATERIALS

A. Steel Sheet: ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated, of grade and coating weight as follows:

1. Grade: As required by structural performance.
2. Coating: G90 or equivalent.

2.3 LOAD-BEARING AND NON-LOAD BEARING EXTERIOR WALL FRAMING

A. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, and as follows:

1. Minimum Base-Metal Thickness: 0.0329 inch
2. Flange Width: 1-5/8 inches (41 mm).
3. Section Properties: As required by structural performance.

B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with straight flanges, and as follows:

1. Minimum Base-Metal Thickness: Matching steel studs.
2. Flange Width: Manufacturer's standard width.
3. Steel Box or Back-to-Back Headers: Manufacturer's standard C-shapes used to form header beams, of web depths indicated, punched, with stiffened flanges, and as follows:
4. Minimum Base-Metal Thickness: 0.0329 inch (0.84 mm).
5. Flange Width: 1-5/8 inches (41 mm).
6. Section Properties: As required by structural performance.

C. Steel Double-L Headers: Manufacturer's standard L-shapes used to form header beams, of web depths indicated, and as follows:

1. Minimum Base-Metal Thickness: 0.0329 inch.
2. Top Flange Width: 1-5/8 inches (41 mm).
3. Section Properties: As required by structural performance.

2.4 FRAMING ACCESSORIES

A. Fabricate steel-framing accessories from steel sheet, ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated, of same grade and coating weight used for framing members.

B. Provide accessories of manufacturer's standard thickness and configuration, unless otherwise indicated, as follows:

1. Supplementary framing.
2. Bracing, bridging, and solid blocking.
3. Web stiffeners.
4. Anchor clips.
5. End clips.
6. Foundation clips.
7. Gusset plates.
8. Stud kickers, knee braces, and girts.
9. Joist hangers and end closures.
10. Hole reinforcing plates.
11. Backer plates.

2.5 ANCHORS, CLIPS, AND FASTENERS

A. Steel Shapes and Clips: ASTM A 36/A 36M, zinc coated by hot-dip process according to ASTM A 123/A 123M.

B. Anchor Bolts: ASTM F 1554, Grade 36, threaded carbon-steel hex-headed bolts and carbon-steel nuts; and flat, hardened-steel washers; zinc coated by hot-dip process according to ASTM A 153/A 153M, Class C.

C. Expansion Anchors: Fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 5 times design load, as determined by testing per ASTM E 488 conducted by a qualified independent testing agency.

D. Power-Actuated Anchors: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 10 times design load, as determined by testing per ASTM E 1190 conducted by a qualified independent testing agency.

E. Mechanical Fasteners: ASTM C 1513, corrosion-resistant-coated, self-drilling, self-tapping steel drill screws.

1. Head Type: Low-profile head beneath sheathing, manufacturer's standard elsewhere.

F. Welding Electrodes: Comply with AWS standards.

2.6 MISCELLANEOUS MATERIALS

A. Galvanizing Repair Paint: SSPC-Paint 20 or DOD-P-21035 or ASTM A 780.

B. Cement Grout: Portland cement, ASTM C 150, Type I; and clean, natural sand, ASTM C 404. Mix at ratio of 1 part cement to 2-1/2 parts sand, by volume, with minimum water required for placement and hydration.

C. Nonmetallic, Nonshrink Grout: Premixed, nonmetallic, noncorrosive, nonstaining grout containing selected silica sands, portland cement, shrinkage-compensating agents, and plasticizing and water-reducing agents, complying with ASTM C 1107, with fluid consistency and 30-minute working time.

D. Shims: Load bearing, high-density multimonomer plastic, nonleaching.

E. Sealer Gaskets: Closed-cell neoprene foam, 1/4 inch thick, selected from manufacturer's standard widths to match width of bottom track or rim track members.

2.7 FABRICATION

A. Fabricate cold-formed metal framing and accessories plumb, square, and true to line, and with connections securely fastened, according to referenced AISI's specifications and standards, manufacturer's written instructions, and requirements in this Section.

1. Fabricate framing assemblies using jigs or templates.
2. Cut framing members by sawing or shearing; do not torch cut.
3. Fasten cold-formed metal framing members by welding, screw fastening, clinch fastening, or riveting as standard with fabricator. Wire tying of framing members is not permitted.

a. Comply with AWS D1.3 requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
b. Locate mechanical fasteners and install according to Shop Drawings, with screw penetrating joined members by not less than three exposed screw threads.

4. Fasten other materials to cold-formed metal framing by welding, bolting, or screw fastening, according to Shop Drawings.

B. Reinforce, stiffen, and brace framing assemblies to withstand handling, delivery, and erection stresses. Lift fabricated assemblies to prevent damage or permanent distortion.

C. Fabrication Tolerances: Fabricate assemblies level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet and as follows:

1. Spacing: Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.
2. Squareness: Fabricate each cold-formed metal framing assembly to a maximum out-of-square tolerance of 1/8 inch.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine supporting substrates and abutting structural framing for compliance with requirements for installation tolerances and other conditions affecting performance.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Install load bearing shims or grout between the underside of wall bottom track or rim track and the top of foundation wall or slab at stud or joist locations to ensure a uniform bearing surface on supporting concrete or masonry construction.

B. Install sealer gaskets to isolate the underside of wall bottom track or rim track and the top of foundation wall or slab at stud or joist locations.

3.3 INSTALLATION, GENERAL

A. Cold-formed metal framing may be shop or field fabricated for installation, or it may be field assembled.

B. Install cold-formed metal framing according to AISI's "Standard for Cold-Formed Steel Framing - General Provisions" and to manufacturer's written instructions unless more stringent requirements are indicated.

C. Install shop- or field-fabricated, cold-formed framing and securely anchor to supporting structure.

1. Screw, bolt, or weld wall panels at horizontal and vertical junctures to produce flush, even, true-to-line joints with maximum variation in plane and true position between fabricated panels not exceeding 1/16 inch.

D. Install cold-formed metal framing and accessories plumb, square, and true to line, and with connections securely fastened.

1. Cut framing members by sawing or shearing; do not torch cut.
2. Fasten cold-formed metal framing members by welding, screw fastening, clinch fastening, or riveting. Wire tying of framing members is not permitted.

a. Comply with AWS D1.3 requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
b. Locate mechanical fasteners and install according to Shop Drawings, and complying with requirements for spacing, edge distances, and screw penetration.

E. Install framing members in one-piece lengths unless splice connections are indicated for track or tension members.

F. Install temporary bracing and supports to secure framing and support loads comparable in intensity to those for which structure was designed. Maintain braces and supports in place, undisturbed, until entire integrated supporting structure has been completed and permanent connections to framing are secured.

G. Do not bridge building expansion and control joints with cold-formed metal framing. Independently frame both sides of joints.

H. Install insulation, specified in Division 7 Section "Thermal Insulation," in built-up exterior framing members, such as headers, sills, boxed joists, and multiple studs at openings, that are inaccessible on completion of framing work.

I. Fasten hole reinforcing plate over web penetrations that exceed size of manufacturer's standard punched openings.

J. Erection Tolerances: Install cold-formed metal framing level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet and as follows:

1. Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.

3.4 LOAD-BEARING AND NON-LOAD BEARING WALL INSTALLATION

A. Install continuous top and bottom tracks sized to match studs. Align tracks accurately and securely anchor at corners and ends, and at spacings as follows:

1. Anchor Spacing: To match stud spacing and as shown on Shop Drawings.

B. Squarely seat studs against top and bottom tracks with gap not exceeding of 1/8 inch between the end of wall framing member and the web of track. Fasten both flanges of studs to top and bottom tracks. Space studs as follows:

1. Stud Spacing: 16 inches or as indicated.

C. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar configurations.

D. Align studs vertically where floor framing interrupts wall-framing continuity. Where studs cannot be aligned, continuously reinforce track to transfer loads.

E. Align floor and roof framing over studs. Where framing cannot be aligned, continuously reinforce track to transfer loads.

F. Anchor studs abutting structural columns or walls, including masonry walls, to supporting structure as indicated.

G. Install headers over wall openings wider than stud spacing. Locate headers above openings as indicated. Fabricate headers of compound shapes indicated or required to transfer load to supporting studs, complete with clip-angle connectors, web stiffeners, or gusset plates.

1. Frame wall openings with not less than a double stud at each jamb of frame as indicated on Shop Drawings. Fasten jamb members together to uniformly distribute loads.
2. Install runner tracks and jack studs above and below wall openings. Anchor tracks to jamb studs with clip angles or by welding, and space jack studs same as full-height wall studs.

H. Install supplementary framing, blocking, and bracing in stud framing indicated to support fixtures, equipment, services, casework, heavy trim, furnishings, and similar work requiring attachment to framing.

1. If type of supplementary support is not indicated, comply with stud manufacturer's written recommendations and industry standards in each case, considering weight or load resulting from item supported.

I. Install horizontal bridging in stud system, spaced as indicated on Shop Drawings. Fasten at each stud intersection.

1. Bridging: Cold-rolled steel channel, welded or mechanically fastened to webs of punched studs with a minimum of 2 screws into each flange of the clip angle for framing members up to 6 inches deep.

J. Install steel sheet diagonal bracing straps to both stud flanges, terminate at and fasten to reinforced top and bottom tracks. Fasten clip-angle connectors to multiple studs at ends of bracing and anchor to structure.

K. Install miscellaneous framing and connections, including supplementary framing, web stiffeners, clip angles, continuous angles, anchors, and fasteners, to provide a complete and stable wall-framing system.

3.5 FIELD QUALITY CONTROL

A. Testing: Engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Field and shop welds will be subject to testing and inspecting.

C. Testing agency will report test results promptly and in writing to Contractor and Architect.

D. Remove and replace work where test results indicate that it does not comply with specified requirements.

E. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.6 REPAIRS AND PROTECTION

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed metal framing with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.

B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer that ensure that cold-formed metal framing is without damage or deterioration at time of Substantial Completion.

END OF SECTION 054000

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SECTION 055000 – METAL FABRICATIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. General: Provide all labor, material, equipment, related services and supervision required, including manufacturing, erection and installation for metal fabrications in accordance with the requirements of the Contract Documents.

B. The extent of metal fabrications is shown on the drawings.

C. This Section includes the following metal fabrications:

1. Rough hardware.

2. Steel Ladders.

3. Loose bearing and leveling plates.

4. Loose steel lintels.

5. Miscellaneous framing and supports for the following:

a. Applications where framing and supports are not specified in other sections.

6. Miscellaneous steel trim, including the following:

a. Steel angle corner guards.

b. Edgings.

7. Structural steel door frames.

8. Pipe guards.

9. Pipe bollards.

D. Related Sections: The following Sections contain requirements that relate to this Section:

1. Division 5 Section 051200 - STRUCTURAL STEEL FRAMING for structural steel framing system components.

1.3 DEFINITIONS

A. Definitions in ASTM E985 for railing related terms apply to this section.

1.4 SUBMITTALS

A. General: Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections.

B. Product data for products used in miscellaneous metal fabrications, including paint products and grout.

C. Shop drawings detailing fabrication and erection of each metal fabrication indicated. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items. Provide templates for anchors and bolts specified for installation under other Sections.

1. Where installed metal fabrications are indicated to comply with certain design loadings, include structural computations, material properties and other information needed for structural analysis that has been signed and sealed by the qualified professional engineer who was responsible for their preparation.

D. Samples representative of materials and finished products as listed below or as may be requested by Architect.

E. Welder certificates signed by Contractor certifying that welders comply with requirements specified under the "Quality Assurance" Article.

F. Qualification data for firms and persons specified in the "Quality Assurance" Article to demonstrate their capabilities and experience. Include a list of completed projects with project name, addresses, names of architects and owners, and other information specified.

1.5 QUALITY ASSURANCE

A. Fabricator Qualifications: Firm experienced in producing metal fabrications similar to those indicated for this Project with a record of successful in-service performance, and with sufficient production capacity to produce required units without delaying the Work.

B. Welding Standards: Comply with applicable provisions of AWS D1.1 "Structural Welding Code--Steel," AWS D1.2 "Structural Welding Code--Aluminum," and AWS D1.3 "Structural Welding Code--Sheet Steel."

1. Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.

C. Engineer Qualifications: A professional engineer legally authorized to practice in jurisdiction where project is located and experienced in providing engineering services of the kind indicated that have resulted in the successful installation of metal fabrications similar in material, design and extent to that indicated for this project.

1.6 PROJECT CONDITIONS

A. Field Measurements: Check actual locations of walls and other construction to which metal fabrications must fit by accurate field measurements before fabrication. Show recorded measurements on final shop drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

PART 2 - PRODUCTS

2.1 FERROUS METALS

A. Metal Surfaces, General: For metal fabrications exposed to view in the completed Work, provide materials selected for their surface flatness, smoothness, and freedom from surface blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, roughness or, for steel sheet, variations in flatness exceeding those permitted by referenced standards for stretcher-leveled sheet.

B. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

C. Rolled Steel Floor Plates: ASTM A 786/A 786M.

D. Steel Pipe: ASTM A 53, Type F, standard weight (schedule 40), unless otherwise indicated, or another weight, type and grade required by structural loads.

1. Galvanized finish for exterior installations and where indicated.

E. Gray-Iron Castings: ASTM A 48, Class 30.

F. Malleable-Iron Castings: ASTM A 47, Grade 32510 (ASTM A 47M, Grade 22010).

G. Uncoated Structural Steel Sheet: Product type (manufacturing method), quality, and grade as follows:

1. Cold-Rolled Structural Steel Sheet: ASTM A 611, Grade A, unless otherwise indicated or required by design loading.

2. Hot-Rolled Structural Steel Sheet: ASTM A 570/A 570M, Grade 30, unless otherwise indicated or required by design loading.

H. Uncoated Steel Sheet: Commercial quality, product type (method of manufacture) as follows:

1. Cold-Rolled Steel Sheet: ASTM A 366/A 366M.

2. Hot-Rolled Steel Sheet: ASTM A 569/A 569M.

I. Galvanized Steel Sheet: Quality as follows:

1. Structural Quality: ASTM A 446/A 446M; Grade A, G 90 (Z 275) coating, unless otherwise indicated, or unless another grade is required for design loading.

2. Commercial Quality: ASTM A 526/A 526M, G 90 (Z 275) coating designation, unless otherwise indicated.

J. Cast-in-Place Anchors in Concrete: Anchors of type indicated below, fabricated from corrosion-resistant materials capable of sustaining, without failure, the load imposed within a safety factor of 4, as determined by testing per ASTM E 488, conducted by a qualified independent testing agency.

1. Threaded or wedge type; galvanized ferrous castings, either ASTM A 47 (ASTM A 47M) malleable iron or ASTM A 27/A 27M cast steel. Provide bolts, washers, and shims as required, hot-dip galvanized per ASTM A 153.

K. Welding Rods and Bare Electrodes: Select according to AWS specifications for the metal alloy to be welded.

L. Brackets, Flanges and Anchors: Cast or formed metal of the same material and finish as supported rails, unless otherwise indicated.

2.2 PAINT

A. Shop Primer for Ferrous Metal: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with performance requirements of FS TT-P-664, selected for good resistance to normal atmospheric corrosion, compatibility with finish paint systems indicated, and capability to provide a sound foundation for field-applied topcoats despite prolonged exposure.

B. Galvanizing Repair Paint: High-zinc-dust-content paint for regalvanizing welds in galvanized steel, with dry film containing not less than 94 percent zinc dust by weight, and complying with DOD-P-21035 or SSPC-Paint 20.

C. Bituminous Paint: Cold-applied asphalt mastic complying with SSPC-Paint 12, except containing no asbestos fibers.

D. Zinc Chromate Primer: Comply with FS-TT-P-645.

2.3 FASTENERS

A. General: Provide plated fasteners complying with ASTM B 633, Class Fe/Zn 25 for electrodeposited zinc coating, for exterior use or where built into exterior walls. Select fasteners for the type, grade, and class required.

B. Bolts and Nuts: Regular hexagon-head bolts, ASTM A 307, Grade A (ASTM F 568, Property Class 4.6), with hex nuts, ASTM A 563 (ASTM A 563M), and, where indicated, flat washers.

C. Machine Screws: ANSI B18.6.3 (ANSI B18.6.7M).

D. Lag Bolts: ANSI B18.2.1 (ANSI B18.2.3.8M).

E. Wood Screws: Flat head, carbon steel, ANSI B18.6.1.

F. Plain Washers: Round, carbon steel, ANSI B18.22.1 (ANSI B18.22M).

G. Lock Washers: Helical, spring type, carbon steel, ANSI B18.21.1.

H. Expansion Anchors: Anchor bolt and sleeve assembly of material indicated below with capability to sustain, without failure, a load equal to 6 times the load imposed when installed in unit masonry and equal to 4 times the load imposed when installed in concrete as determined by testing per ASTM E 488 conducted by a qualified independent testing agency.

1. Material: Carbon steel components zinc-plated to comply with ASTM B 633, Class Fe/Zn 5.

2. Material: Group 1 alloy 304 or 316 stainless-steel bolts and nuts complying with ASTM F 593 (ASTM F 738M) and ASTM F 594 (ASTM F 836M).

I. Toggle Bolts: FS FF-B-588, tumble-wing type, class and style as required.

2.4 GROUT AND ANCHORING CEMENT

A. Nonshrink, Metallic Grout: Factory-packaged, ferrous-aggregate grout complying with ASTM C 1107, specifically recommended by manufacturer for heavy-duty loading applications.

B. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.

C. Erosion Resistant Anchoring Cement: Factory-packaged, nonshrink, nonstaining, hydraulic controlled expansion cement formulation for mixing with water at project site to create pourable anchoring, patching and grouting compound. Provide formulation that is resistant to erosion from water exposure without need for protection by a sealer or waterproof coating and is recommended for exterior use by manufacturer.

D. Products: Subject to compliance with requirements, provide one of the following:

1. Nonshrink, Nonmetallic Grouts:

a. "Euco N-S Grout;" Euclid Chemical Co.

b. "Masterflow 713;" Master Builders Technologies, Inc.

c. "Sonogrout;" Sonneborn Building Products--ChemRex, Inc.

2. Erosion-Resistant Anchoring Cement:

a. "Bonsal Anchor Cement;" W.R. Bonsal Co.

b. "Super Por-Rok;" Minwax Construction Products Division.

c. "Thorogrip;" Thoro Systems Products.

2.5 CONCRETE FILL AND REINFORCING MATERIALS

A. Concrete Materials and Properties: Comply with requirements of Division 3 Section 03300 - CAST-IN-PLACE CONCRETE for normal-weight, air-entrained, ready-mix concrete with a minimum 28-day compressive strength of 3000 psi, unless higher strengths are indicated.

B. Nonslip Aggregate Finish: Factory-packaged abrasive aggregate made from fused, aluminum-oxide grits or crushed emery; rust-proof and nonglazing; unaffected by freezing, moisture, or cleaning materials.

C. Reinforcing Bars: ASTM A 615 (ASTM A 615M), Grade 60 (Grade 400), unless otherwise indicated.

2.6 FABRICATION, GENERAL

A. Form metal fabrications from materials of size, thickness, and shapes indicated but not less than that needed to comply with performance requirements indicated. Work to dimensions indicated or accepted on shop drawings, using proven details of fabrication and support. Use type of materials indicated or specified for various components of each metal fabrication.

B. Form exposed work true to line and level with accurate angles and surfaces and straight sharp edges.

C. Allow for thermal movement resulting from the following maximum change (range) in ambient temperature in the design, fabrication, and installation of installed metal assemblies to prevent buckling, opening up of joints, and overstressing of welds and fasteners. Base

design calculations on actual surface temperatures of metals due to both solar heat gain and nighttime sky heat loss.

1. Temperature Change (Range): 100 deg F.

D. Shear and punch metals cleanly and accurately. Remove burrs from exposed cut edges.

E. Ease exposed edges to a radius of approximately 1/32 inch, unless otherwise indicated. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

F. Remove sharp or rough areas on exposed surfaces.

G. Weld corners and seams continuously to comply with AWS recommendations and the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.

2. Obtain fusion without undercut or overlap.

3. Remove welding flux immediately.

4. At exposed connections, finish exposed welds and surfaces smooth and blended so that no roughness shows after finishing, and contour of welded surface matches those adjacent.

H. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners wherever possible. Use exposed fasteners of type indicated or, if not indicated, Phillips flat-head (countersunk) screws or bolts. Locate joints where least conspicuous.

I. Provide for anchorage of type indicated; coordinate with supporting structure. Fabricate and space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.

J. Shop Assembly: Preassemble items in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.

K. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.

L. Fabricate joints that will be exposed to weather in a manner to exclude water, or provide weep holes where water may accumulate.

2.7 ROUGH HARDWARE

A. Furnish bent, or otherwise custom-fabricated, bolts, plates, anchors, hangers, dowels, and other miscellaneous steel and iron shapes as required for framing and supporting woodwork, and for anchoring or securing woodwork to concrete or other structures. Straight bolts and other stock rough hardware items are specified in Division 6 Sections.

B. Fabricate items to sizes, shapes, and dimensions required. Furnish malleable-iron washers for heads and nuts that bear on wood structural connections, and furnish steel washers elsewhere.

2.8 STEEL LADDERS

A. General: Fabricate ladders for the locations shown, including at leas one at each elevator pit, with dimensions, spacings, details, and anchorages as indicated. Comply with requirements of ANSI A14.3.

B. Siderails: Continuous, ½-by2-1/2-inch flat bars, with ease edges, spaced 18 inches apart.

C. Bar Rungs: ¾-inch diameter steel bars, spaced 12 inches o.c.

D. Fit rungs in centerline of siderails, plug weld and grind smooth on outer rail faces.

E. Support each ladder at top and bottom and at intermediate points spaced not more than 5 feet o.c. with welded or bolted steel brackets.

1. Size brackets to support design dead and live loads indicated and to hold centerline of ladder rung clear of the wall surface by not less than 7 inches.

2. Extend side rails 42 inches above top rung, and return rail to wall or structure unless other secure handholds are provided. If the adjacent structure does not extend above the top rung, goose-neck the extended rails back to the structure to provide secure ladder access.

F. Provide nonslip surfaces on top of each rung, either by coating the rung with aluminum-oxide granules set in epoxy-resin adhesive, or by using a type of manufactured rung that is filled with aluminum-oxide grout.

G. Galvanize ladders, including brackets and fasteners, at exterior locations and at interior locations where indicated.

2.9 LOOSE BEARING AND LEVELING PLATES

A. Provide loose bearing and leveling plates for steel items bearing on masonry or concrete construction, made flat, free from warps or twists, and of the required thickness and bearing area. Drill plates to receive anchor bolts and for grouting as required. Galvanize after fabrication.

2.10 LOOSE STEEL LINTELS

A. Fabricate loose structural steel lintels from steel angles and shapes of size indicated for openings and recesses in masonry walls and partitions at locations indicated.

B. Weld adjoining members together to form a single unit where indicated.

C. Size loose lintels for equal bearing of 1 inch per foot of clear span but not less than 8 inches bearing at each side of openings, unless otherwise indicated.

D. Hot-dip galvanize loose steel lintels located in exterior walls.

2.11 MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Provide steel framing and supports for applications indicated that are not a part of structural steel framework as required to complete the Work.

B. Fabricate units to sizes, shapes, and profiles indicated and required to receive other adjacent construction retained by framing and supports. Fabricate from structural steel shapes, plates, and steel bars of welded construction using mitered joints for field connection. Cut, drill, and tap units to receive hardware, hangers, and similar items.

1. Equip units with integrally welded anchors for casting into concrete or building into masonry. Furnish inserts if units must be installed after concrete is placed.

2. Except as otherwise indicated, space anchors 24 inches o.c. and provide minimum anchor units in the form of steel straps 1-1/4 inches wide by 1/4 inch thick by 8 inches long.

A. Fabricate support for suspended toilet partitions as follows:

1. Beams: Continuous steel shapes of size required to limit deflection to L/360 between hangers, but not less than C8 by 11.5 channels or another shape with equivalent structural properties.

2. Hangers: Steel rods, ½-inch minimum diameter, spaced not more than 36 inches o.c. Thread rods to receive anchor and stop nuts. Fit hangers with wedge-shaped washers for full bearing on sloping flanges of support beam.

3. Braces and Angles: Steel angles of size required for rigid support of beam and for secure anchorage.

B. Galvanize miscellaneous framing and supports at exterior locations and at interior locations where indicated.

2.12 MISCELLANEOUS STEEL TRIM

A. Unless otherwise indicated, fabricate units from structural steel shapes, plates, and bars of profiles shown with continuously welded joints, and smooth exposed edges. Miter corners and use concealed field splices wherever possible.

B. Provide cutouts, fittings, and anchorages as required to coordinate assembly and installation with other work. Provide anchors, welded to trim, for embedding in concrete or masonry construction, spaced not more than 6 inches from each end, 6 inches from corners, and 24 inches o.c., unless otherwise indicated.

C. Hot-dip galvanize miscellaneous steel trim at exterior locations and at interior locations where indicated.

2.13 STRUCTURAL STEEL DOOR FRAMES FOR OVERHEAD COILING GRILLES

A. Fabricate steel door frames from structural shapes and bars of size and to dimensions indicated, fully welded together, with 5/8-by-1-1/2-inch steel bar stops, unless otherwise indicated. Plug-weld built-up members and continuously weld exposed joints. Secure removable stops to frame with countersunk machine screws, uniformly spaced at not more than 10 inches o.c. Reinforce frames and drill and tap as required to accept finish hardware.

B. Provide steel anchors for securing door frames into adjoining construction, using 1/8-inch steel plate of the length required unless otherwise indicated. Weld anchors to frame jambs

no more than 12 inches from both bottom and head of frame and space anchors not more than 30 inches apart.

C. Extend bottom of frames to floor elevation indicated with steel angle clips welded to frames for anchoring frame to floor with expansion shields and bolts.

D. Hot-dip galvanize frames and anchors at exterior locations and at interior locations where indicated.

2.14 PIPE BOLLARDS

A. Fabricate pipe bollards from Schedule 80 steel pipe, grind smooth and ease all exposed edges at top of bollards.

B. Hot-Dip galvanize bollards and sleeves at exterior locations and at interior locations where indicated.

C. Provide black PVC caps for all bollards.

2.15 FINISHES, GENERAL

A. Comply with NAAMM "Metal Finishes Manual" for recommendations relative to applying and designing finishes.

B. Finish metal fabrications after assembly.

C. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering prior to shipment.

D. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one half of the range of approved samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved samples and they are assembled or installed to minimize contrast.

E. Provide exposed fasteners with finish matching appearance, including color and texture, of handrails and railing systems.

2.16 STEEL AND IRON FINISHES

A. Galvanizing: For those items indicated for galvanizing, apply zinc coating by the hot-dip process complying with the following requirements:

1. ASTM A 153 for galvanizing iron and steel hardware.

2. ASTM A 123 for galvanizing both fabricated and unfabricated iron and steel products made of uncoated rolled, pressed, and forged shapes, plates, bars, and strip 0.0299 inch (0.76 mm) thick or thicker.

3. Fill vent and drain holes that will be exposed in the finished work, unless indicated to remain as weep holes, by plugging with zinc solder and filing off smooth.

B. Preparation for Shop Priming: Prepare uncoated ferrous metal surfaces to comply with minimum requirements indicated below for SSPC surface preparation specifications and environmental exposure conditions of installed metal fabrications:

1. Exteriors (SSPC Zone 1B): SSPC-SP 6 "Commercial Blast Cleaning."

2. Interiors (SSPC Zone 1A): SSPC-SP 3 "Power Tool Cleaning."

C. Apply shop primer to uncoated surfaces of metal fabrications, except those with galvanized finishes or to be embedded in concrete, sprayed-on fireproofing, or masonry, unless otherwise indicated. Comply with requirements of SSPC-PA 1 "Paint Application Specification No. 1" for shop painting.

PART 3 - EXECUTION

3.1 PREPARATION

A. Coordinate and furnish anchorages, setting drawings, diagrams, templates, instructions, and directions for installing anchorages, including concrete inserts, sleeves, anchor bolts, and miscellaneous items having integral anchors that are to be embedded in concrete or masonry construction. Coordinate delivery of such items to Project site.

3.2 INSTALLATION, GENERAL

A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing miscellaneous metal fabrications and for properly transferring loads to in-place construction. Include threaded fasteners for concrete and masonry inserts, through-bolts and other connectors as required.

B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing miscellaneous metal fabrications. Set metal fabrication accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.

C. Provide temporary bracing or anchors in formwork for items that are to be built into concrete masonry or similar construction.

D. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop-welded because of shipping size limitations. Do not weld, cut, or abrade the surfaces of exterior units that have been hot-dip galvanized after fabrication and are intended for bolted or screwed field connections.

E. Field Welding: Comply with the following requirements:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.

2. Obtain fusion without undercut or overlap.

3. Remove welding flux immediately.

4. At exposed connections, finish exposed welds and surfaces smooth and blended so that no roughness shows after finishing, and contour of welded surface matches those adjacent.

F. Corrosion Protection: Coat concealed surfaces of aluminum that will come into contact with grout, concrete, masonry, wood, or dissimilar metals with a heavy coat of bituminous paint.

3.3 SETTING LOOSE PLATES

A. Clean concrete and masonry bearing surfaces of bond-reducing materials, and roughen to improve bond to surfaces. Clean bottom surface of bearing plates.

B. Set loose leveling and bearing plates on wedges or other adjustable devices. After the bearing members have been positioned and plumbed, tighten the anchor bolts. Do not remove wedges or shims, but if protruding, cut off flush with the edge of the bearing plate before packing with grout.

1. Use nonshrink, metallic grout in concealed locations where not exposed to moisture; use nonshrink, nonmetallic grout in exposed locations, unless otherwise indicated.

2. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

3.4 INSTALLING SUPPORTS FOR TOILET PARTITIONS

A. Anchor supports securely to and rigidly brace from overhead building structure.

3.5 INSTALLING PIPE GUARDS

A. Install pipe guards at exposed vertical pipes in tug drive as indicated on the drawings.

3.6 INSTALLING PIPE BOLLARDS

A. Anchor bollards in concrete with pipe sleeves preset and anchored into concrete. After bollards have been inserted into sleeves, fill annular space between bollard and sleeve solidly with nonshrink, nonmetallic grout.

B. Fill cavity bollard pipe solidly with 3,000 PSI concrete, mounding top surface.

3.7 ADJUSTING AND CLEANING

A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with same material as used for shop painting to comply with SSPC-PA 1 requirements for touching up shop-painted surfaces.

1. Apply by brush or spray to provide a 2.0-mil minimum dry film thickness.

B. For galvanized surfaces, clean welds, bolted connections, and abraded areas, and apply galvanizing repair paint to comply with ASTM A 780.

C. Clean the following metals by washing thoroughly with clean water and soap, followed by rinsing with clean water.

1. Aluminum.

3.8 PROTECTION

A. Protect finishes of handrails and railing systems from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at time of Substantial Completion.

B. Restore finishes damaged during installation and construction period so that no evidence remains of correction work. Return items that cannot be refinished in the field to the shop; make required alterations and refinish entire unit, or provide new units.

END OF SECTION 055000

SECTION 055113 – METAL PAN STAIRS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Preassembled steel stairs with concrete-filled treads.
2. Steel tube railings attached to metal stairs.
3. Steel tube handrails attached to walls adjacent to metal stairs.
4. Industrial-type stairs with steel grating landings and treads.

B. Related Sections include the following:

1. Division 3 Section "Cast-in-Place Concrete" for concrete fill for stair treads and platforms.
2. Division 5 Section "Pipe and Tube Railings" for pipe and tube railings not attached to metal stairs or to walls adjacent to metal stairs.

1.3 PERFORMANCE REQUIREMENTS

A. Structural Performance of Stairs: Provide metal stairs capable of withstanding the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

1. Uniform Load: 100 lbf/sq. ft.
2. Concentrated Load: 300 lbf applied on an area of 4 sq. in.
3. Uniform and concentrated loads need not be assumed to act concurrently.
4. Stair Framing: Capable of withstanding stresses resulting from railing loads in addition to loads specified above.
5. Limit deflection of treads, platforms, and framing members to L/360 or 1/4 inch, whichever is less.

B. Structural Performance of Railings: Provide railings capable of withstanding the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

1. Handrails:

a. Uniform load of 50 lbf/ ft. applied in any direction.
b. Concentrated load of 200 lbf applied in any direction.
c. Uniform and concentrated loads need not be assumed to act concurrently.

2. Top Rails of Guards:

a. Uniform load of 50 lbf/ ft. applied in any direction.
b. Concentrated load of 200 lbf applied in any direction.
c. Uniform and concentrated loads need not be assumed to act concurrently.

3. Infill of Guards:

a. Concentrated load of 50 lbf applied horizontally on an area of 1 sq. ft.
b. Infill load and other loads need not be assumed to act concurrently.

1.4 SUBMITTALS

A. Product Data: For metal stairs and the following:

1. Abrasive nosings.
2. Paint products.
3. Grout.
4. Grating for landings and treads.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1. Provide templates for anchors and bolts specified for installation under other Sections.
2. For installed products indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

C. Samples for Initial Selection: For products involving selection of color, texture, or design.

D. Welding certificates.

E. Qualification Data: For professional engineer and testing agency.

F. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for stairs and railings.

1. Test railings according ASTM E 894 and ASTM E 935.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Fabricator of products.

B. NAAMM Stair Standard: Comply with "Recommended Voluntary Minimum Standards for Fixed Metal Stairs" in NAAMM AMP 510, "Metal Stairs Manual," for class of stair designated, unless more stringent requirements are indicated.

1. Preassembled Stairs: Commercial class.
2. Industrial-Type Stairs: Industrial class.

C. Welding: Qualify procedures and personnel according to the following:

1. AWS D1.1, "Structural Welding Code--Steel."

2. AWS D1.3, "Structural Welding Code--Sheet Steel."

1.6 COORDINATION

A. Coordinate installation of anchorages for metal stairs. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

B. Coordinate locations of hanger rods and struts with other work so that they will not encroach on required stair width and will be within the fire-resistance-rated stair enclosure.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products specified.
2. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.

2.2 METALS, GENERAL

A. Metal Surfaces, General: Provide materials with smooth, flat surfaces, unless otherwise indicated. For components exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

2.3 FERROUS METALS

A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

B. Steel Tubing: ASTM A 500 (cold formed) or ASTM A 513, Type 5 (mandrel drawn).

C. Rolled-Steel Floor Plate: ASTM A 786/A 786M, rolled from plate complying with ASTM A 36/A 36M or ASTM A 283/A 283M, Grade C or D.

D. Iron Castings: Either gray or malleable iron, unless otherwise indicated.

1. Gray Iron: ASTM A 48/A 48M, Class 30, unless another class is indicated or required by structural loads.
2. Malleable Iron: ASTM A 47/A 47M.

E. Uncoated, Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, either commercial steel, Type B, or structural steel, Grade 30 (Grade 205), unless another grade is required by design loads.

F. Galvanized Steel Sheet: ASTM A 653/A 653M, G90 (Z275) coating, either commercial steel, Type B, or structural steel, Grade 33 (Grade 230), unless another grade is required by design loads.

G. Woven-Wire Mesh: Intermediate-crimp, square pattern, 2-inch (50-mm) woven-wire mesh, made from 0.135-inch (3.5-mm) nominal diameter wire complying with ASTM A 510 (ASTM A 510M).

H. Steel Bars for Grating: ASTM A36/A36M.

I. Zinc-Rich Primer: Complying with SSPC-Paint 20 or SSPC-Paint 29 and compatible with topcoat.

1. Products:

a. Carboline Company; Carbozinc 621.

b. ICI DevoeCoatings; Catha-Coat 313.

c. International Coatings Limited; Interzinc 315 Epoxy Zinc-Rich Primer.

d. Moore, Benjamion, & Co.; Expoxu Zinc-Rich Primer CM 18/19.

e. Ppg Architectural Finishes, Inc.; Aquapon Zinc-Rich Primer 97-670.

f. Sherwin-Williams Company (The); Corothane I GalvaPac Zinc Primer.

g. Tnemec Company, Inc.; Tneme-Zinc 90-97.

J. Galvanizing Repair Paint: High-zinc-dust-content paint for regalvanizing welds in steel, complying with SSPC-Paint 20.

2.4 FASTENERS

A. General: Provide zinc-plated fasteners with coating complying with ASTM B 633, Class Fe/Zn 25 for exterior use, and Class Fe/Zn 5 where built into exterior walls. Select fasteners for type, grade, and class required.

B. Bolts and Nuts: Regular hexagon-head bolts, ASTM A 307, Grade A; with hex nuts, and, where indicated, flat washers.

C. Anchor Bolts: ASTM F 1554, Grade 36.

1. Provide hot-dip or mechanically deposited, zinc-coated anchor bolts for stairs indicated to be galvanized.

D. Machine Screws: ASME B18.6.3

E. Lag Bolts: ASME B18.2.1

F. Plain Washers: Round, ASME B18.22.1

G. Lock Washers: Helical, spring type, ASME B18.21.1

H. Expansion Anchors: Anchor bolt and sleeve assembly with capability to sustain, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.

1. Material for Anchors in Interior Locations: Carbon-steel components zinc-plated to comply with ASTM B 633, Class Fe/Zn 5.
2. Material for Anchors in Exterior Locations: Alloy Group 1 stainless-steel bolts complying with ASTM F 593 and nuts complying with ASTM F 594.

2.5 MISCELLANEOUS MATERIALS

A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

B. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79.

1. Use primer with a VOC content of 420 g/L (3.5 lb/gal.) or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

D. Concrete Materials and Properties: Comply with requirements in Division 3 Section "Cast-in-Place Concrete" for normal-weight, air-entrained, ready-mix concrete with a minimum 28-day compressive strength of 3000 psi, unless otherwise indicated.

E. Welded Wire Fabric: ASTM A 185, 6 by 6 inches--W1.4 by W1.4, unless otherwise indicated.

2.6 FABRICATION, GENERAL

A. Provide complete stair assemblies, including metal framing, hangers, struts, railings, clips, brackets, bearing plates, and other components necessary to support and anchor stairs and platforms on supporting structure.

1. Join components by welding, unless otherwise indicated.
2. Use connections that maintain structural value of joined pieces.
3. Fabricate treads and platforms of exterior stairs so finished walking surfaces slope to drain.

B. Preassembled Stairs: Assemble stairs in shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.

C. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch, unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

D. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

E. Form exposed work true to line and level with accurate angles and surfaces and straight edges.

F. Weld connections to comply with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. Weld exposed corners and seams continuously, unless otherwise indicated.
5. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

G. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) screws or bolts unless otherwise indicated. Locate joints where least conspicuous.

H. Fabricate joints that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.

2.7 STEEL-FRAMED STAIRS

A. Available Manufacturers:

1. Alfab, Inc.
2. American Stair, Inc.
3. Sharon Companies Ltd. (The).

B. Stair Framing:

1. Fabricate stringers of steel plates or channels.

   a. Provide closures for exposed ends of channel stringers.

2. Construct platforms of steel plate or channel headers and miscellaneous framing members as needed to comply with performance requirements.

3. Weld stringers to headers; weld framing members to stringers and headers.

4. Where masonry walls support metal stairs, provide temporary supporting struts designed for erecting steel stair components before installing masonry.

C. Metal-Pan Stairs: Form risers, subtread pans, and subplatforms to configurations shown from steel sheet of thickness needed to comply with performance requirements but not less than 0.0677 inch.

1. Steel Sheet: Uncoated hot-rolled steel sheet, unless otherwise indicated, for interior stairs.

2. Attach risers and subtreads to stringers with brackets made of steel angles or bars. Weld brackets to stringers and attach metal pans to brackets by welding, riveting, or bolting.

3. Shape metal pans to include nosing integral with riser.

D. Metal Bar-Grating Stairs: Form treads and platforms to configurations shown from metal bar grating; fabricate to comply with NAAMM MBG 531, “Metal Bar Grating Manual.”

1. Fabricate treads and platforms from welded steel grating with 1-1/4-by-3/16-inch beraring bars at 15/16 inch o.c. and crossbars at 4 inches o.c., NAAMM designation: W-15-4(1-1/4 X 3/16) STEEL.

2. Surface: Serrated.

3. Finish: Galvanized.

4. Fabricate grating treads with cast abrasive nosing and with steel angle or steel plate carrier at each end for stringer connections. Secure treads to stringers with bolts.

5. Fabricate grating platforms with nosing matching that on grating treads. Provide toeplates at open-sided edges of grating platforms. Weld grating to platform framing.

2.8 STEEL TUBE RAILINGS

A. General: Fabricate railings to comply with requirements indicated for design, dimensions, details, finish, and member sizes, including wall thickness of tube, post spacings, and anchorage, but not less than that needed to withstand indicated loads.

1. Configuration: 1-5/8-inch-diameter
2. Top and bottom rails and posts with infill panels made from woven wire mesh crimped into 1-by-1/2-by-1/8-inch steel channel frames.

a. Orient wire mesh with wires horizontal and vertical.

B. Welded Connections: Fabricate railings with welded connections. Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.

C. Form changes in direction of railings as follows:

1. By flush bends or by inserting prefabricated flush-elbow fittings.

D. Form simple and compound curves by bending members in jigs to produce uniform curvature for each repetitive configuration required; maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.

E. Close exposed ends of railing members with prefabricated end fittings.

F. Provide wall returns at ends of wall-mounted handrails, unless otherwise indicated. Close ends of returns unless clearance between end of rail and wall is 1/4 inch or less.

G. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, end closures, flanges, miscellaneous fittings, and anchors for interconnecting components and for attaching to

other work. Furnish inserts and other anchorage devices for connecting to concrete or masonry work.

1. Connect posts to stair framing by direct welding, unless otherwise indicated.
2. For galvanized railings, provide galvanized fittings, brackets, fasteners, sleeves, and other ferrous-metal components.
3. For nongalvanized railings, provide nongalvanized ferrous-metal fittings, brackets, fasteners, and sleeves, except galvanize anchors embedded in exterior masonry and concrete construction.

H. Fillers: Provide fillers made from steel plate, or other suitably crush-resistant material, where needed to transfer wall bracket loads through wall finishes to structural supports. Size fillers to suit wall finish thicknesses and to produce adequate bearing area to prevent bracket rotation and overstressing of substrate.

2.9 FINISHES

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Finish metal stairs after assembly.

C. Galvanizing: Hot-dip galvanize items as indicated to comply with applicable standard listed below:

1. ASTM A 123/A 123M, for galvanizing steel and iron products.
2. ASTM A 153/A 153M, for galvanizing steel and iron hardware.
3. Fill vent and drain holes that will be exposed in finished Work, unless indicated to remain as weep holes, by plugging with zinc solder and filing off smooth.

D. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with minimum requirements indicated below for SSPC surface preparation specifications and environmental exposure conditions of installed products:

1. Exterior Stairs (SSPC Zone 1B): SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
2. Interior Stairs (SSPC Zone 1A): SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."

E. Apply shop primer to uncoated surfaces of metal stair components, except those with galvanized finishes and those to be embedded in concrete or masonry unless otherwise indicated. Comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing metal stairs to in-place construction. Include threaded fasteners for concrete and masonry inserts, through-bolts, lag bolts, and other connectors.

B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal stairs. Set units accurately in location, alignment, and elevation, measured from established lines and levels and free of rack.

C. Install metal stairs by welding stair framing to steel structure or to weld plates cast into concrete, unless otherwise indicated.

D. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

E. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.

F. Field Welding: Comply with the following requirements:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

G. Place and finish concrete fill for treads and platforms to comply with Division 3 Section "Cast-in-Place Concrete."

1. Install abrasive nosings with anchors fully embedded in concrete. Center nosings on tread width.

3.2 INSTALLING METAL STAIRS WITH GROUTED BASEPLATES

A. Clean concrete and masonry bearing surfaces of bond-reducing materials, and roughen to improve bond to surfaces. Clean bottom surface of baseplates.

B. Set steel stair baseplates on wedges, shims, or leveling nuts. After stairs have been positioned and aligned, tighten anchor bolts. Do not remove wedges or shims but, if protruding, cut off flush with edge of bearing plate before packing with grout.

1. Use nonmetallic, nonshrink grout, unless otherwise indicated.
2. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

3.3 INSTALLING STEEL TUBE RAILINGS

A. Adjust railing systems before anchoring to ensure matching alignment at abutting joints. Space posts at spacing indicated or, if not indicated, as required by design loads. Plumb posts in each direction. Secure posts and rail ends to building construction as follows:

1. Anchor posts to steel by welding directly to steel supporting members.
2. Anchor handrail ends to concrete and masonry with steel round flanges welded to rail ends and anchored with postinstalled anchors and bolts.

B. Attach handrails to wall with wall brackets. Provide bracket with 1-1/2-inch clearance from inside face of handrail and finished wall surface. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads. Secure wall brackets to building construction as follows:

1. Use type of bracket with flange tapped for concealed anchorage to threaded hanger bolt.
2. For concrete and solid masonry anchorage, use drilled-in expansion shields and hanger or lag bolts.
3. For hollow masonry anchorage, use toggle bolts.

3.4 ADJUSTING AND CLEANING

A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

1. Apply by brush or spray to provide a minimum 2.0-mil dry film thickness.

B. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Division 9 painting Sections.

C. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

END OF SECTION 055113

SECTION 055213 – PIPE AND TUBE RAILINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and General Provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Steel pipe railings.

B. Related Sections include the following:

1. Division 5 Section "Metal Pan Stairs" for steel tube railings associated with metal stairs.

2. Division 5 Section “Decorative Metal Railings” for ornamental railings fabricated from pipes and tubes for catwalk railings.

1.3 PERFORMANCE REQUIREMENTS

A. General: Railings shall withstand structural loads indicate.

B. Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design railings, including attachment to building construction.

C. Structural Performance: Provide railings capable of withstanding the effects of gravity loads, self-weight and applied loads, and the following loads and stresses within limits and under conditions indicated:

1. Handrails:

a. Uniform load of 50 lbf/ ft. applied in any direction.
b. Concentrated load of 200 lbf applied in any direction.
c. Uniform and concentrated loads need not be assumed to act concurrently.

2. Top Rails of Guards:

a. Uniform load of 50 lbf/ ft. applied in any direction.
b. Concentrated load of 200 lbf applied in any direction.
c. Uniform and concentrated loads need not be assumed to act concurrently.

3. Infill of Guards:

a. Concentrated load of 50 lbf applied horizontally on an area of 1 sq. ft.
b. Infill load and other loads need not be assumed to act concurrently.

D. Thermal Movements: Provide exterior railings that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

E. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

1.4 SUBMITTALS

A. Product Data: For the following:

1. Manufacturer's product lines of mechanically connected railings.
2. Grout, anchoring cement, and paint products.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1. For installed products, comply with design loads. Include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

C. Samples for Verification: For each type of exposed finish required.

1. Sections of each distinctly different linear railing member, including handrails, top rails, posts, and balusters.
2. Fittings and brackets.
3. Assembled Sample of railing system, made from full-size components, including top rail, post, handrail, and infill. Sample need not be full height.

a. Show method of connecting members at intersections.

D. Welding certificates.

E. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers certifying that shop primers are compatible with topcoats.

F. Qualification Data: For professional engineer.

G. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, according to ASTM E 894 and ASTM E 935.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain each type of railing through one source from a single manufacturer.

B. Welding: Qualify procedures and personnel according to the following:

1. AWS D1.1, "Structural Welding Code--Steel."
2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
3. AWS D1.6, "Structural Welding Code - Stainless Steel."

1.6 PROJECT CONDITIONS

A. Field Measurements: Verify actual locations of walls and other construction contiguous with railings by field measurements before fabrication and indicate measurements on Shop Drawings.

1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating railings without field measurements. Coordinate wall and other contiguous construction to ensure that actual dimensions correspond to established dimensions.
2. Provide allowance for trimming and fitting at site.

1.7 COORDINATION AND SCHEDULING

A. Coordinate installation of anchorages for railings. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

B. Schedule installation so wall attachments are made only to completed walls. Do not support railings temporarily by any means that do not satisfy structural performance requirements.

PART 2 - PRODUCTS

2.1 METALS, GENERAL

A. Metal Surfaces, General: Provide materials with smooth surfaces, without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.

B. Brackets, Flanges, and Anchors: Cast or formed metal of same type of material and finish as supported rails, unless otherwise indicated.

2.2 STEEL AND IRON

A. Tubing: ASTM A 500 (cold formed) or ASTM A 513, Type 5 (mandrel drawn).

B. Pipe: ASTM A 53/A 53M, Type S, Grade B, Standard Weight, unless another grade and weight are required by structural loads.

1. Provide galvanized finish for exterior installations and where indicated.

C. Plates, Shapes, and Bars: ASTM A 36/A 36M.

D. Castings: Either gray or malleable iron, unless otherwise indicated.

1. Gray Iron: ASTM A 48/A 48M, Class 30, unless another class is indicated or required by structural loads.
2. Malleable Iron: ASTM A 47/A 47M.

2.3 ALUMINUM

A. Aluminum, General: Provide alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with not less than the strength and durability properties of alloy and temper designated below for each aluminum form required.

B. Extruded Bars and Tubing: ASTM B 221 (ASTM B 221M), Alloy 6063-T5/T52.

C. Extruded Structural Pipe and Round Tubing: ASTM B 429/B 429M, Alloy 6063-T6.

1. Provide Standard Weight (Schedule 40) pipe, unless otherwise indicated.

D. Drawn Seamless Tubing: ASTM B 210 Alloy 6063-T832.

E. Plate and Sheet: ASTM B 209 (ASTM B 209M), Alloy 6061-T6.

F. Die and Hand Forgings: ASTM B 247 (ASTM B 247M), Alloy 6061-T6.

G. Castings: ASTM B 26/B 26M, Alloy A356.0-T6.

2.4 FASTENERS

A. General: Provide the following:

1. Steel Railings: Plated steel fasteners complying with ASTM B 633, Class Fe/Zn 25 for electrodeposited zinc coating.

B. Fasteners for Anchoring Railings to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings to other types of construction indicated and capable of withstanding design loads.

C. Fasteners for Interconnecting Railing Components:

1. Provide concealed fasteners for interconnecting railing components and for attaching them to other work, unless otherwise indicated.
2. Provide Phillips flat-head machine screws for exposed fasteners, unless otherwise indicated.

D. Anchors: Provide chemical or torque-controlled expansion anchors, fabricated from corrosion-resistant materials with capability to sustain, without failure, a load equal to six times the load imposed when installed in unit masonry and equal to four times the load imposed when installed in concrete, as determined by testing per ASTM E 488 conducted by a qualified independent testing agency.

2.5 MISCELLANEOUS MATERIALS

A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

B. Shop Primer for Galvanized Steel: Zinc-dust, zinc-oxide primer formulated for priming zinc-coated steel and for compatibility with finish paint systems indicated, and complying with SSPC-Paint 5.

C. Galvanizing Repair Paint: High-zinc-dust-content paint for regalvanizing welds in steel, complying with SSPC-Paint 20.

D. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.

E. Anchoring Cement: Factory-packaged, nonshrink, nonstaining, hydraulic-controlled expansion cement formulation for mixing with water at Project site to create pourable anchoring, patching, and grouting compound.

1. Water-Resistant Product: At exterior locations and where indicated provide formulation that is resistant to erosion from water exposure without needing protection by a sealer or waterproof coating and that is recommended by manufacturer for exterior use.

2.6 FABRICATION

A. General: Fabricate railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage**,** but not less than that required to support structural loads].

B. Assemble railings in the shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation. Use connections that maintain structural value of joined pieces.

C. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch, unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

D. Form work true to line and level with accurate angles and surfaces.

E. Fabricate connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.

F. Cut, reinforce, drill, and tap as indicated to receive finish hardware, screws, and similar items.

G. Connections: Fabricate railings with welded connections, unless otherwise indicated.

H. Welded Connections: Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove flux immediately.
4. At exposed connections, finish exposed surfaces smooth and blended so no roughness shows after finishing and welded surface matches contours of adjoining surfaces.

I. Form changes in direction as follows:

1. By flush bends or by inserting prefabricated flush-elbow fittings.

J. Form simple and compound curves by bending members in jigs to produce uniform curvature for each repetitive configuration required; maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.

K. Close exposed ends of railing members with prefabricated end fittings.

L. Provide wall returns at ends of wall-mounted handrails, unless otherwise indicated. Close ends of returns unless clearance between end of rail and wall is 1/4 inch or less.

M. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect railing members to other work, unless otherwise indicated.

N. Provide inserts and other anchorage devices for connecting railings to concrete or masonry work. Fabricate anchorage devices capable of withstanding loads imposed by railings. Coordinate anchorage devices with supporting structure.

O. For railing posts set in concrete, provide steel sleeves not less than 6 inches long with inside dimensions not less than 1/2 inch greater than outside dimensions of post, with steel plate forming bottom closure.

P. Toe Boards: Where indicated, provide toe boards at railings around openings and at edge of open-sided floors and platforms. Fabricate to dimensions and details indicated.

2.7 FINISHES, GENERAL

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Provide exposed fasteners with finish matching appearance, including color and texture, of railings.

2.8 STEEL AND IRON FINISHES

A. Galvanized Railings:

1. Hot-dip galvanize exterior steel and iron railings, including hardware, after fabrication.
2. Hot-dip galvanize indicated steel and iron railings, including hardware, after fabrication.
3. Comply with ASTM A 123/A 123M for hot-dip galvanized railings.
4. Comply with ASTM A 153/A 153M for hot-dip galvanized hardware.

B. Stainless Steel Components: 316 grade.

C. Fill vent and drain holes that will be exposed in the finished Work, unless indicated to remain as weep holes, by plugging with zinc solder and filing off smooth.

D. For galvanized railings, provide hot-dip galvanized fittings, brackets, fasteners, sleeves, and other ferrous components.

E. For nongalvanized steel railings, provide nongalvanized ferrous-metal fittings, brackets, fasteners, and sleeves, except galvanize anchors to be embedded in exterior concrete or masonry.

F. Preparation for Shop Priming: After galvanizing, thoroughly clean railings of grease, dirt, oil, flux, and other foreign matter, and treat with metallic-phosphate process.

G. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with minimum requirements indicated below for SSPC surface preparation specifications and environmental exposure conditions of installed railings:

1. Exterior Railings (SSPC Zone 1B): SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
2. Interior Railings (SSPC Zone 1A): SSPC-SP 7/NACE No. 4, "Brush-off Blast Cleaning."

H. Apply shop primer to prepared surfaces of railings, unless otherwise indicated. Comply with requirements in SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting. Primer need not be applied to surfaces to be embedded in concrete or masonry.

2.9 ALUMINUM FINISHES

A. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.

2.10 STAINLESS-STEEL FINISHES

A. Remove tool and die marks and stretch lines, or blend into finish.

B. Grind and polish surfaces to produce uniform, directionally textured, polished finish indicated, free of cross scratches. Run grain with long dimension of each piece.

C. 180-Grit Polished Finish: Oil-ground, uniform, directionally textured finish.

D. 320-Grit Polished Finish: Oil-ground, uniform, fine, directionally textured finish.

E. Polished and Buffed Finish: Oil-ground, 180-grit finish followed by buffing.

F. Dull Satin Finish: No. 6.

G. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Fit exposed connections together to form tight, hairline joints.

B. Perform cutting, drilling, and fitting required for installing railings. Set railings accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.

1. Do not weld, cut, or abrade surfaces of railing components that have been coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.
2. Set posts plumb within a tolerance of 1/16 inch in 3 feet.
3. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet.

C. Adjust railings before anchoring to ensure matching alignment at abutting joints.

D. Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing railings and for properly transferring loads to in-place construction.

E. Corrosion Protection: Coat concealed surfaces of aluminum that will be in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.

3.2 RAILING CONNECTIONS

A. Welded Connections: Use fully welded joints for permanently connecting railing components. Comply with requirements for welded connections in Part 2 "Fabrication" Article whether welding is performed in the shop or in the field.

B. Expansion Joints: Install expansion joints at locations indicated but not farther apart than required to accommodate thermal movement. Provide slip-joint internal sleeve extending 2 inches (50 mm) beyond joint on either side, fasten internal sleeve securely to one side, and locate joint within 6 inches (150 mm) of post.

3.3 ANCHORING POSTS

A. Use steel pipe sleeves preset and anchored into concrete for installing posts. After posts have been inserted into sleeves, fill annular space between post and sleeve with nonshrink, nonmetallic grout or anchoring cement, mixed and placed to comply with anchoring material manufacturer's written instructions.

B. Cover anchorage joint with flange of same metal as post, welded to post after placing anchoring material or attached to post with set screws.

C. Anchor posts to metal surfaces with oval flanges, angle type, or floor type as required by conditions, connected to posts and to metal supporting members as follows:

1. For steel pipe railings, weld flanges to post and bolt to metal supporting surfaces.

3.4 ANCHORING RAILING ENDS

A. Anchor railing ends to concrete and masonry with round flanges connected to railing ends and anchored to wall construction with anchors and bolts.

B. Anchor railing ends to metal surfaces with flanges bolted to metal surfaces and welded to railing ends or connected to railing ends using nonwelded connections.

3.5 ATTACHING HANDRAILS TO WALLS

A. Attach handrails to wall with wall brackets. Provide brackets with 1-1/2-inch clearance from inside face of handrail and finished wall surface.

1. Use type of bracket with predrilled hole for exposed bolt anchorage.

B. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.

C. Secure wall brackets to building construction as follows:

1. For concrete and solid masonry anchorage, use drilled-in expansion shields and hanger or lag bolts.
2. For hollow masonry anchorage, use toggle bolts.
3. For steel-framed gypsum board partitions, fasten brackets directly to steel framing or concealed steel reinforcements using self-tapping screws of size and type required to support structural loads.

3.6 ADJUSTING AND CLEANING

A. Clean aluminum and stainless steel by washing thoroughly with clean water and soap and rinsing with clean water.

B. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

C. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

3.7 PROTECTION

A. Protect finishes of railings from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at time of Substantial Completion.

B. Restore finishes damaged during installation and construction period so no evidence remains of correction work. Return items that cannot be refinished in the field to the shop; make required alterations and refinish entire unit, or provide new units.

END OF SECTION 055213

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SECTION 057300 – DECORATIVE METAL RAILINGS

PART I - GENERAL

1.1 WORK INCLUDED

A. Furnish and install aluminum pipe and tube railings and components.

1.2 REFERENCE

A. American National Standards Institute (ANSI)
   1. *A21.I* Safety Requirements for Floor and Wall Openings, Railings and Toe Boards.
   2. A58.I Minimum Design Loads in Buildings and Other Structures.
   3. Al 17.1 Accessible and Usable Buildings and Facilities.
   4. Z97.I Safety Performance Specifications and Methods of Test for Safety Glazing Materials Used in Buildings.

B. American Society for Testing and Materials (ASTM)

   1. ASTME 894-88 - Standard Test Method for Anchorage of Permanent Metal Railing Systems and Rails for Buildings ASTME 935-93 - Standard Test Methods for Performance of Permanent Metal Railing Systems and Rails for Buildings ASTME 985-93 - Standard Specification for Permanent Metal Railing Systems and Rails for Buildings

C. Americans with disabilities act accessibility guidelines (ADA)

D. National Association of Architectural Metal Manufacturers (NAAMM)
   1. Metal Finishes Manual
   2. Pipe Railing Manual
   3. Stair Manual

E. American Welding Society DI .2 (AWS)

1.3 PERFORMANCE REQUIREMENTS

A. General: Railings shall withstand structural loads indicate.

B. Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design railings, including attachment to building construction.

C. Structural Performance: Provide railings capable of withstanding the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

   1. Handrails:

      a. Uniform load of 50 lbf/ ft. applied in any direction.
      b. Concentrated load of 200 lbf applied in any direction.
      c. Uniform and concentrated loads need not be assumed to act concurrently.

   2. Top Rails of Guards:

      a. Uniform load of 50 lbf/ ft. applied in any direction.
      b. Concentrated load of 200 lbf applied in any direction.
      c. Uniform and concentrated loads need not be assumed to act concurrently.

3. Infill of Guards:

   a. Concentrated load of 50 lbf applied horizontally on an area of 1 sq. ft.
   b. Infill load and other loads need not be assumed to act concurrently.

1.4 SUBMITTALS

A. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

   a. For installed products, comply with design loads. Include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

B. Samples of manufacturer's standard color chart. For custom colors 2 chips will be submitted for color match and approval by Landscape Architect.

1.6 DELIVERY, STORAGE AND HANDLING

A. Materials to be delivered to the job site in good condition and adequately protected against damage as handrails are a finished product.

B. Store on site in a location and manner to avoid damage. Stacking should be done in a manner that will prevent bending. Store material in a clean, dry location away from uncured concrete and masonry. Any protection on the railings during transportation should remain until installed.

C. Keep handling on site to a minimum. Exercise caution to avoid damage to finishes of material.

1.7 PROJECT CONDITIONS

A. Field Measurements: Where handrails and railings are indicated to fit to other construction, check actual dimensions of other construction by accurate field measurements before fabrication; show recorded measurements on final shop drawings. Where field measurements cannot be made without delaying the railing fabrication and delivery, obtain guaranteed dimensions in writing by the contractor or Landscape Architect and proceed with fabrication of products so as not to delay fabrication, delivery and installation.

B. Coordinate fabrication and delivery schedule of handrails with construction progression and sequence to avoid delay of railing installation.

PART 2- PRODUCTS

2.1 MATERIALS AND FINISHES (Choose from applicable material specification below)

A. Materials

   1. All extrusions to be 6063-T5 or T6, 6061-T6 or 6005-T5 alloy aluminum. 304 or 316 Stainless Steel pipe- 1 ½" industry (1.90 inches O D) or 1.5 inches O D with a #6 polish. All Stainless Steel pipe and tubing to be a 304/ 316 Stainless.
   2. All fittings to be stainless steel or aluminum as required.

B. Finishes

   1. Aluminum Finishes

      a. KYNAR 500® 2-Coat meets AAMA 2605-98
      b. KYNAR 500® XL 3-Coat meets AAMA 2605-98
      c. Powder Coat to meet 2604-98

2.2 FASTENERS

A. All mechanical fasteners used shall be manufactured from stainless steel.

2.4 FABRICATION

A. All mitered and welded corners shall be ground down smooth before finishing unless otherwise noted.

B. Make exposed joints butt tight and flush.

C. Interior sleeves shall be of used for typical splices.

D. Fasteners are allowed at splice connection.

E. Verify dimensions on site prior to shop fabrication.

F. End connections required to fasten to the building structure requires a slide wall mount bracket.

G. Provide weep holes when necessary to drain closed sections from pretreatment immersion and finishes. Provide weep holes when necessary for moisture from condensation to escape.

PART 3- EXECUTION

3.1 PREPARATION

A. Coordinate post setting drawings, diagrams, templates, instructions, and directions for installation of anchorages, such as sleeves, concrete inserts, anchor bolts, and miscellaneous items having integral anchors, that are to be embedded in concrete as masonry construction. Coordinate delivery of such items to project site. Should railings require wall mounting, wood blocking will be provided by the contractor.

3.2 INSTALLATION

A. Fit exposed connections accurately together to form tight joints, except as necessary for expansion.

A. Perform cutting, drilling, and fitting required for installation of handrails. Set handrails and accurately in location, alignment, and elevation, measured from established lines and levels.

B. Set posts plumb within a tolerance of 1/8”.

C. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing handrails and railings to in-place construction.

3.3 CLEANING AND PROTECTION

A. Upon delivery railing will have protective wrapping over cap only. Immediately upon completion of installation of railing installer shall remove cap cover and clean all work for inspection and approval.

B. After installation the General Contractor shall be responsible for protecting the railings during the balance of construction.

C. When cleaning painted aluminum surfaces use plain water containing a mild soap or detergent. No abrasive agents or harsh chemicals are to be used.

END OF SECTION 057300

SECTION 061000 – ROUGH CARPENTRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this section.

1.2 SUMMARY

A. This section includes the following:

1. Wood furring, grounds, nailers, and blocking.

B. Related Sections: The following sections contain requirements that relate to this section:

1. Division 6, Section 062023 - INTERIOR FINSIH CARPENTRY for interior woodwork specially fabricated for this project.
2. Division 7, Section 075419- POLYVINYL-CHORIDE (PVC) ROOFING for grounds, nailers and blocking.

1.3 DEFINITIONS

A. Rough Carpentry: Carpentry work not specified in other sections and generally not exposed, unless otherwise specified.

1.4 SUBMITTALS

A. General: Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections.

B. Wood treatment data as follows, including chemical treatment manufacturer's instructions for handling, storing, installing, and finishing treated materials:

1. For each type of preservative-treated wood product, include certification by treating plant stating type of preservative solution and pressure process used, net amount of preservative retained, and compliance with applicable standards.

2. For waterborne-treated products, include statement that moisture content of treated materials was reduced to levels indicated before shipment to Project site.

3. Warranty of chemical treatment manufacturer for each type of treatment.
4. For fire-retardant-treated wood products, include certification by treating plant that treated materials comply with specified standard and other requirements.

5. Material test reports from a qualified independent testing agency indicating and interpreting test results relative to compliance of fire-retardant-treated wood products with requirements indicated.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Keep materials under cover and dry. Protect from weather and contact with damp or wet surfaces. Stack lumber, plywood, and other panels. Provide for air circulation within and around stacks and under temporary coverings including polyethylene and similar materials.

1. For lumber and plywood pressure treated with waterborne chemicals, place spacers between each bundle to provide air circulation.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: To qualify for approval, an independent testing agency must demonstrate to Architect's satisfaction, based on evaluation of agency-submitted criteria conforming to ASTM E699, that it has the experience and capability to satisfactorily conduct the testing indicated without delaying the Work.

B. Single-Source Responsibility for Fire-Retardant-Treated Wood: Obtain each type of fire-retardant-treated wood product from one source and by a single producer.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Wood-Preservative-Treated Materials:

a. Baxter: J. H. Baxter Co.

b. Chemical Specialties, Inc.

c. Continental Wood Preservers, Inc.

d. Hickson Corp.

e. Hoover Treated Wood Products, Inc.

f. Osmose Wood Preserving, Inc.

2. Fire-Retardant-Treated Materials:

a. Baxter: J.H. Baxter Co.

b. Chemical Specialties, Inc.

c. Continental Wood Preservers, inc.

d. Hickson Corp.

e. Hoover Treated Wood Products, Inc.

f. American Wood Treaters, Inc.

2.2 LUMBER, GENERAL

A. Lumber Standards: Comply with DOC PS 20, "American Softwood Lumber Standard," and with applicable grading rules of inspection agencies certified by American Lumber Standard Committee's (ALSC) Board of Review.

1. SPIB - Southern Pine Inspection Bureau.

2. WWPA - Western Wood Products Association.

3. NELMA - Northeastern Lumber Manufacturer's Association.

B. Grade Stamps: Provide lumber with each piece factory marked with grade stamp of inspection agency evidencing compliance with grading rule requirements and identifying grading agency, grade, species, moisture content at time of surfacing, and mill.

C. Where nominal sizes are indicated, provide actual sizes required by DOC PS 20 for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry lumber.

1. Provide dressed lumber, S4S, unless otherwise indicated.

2. Provide dry lumber with 19 percent maximum moisture content at time of dressing for 2-inch nominal thickness or less, unless otherwise indicated.

2.3 WOOD-PRESERVATIVE-TREATED MATERIALS

A. General: Where lumber or plywood is indicated as preservative treated or is specified to be treated, comply with applicable requirements of AWPA C2 (lumber) and AWPA C9 (plywood). Mark each treated item with the Quality Mark Requirements of an inspection agency approved by ALSC's Board of Review.

1. Do not use chemicals containing chromium, **amonia** or arsenic.

B. Pressure treat aboveground items with waterborne preservatives to a minimum retention of 0.25 lb/cu. ft. **and a maximum of 0.39 lb/cu. ft.** After treatment, kiln-dry lumber and plywood to a maximum moisture content of 19 and 15 percent, respectively. Treat indicated items and the following:

1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.

2. Wood sills, sleepers, blocking, furring, stripping, and similar concealed members in contact with masonry or concrete.

3. Wood framing members less than 18 inches above grade.

C. Complete fabrication of treated items before treatment, where possible. If cut after treatment, apply field treatment complying with AWPA M4 to cut surfaces. Inspect each piece of lumber or plywood after drying and discard damaged or defective pieces.

D. Do not use oil borne pentachlorophenol for surfaces that are to be painted and surfaces in contact with roofing.

2.4 FIRE-RETARDANT-TREATED MATERIALS

A. General: Where wood is used for blocking and indicated elsewhere, use fire-retardant-treated materials that comply with performance requirements in AWPA C20 (lumber) and AWPA C27 (plywood). Identify fire-retardant-treated wood with appropriate classification marking of UL, U.S. Testing, Timber Products Inspection, or another testing and inspecting agency acceptable to authorities having jurisdiction.

1. Use treatment for which chemical manufacturer publishes physical properties of treated wood after exposure to elevated temperatures, when tested by a qualified independent testing agency according to ASTM D 5664, for lumber and ASTM D 5516, for plywood.
2. Use treatment that does not promote corrosion of metal fasteners.
3. Use Exterior type for exterior locations and where indicated.

Use Interior Type A High Temperature (HT), unless otherwise indicated.

For exposed items indicated to receive a stained or natural finish, use chemical formulations that do not bleed through, contain colorants, or otherwise adversely affect finishes.

2.5 MISCELLANEOUS LUMBER

A. General: Provide lumber for support or attachment of other construction, including cant strips, bucks, nailers, blocking, furring, grounds, stripping, and similar members.

B. Fabricate miscellaneous lumber from dimension lumber of sizes indicated and into shapes shown.

C. Moisture Content: 19 percent maximum for lumber items not specified to receive wood preservative treatment.

D. Grade: For dimension lumber sizes, provide No. 3 or Standard grade lumber per ALSC's NGRs of Southern pine-SPIB or Douglas fir south-WWPA, unless otherwise indicated.

2.6 PLYWOOD, GENERAL

A. Plywood Panel Standard: Provide plywood panels complying with DOC PS 1, "U.S. Product Standard for Construction and Industrial Plywood."

B. Trademark: Factory mark plywood panels with APA trademark evidencing compliance with grade requirements.

2.7 PLYWOOD PANELS FOR BACKING

A. Plywood Backing Panels: For mounting electrical or telephone equipment, provide plywood panels with grade C-D Plugged Exposure 1 in thickness indicated or, if not otherwise indicated, not less than 15/32 inch thick. Provide fire-retardant paint coating equivalent to PPG "Speedhide Latex Fire Retardant Paint" or Flame Control Coatings, Inc. "No. 20-20 Flat Latex Intumescent Fire Retardant Paint". Follow manufacturer□s instructions and recommendations for application and dry film thickness.

2.8 FASTENERS

A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.

1. Where rough carpentry is exposed to weather, in ground contact, or in area of high relative humidity, provide fasteners with a hot-dip zinc coating per ASTM A153 or of Type 304 stainless steel. **Only use ASTM A153 galvanized fasteners where fasteners are in contact with other galvanized materials.**

B. Nails, Wire, Brads, and Staples: FS FF-N-105.

C. Power-Driven Fasteners: CABO National Evaluation Report NER-272.

D. Wood Screws: ASME B18.6.1.

E. Lag Bolts: ASME B18.2.1.

F. Bolts: Steel bolts complying with ASTM A307, Grade A (ASTM F568, Property Class 4.6); with ASTM A563 hex nuts and, where indicated, flat washers.

2.9 MISCELLANEOUS MATERIALS

A. Water-Repellent Preservative: NWWDA-tested and -accepted formulation containing 3-iodo-2-propynyl butyl carbonate (IPBC) as its active ingredient.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Discard units of material with defects that impair quality of rough carpentry construction and that are too small to use in fabricating rough carpentry with minimum number of joints or optimum joint arrangement.

B. Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted.

C. Fit rough carpentry to other construction; scribe and cope as required for accurate fit. Correlate location of furring, nailers, blocking, grounds, and similar supports to allow attachment of other construction.

D. Apply field treatment complying with AWPA M4 to cut surfaces of preservative-treated lumber and plywood.

E. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:

1. CABO NER-272 for power-driven staples, P-nails, and allied fasteners.

2. "Recommended Nailing Schedule" of referenced framing standard and with AFPA's "National Design Specifications for Wood Construction." Comply with requirements of applicable codes and of authorities having jurisdiction.

F. Use hot-dip galvanized nails, unless otherwise indicated. Use finishing nails for finish work. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood; predrill as required.

G. Countersink nail heads on exposed carpentry work and fill holes.

3.2 WOOD GROUNDS, NAILERS, BLOCKING, AND SLEEPERS

A. Install wood grounds, nailers, blocking, and sleepers where shown and where required for screening or attaching other work. Form to shapes shown and cut as required for true line and level of attached work. Coordinate locations with other work involved.

B. Attach to substrates to support applied loading. Recess bolts and nuts flush with surfaces, unless otherwise indicated. Build into masonry during installation of masonry work. Where possible, anchor to form work before concrete placement.

3.3 INSTALLATION OF PLYWOOD PANELS

A. General: Comply with applicable recommendations contained in APA Form No. E30, "APA Design/Construction Guide: Residential & Commercial," for types of plywood panels and applications indicated.

1. Plywood Backing Panels: Nail or screw to supports.

END OF SECTION 061000

SECTION 062023 – INTERIOR FINISH CARPENTRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this section.

1.2 SUMMARY

A. This section includes the following:

1. Plastic-laminate clad cabinets.

2. Countertops.

3. Solid-surfacing material casework and countertops.

B. Related Sections: The following sections contain requirements that relate to this section:

1. Division 6 Section 061000 - ROUGH CARPENTRY for furring, blocking, and other carpentry work that is not exposed to view.

2. Division 8 Section 081416 - FLUSH WOOD DOORS for doors specified by reference to architectural woodwork standards.

1.3 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.

B. Product data for each type of product and process specified in this section and incorporated into items of architectural woodwork during fabrication, finishing, and installation.

C. Shop drawings showing location of each item, dimensioned plans and elevations, large-scale details, attachment devices, and other components.

1. Show details full size.

2. Show locations and sizes of furring, blocking and hanging strips, including concealed blocking and reinforcement specified in other sections.

3. Show locations and sizes of cutouts and holes for plumbing fixtures, faucets, soap dispensers and other items installed in architectural woodwork.

D. Samples for initial selection purposes of the following in form of manufacturer's color charts consisting of actual units or sections of units showing full range of colors, textures, and patterns available for each type of material indicated.

1. Plastic laminate.

2. Solid-surfacing materials.

E. Samples for verification purposes of the following:

1. Laminate clad panel products, 8-1/2 inches by 11 inches for each type, color, pattern, and surface finish, with separate samples of unfaced panel product used for core.

2. Solid-surfacing materials, 6 inches square.

3. Corner pieces as follows:

a. Cabinet front frame joints between stiles and rail as well as exposed end pieces, 18 inches high by 18 inches wide by 6 inches deep.

F. Product certificates signed by woodwork manufacturer certifying that products comply with specified requirements.

G. Qualification data for firms and persons specified in "Quality Assurance" article to demonstrate their capabilities and experience. Include list of completed projects with project names, addresses, names of Architects and Owners, and other information specified.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: Firm experienced in successfully producing architectural woodwork similar to that indicated for this Project, with sufficient production capacity to produce required units without causing delay in the work.

B. Single-Source Manufacturing and Installation Responsibility: Engage a qualified manufacturer to assume undivided responsibly for woodwork specified in this section, including fabrication, finishing, and installation.

C. AWI Quality Standard: Comply with applicable requirements of "Architectural Woodwork Quality Standards" published by the Architectural Woodwork Institute (AWI) except as otherwise indicated.

1. Provide AWI Quality Certification Program labels indicating that woodwork complies with requirements of grades specified.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Protect woodwork during transit, delivery, storage, and handling to prevent damage, soilage, and deterioration.

B. Do not deliver woodwork until painting, wet work, grinding, and similar operations that could damage, soil, or deteriorate woodwork have been completed in installation areas. If woodwork must be stored in other than installation areas, store only in areas whose environmental conditions meet requirements specified in "Project Conditions."

1.6 PROJECT CONDITIONS

A. Environmental Conditions: Obtain and comply with woodwork manufacturer's and installer's coordinated advice for optimum temperature and humidity conditions for woodwork during its storage and installation. Do not install woodwork until these conditions have been attained and stabilized so that woodwork is within plus or minus 1.0% of optimum moisture content from date of installation through remainder of construction period.

B. Field Measurements: Where woodwork is indicated to be fitted to other construction, check actual dimensions of other construction by accurate field measurements before manufacturing woodwork; show recorded measurements on final shop drawings. Coordinate manufacturing schedule with construction progress to avoid delay of work.

1.7 COORDINATION

A. Coordinate sizes and locations of framing, blocking, furring, reinforcements and other related units of work specified in other sections to ensure that interior architectural woodwork can be supported and installed as indicated.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General: Provide materials that comply with requirements of the AWI quality standard for each type of woodwork and quality grade specified unless otherwise indicated.

B. Wood Products: Comply with the following:

1. Hardboard: AHA A135.4

2. Hardwood Plywood and Face Veneers: HPVA HP-1.

3. Medium Density Fiberboard: ANSI A208.2, Grade M-2.

4. Particleboard: Not Acceptable

5. Softwood Plywood: DOC PS1, medium Density Overly.

6. Formaldehyde Emission Levels: Comply with formaldehyde emission requirements of each voluntary standard referenced below:

a. Medium Density Fiberboard: NPA 9.
b. Hardwood Plywood: HPMA FE.

C. High-Pressure Decorative Laminate: NEMA LD 3, grades as indicated, or if not indicated, as required by woodwork quality standard.

1. Manufacturer: Subject to compliance with requirements, provide high-pressure decorative laminates by one of the following:

a. Formica Corporation.
b. International Paper; Decorative Products Div.
c. Laminart.
d. Pioneer Plastics Corp.
e. Westinghouse Electric Corp.; Specialty Products Div.
f. Wilsonart International; Div. of Premark International, Inc.
g. Nevamar.

D. Adhesive for Bonding Plastic Laminate: Unpigmented contact cement.

1. Adhesive for Bonding Edges: Hot-melt adhesive or adhesive specified above for faces.

E. Solid-Surfacing Material: Homogeneous solid sheets of filled plastic resin complying with material and performance requirements in ANSI Z124.3, for Type 5 or Type 6, without a precoated finish.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Corian; DuPont Polymers.
b. Surell; Formica Corporation.
c. Staron; Samsung.

F. Stainless Steel Trim and Edging:

1. Provide stainless steel sheet formed to shapes indicated on drawings and applied to wood substrate. Provide Type 302/304 stainless steel with No. 4 satin finish, 16 gauge unless indicated otherwise on drawings. Brake or form to profile indicated on drawings. Brakes shall be sharp, straight and true to line. Radii shall be true and smooth without waves and distortion. Use concealed anchors where items are exposed to view, no exposed fasteners permitted. Exposed edges shall be ground or filed to remove sharp edges and corners.

2. Stainless steel shall be adhesive bonded to wood back-up.

2.2 INSTALLATION MATERIALS

A. Furring, Blocking, Shims and Hanging Strips: Softwood or hardwood lumber, kiln-dried to less than 15 percent moisture content.

B. Anchors: Select the material, type, size and finish required for each substrate for secure anchorage. Provide non-ferrous metal or hot-dip galvanized anchors and inserts on inside face of exterior walls and elsewhere as required for corrosion resistance. Provide toothed-steel or lead expansion sleeves for drilled-in-place anchors.

2.3 FABRICATION, GENERAL

A. Provide Premium Grade interior woodwork complying with the referenced quality standard.

B. Wood Moisture Content: Comply with requirements of referenced quality standard for moisture content of lumber in relation to relative humidity conditions existing during time of fabrication and in installation areas.

C. Fabricate woodwork to dimensions, profiles, and details indicated. Ease edges to radius indicated for the following:

1. Corners of Cabinets and Edges of Solid Wood (Lumber) Members and Rails: 1/16 inch.

D. Complete fabrication, including assembly, finishing, and hardware application, before shipment to project site to maximum extent possible. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.

E. Factory-cut openings, to maximum extent possible, to receive hardware, appliances, plumbing fixtures, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Smooth edges of cutouts and, where located in countertops and similar exposures, seal edges of cutouts with a water-resistant coating.

2.4 CABINET HARDWARE AND ACCESSORY MATERIALS

A. General: Provide cabinet hardware and accessory materials associated with architectural cabinets.

B. Hardware Standard: Comply with ANSI/BHMA A156.9 "American National Standard for Cabinet Hardware" for items indicated by reference to BHMA numbers or referenced to this standard.

C. Exposed Hardware Finishes: For exposed hardware, provide finish that complies with ANSI/BHMA A156.18 for BHMA code number indicated.

1. Satin Stainless Steel, Stainless Steel Base: BHMA 630.

D. Butt Hinges: 2-3/4-inch (70-mm), 5-knuckle steel hinges made from 0.095-inch- (2.4-mm-) thick metal, and as follows:

1. Semiconcealed Hinges for Flush Doors: BHMA A156.9, B01361.
2. Semiconcealed Hinges for Overlay Doors: BHMA A156.9, B01521.

E. Back-Mounted Pulls: BHMA A156.9, B02011.

F. Wire Pulls: Back mounted, 4 inches (100 mm) long, 5/16 inches (8 mm) in diameter.

G. Catches: Magnetic catches, BHMA A156.9, B03141.

H. Adjustable Shelf Standards and Supports: BHMA A156.9, B04102; with shelf brackets, B04112.

I. Shelf Rests: BHMA A156.9, B04013.

J. Drawer Slides: Side-mounted, full-extension, zinc-plated steel drawer slides with steel ball bearings, BHMA A156.9, B05091, and rated for the following loads:

a. Box Drawer Slides: 100 lbf (440 N).
b. File Drawer Slides: 200 lbf (890 N).
c. Pencil Drawer Slides: 45 lbf (200 N).
d. Keyboard Slide: 75 lbf (330 N).
e. Trash Bin Slides: 200 lbf (890 N).

K. Aluminum Slides for Sliding Glass Doors: BHMA A156.9, B07063.

L. Door Locks: BHMA A156.11, E07121.

M. Drawer Locks: BHMA A156.11, E07041.

N. Grommets for Cable Passage through Countertops: 2-inch (51-mm) OD, black molded-plastic grommets and matching plastic caps with slot for wire passage.

a. Product: Subject to compliance with requirements, provide SG series by Doug Mockett and Co., Inc.

O. Paper Slots: 17 inches (432 mm) long by 1-3/4 inches (45 mm) wide by 1 inch (25 mm) deep; molded-plastic, paper-slot liner with 1/4-inch (6-mm) lip.

1. Product: Subject to compliance with requirements, provide Model "CP-2" by Doug Mockett and Co., Inc.

P. Exposed Hardware Finishes: For exposed hardware, provide finish that complies with BHMA A156.18 for BHMA finish number indicated.

1. Satin Stainless Steel: BHMA 630.

P. For concealed hardware provide manufacturer's standard finish that complies with product class requirements of ANSI/BHMA A156.9.

2.5 PLASTIC LAMINATE CLAD CABINETS

A. Quality Standard: Comply with AWI Section 400 requirements for laminate cabinets.

B. AWI Type of Cabinet Construction: Flush overlay. Provide stainless steel trim and edging as indicated on the drawings.

C. Laminate Cladding: High pressure decorative laminate complying with the following requirements:

1. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:

a. Provide selections made by Architect from laminate manufacturer's full range of standard colors and finishes on the Finish Schedule

2. Laminate Grade for Exposed Surfaces: Provide laminate cladding complying with the following requirements for type of surface and grade.

a. Horizontal Surfaces Other Than Tops: HGS.
b. Post-formed Surfaces: HGP.
c. Vertical Surfaces: HGS.
d. Edges: HGS.

3. Semi-exposed Surfaces: Provide surface materials indicated below:

a. High pressure laminate, VGS.

D. Provide dust panels of 1/4 inch plywood or tempered hardboard above compartments and drawers except where located directly under tops.

2.6 PLASTIC LAMINATE COUNTERTOPS

A. Quality Standard: Comply with AWI Section 400 requirements for high-pressure decorative laminate countertops.

B. High Pressure Decorative Laminate Grade: HGS.

C. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:

1. Provide Architect's selections from manufacturer's full range of colors and finishes.

D. Edge Treatment: Same as laminate cladding on horizontal surfaces.

E. Core Material: Exterior-grade plywood.

2.7 SOLID-SURFACING-MATERIAL CASEWORK COUNTERTOPS

A. Quality Standard: Comply with AWI Section 400 requirements for countertops.

1. Grade: Custom

B. Solid-Surfacing-Material Thickness: 1/2 inch unless noted otherwise.

C. Colors, Patterns, and Finishes: Provide materials and products that result in colors of solid-surfacing material complying with the following requirements:

1. Provide Architect's selections from manufacturer's full range of colors and finishes.

D. Fabricate tops in one piece with shop-applied backsplashes and edges, unless otherwise indicated. Comply with solid-surfacing-material manufacturer's written recommendations for adhesives, sealers, fabrication, and finishing.

E. Install integral sink bowls in countertops in shop.

F. Drill holes in countertops for plumbing fittings and soap dispensers in shop.

PART 3 - EXECUTION

3.1 PREPARATION

A. Condition woodwork to average prevailing humidity conditions in installation areas before installing.

B. Deliver concrete inserts and similar anchoring devices to be built into substrates well in advance of time substrates are to be built.

C. Before installing architectural woodwork, examine shop-fabricated work for completion and complete work as required, including back priming and removal of packing.

3.2 INSTALLATION

A. Quality Standard: Install woodwork to comply with AWI Section 1700 for same grade specified in Part 2 of this section for type of woodwork involved.

B. Install woodwork plumb, level, true, and straight with no distortions. Shim as required with concealed shims. Install to a tolerance of 1/8 inch in 8 feet - 0 inches for plumb and level (including tops) and with no variations in flushness of adjoining surfaces.

C. Scribe and cut woodwork to fit adjoining work and refinish cut surfaces or repair damaged finish at cuts.

D. Anchor woodwork to anchors or blocking built in or directly attached to substrates. Secure to grounds, stripping and blocking with countersunk, concealed fasteners and blind nailing as required for a complete installation. Except where prefinished matching fastener heads are

required, use fine finishing nails for exposed nailing, countersunk and filled flush with woodwork and matching final finish where transparent finish is indicated.

E. Cabinets: Install without distortion so that doors and drawers fit openings properly and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete the installation of hardware and accessory items as indicated.

1. Install cabinets with no more than 1/8 inch in 96-inch sag, bow, or other variation from a straight line.

2. Fasten wall cabinets through back, near top and bottom, at ends and not more than 16 inches o.c. with appropriate fasteners.

F. Countertops: Anchor securely by screwing through corner blocks of base cabinets or other supports into underside of countertop.

1. Align adjacent solid-surfacing-material countertops and form seams to comply with manufacturer's written recommendations using adhesive in color to match countertop. Carefully dress joints smooth, remove surface scratches, and clean entire surface.

2. Install countertops with no more than 1/8 inch in 96-inch sag, bow, or other variation from a straight line.

3. Caulk space between backsplash and wall with sealant specified in Division 7 Section "Joint Sealants."

G. Wall Panels: Anchor securely to wall with fabricated metal hanger clips. Install true and level with equally spaced reveals as shown on drawings.

3.3 ADJUSTMENT AND CLEANING

A. Repair damaged and defective woodwork where possible to eliminate defects functionally and visually; where not possible to repair, replace woodwork. Adjust joinery for uniform appearance.

B. Clean, lubricate, and adjust hardware.

C. Clean woodwork on exposed and semi-exposed surfaces. Touch up factory-applied finishes to restore damaged or soiled areas.

3.4 PROTECTION

A. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and installer that ensures that woodwork is being without damage or deterioration at time of Substantial Completion.

END OF SECTION 062023

SECTION 06 40 00 – INTERIOR ARCHITECTURAL WOODWORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this section.

1.2 SUMMARY

A. This section includes the following:

1. Plastic-laminate clad cabinets.

2. Countertops.

3. Solid-surfacing material casework and countertops.

B. Related Sections: The following sections contain requirements that relate to this section:

1. Division 6 Section 06 10 00 - ROUGH CARPENTRY for furring, blocking, and other carpentry work that is not exposed to view.

2. Division 8 Section 08 21 00 - FLUSH WOOD DOORS for doors specified by reference to architectural woodwork standards.

1.3 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.

B. Product data for each type of product and process specified in this section and incorporated into items of architectural woodwork during fabrication, finishing, and installation.

C. Shop drawings showing location of each item, dimensioned plans and elevations, large-scale details, attachment devices, and other components.

1. Show details full size.

2. Show locations and sizes of furring, blocking and hanging strips, including concealed blocking and reinforcement specified in other sections.

3. Show locations and sizes of cutouts and holes for plumbing fixtures, faucets, soap dispensers and other items installed in architectural woodwork.

D. Samples for initial selection purposes of the following in form of manufacturer's color charts consisting of actual units or sections of units showing full range of colors, textures, and patterns available for each type of material indicated.

1. Plastic laminate.

2. Solid-surfacing materials.

E. Samples for verification purposes of the following:

1. Laminate clad panel products, 8-1/2 inches by 11 inches for each type, color, pattern, and surface finish, with separate samples of unfaced panel product used for core.

2. Solid-surfacing materials, 6 inches square.

3. Corner pieces as follows:

a. Cabinet front frame joints between stiles and rail as well as exposed end pieces, 18 inches high by 18 inches wide by 6 inches deep.

F. Product certificates signed by woodwork manufacturer certifying that products comply with specified requirements.

G. Qualification data for firms and persons specified in "Quality Assurance" article to demonstrate their capabilities and experience. Include list of completed projects with project names, addresses, names of Architects and Owners, and other information specified.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: Firm experienced in successfully producing architectural woodwork similar to that indicated for this Project, with sufficient production capacity to produce required units without causing delay in the work.

B. Single-Source Manufacturing and Installation Responsibility: Engage a qualified manufacturer to assume undivided responsibly for woodwork specified in this section, including fabrication, finishing, and installation.

C. AWI Quality Standard: Comply with applicable requirements of "Architectural Woodwork Quality Standards" published by the Architectural Woodwork Institute (AWI) except as otherwise indicated.

1. Provide AWI Quality Certification Program labels indicating that woodwork complies with requirements of grades specified.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Protect woodwork during transit, delivery, storage, and handling to prevent damage, soilage, and deterioration.

B. Do not deliver woodwork until painting, wet work, grinding, and similar operations that could damage, soil, or deteriorate woodwork have been completed in installation areas. If woodwork must be stored in other than installation areas, store only in areas whose environmental conditions meet requirements specified in "Project Conditions."

1.6 PROJECT CONDITIONS

A. Environmental Conditions: Obtain and comply with woodwork manufacturer's and installer's coordinated advice for optimum temperature and humidity conditions for woodwork during its storage and installation. Do not install woodwork until these conditions have been attained and stabilized so that woodwork is within plus or minus 1.0% of optimum moisture content from date of installation through remainder of construction period.

B. Field Measurements: Where woodwork is indicated to be fitted to other construction, check actual dimensions of other construction by accurate field measurements before manufacturing woodwork; show recorded measurements on final shop drawings. Coordinate manufacturing schedule with construction progress to avoid delay of work.

1.7 COORDINATION

A. Coordinate sizes and locations of framing, blocking, furring, reinforcements and other related units of work specified in other sections to ensure that interior architectural woodwork can be supported and installed as indicated.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General: Provide materials that comply with requirements of the AWI quality standard for each type of woodwork and quality grade specified unless otherwise indicated.

B. Wood Products: Comply with the following:

1. Hardboard: AHA A135.4

2. Hardwood Plywood and Face Veneers: HPVA HP-1.

3. Medium Density Fiberboard: ANSI A208.2, Grade M-2.

4. Particleboard: Not Acceptable

5. Softwood Plywood: DOC PS1, medium Density Overly.

6. Formaldehyde Emission Levels: Comply with formaldehyde emission requirements of each voluntary standard referenced below:

a. Medium Density Fiberboard: NPA 9.
b. Hardwood Plywood: HPMA FE.

C. High-Pressure Decorative Laminate: NEMA LD 3, grades as indicated, or if not indicated, as required by woodwork quality standard.

1. Manufacturer: Subject to compliance with requirements, provide high-pressure decorative laminates by one of the following:

a. Formica Corporation.
b. International Paper; Decorative Products Div.
c. Laminart.
d. Pioneer Plastics Corp.
e. Westinghouse Electric Corp.; Specialty Products Div.
f. Wilsonart International; Div. of Premark International, Inc.
g. Nevamar.

D. Adhesive for Bonding Plastic Laminate: Unpigmented contact cement.

1. Adhesive for Bonding Edges: Hot-melt adhesive or adhesive specified above for faces.

E. Solid-Surfacing Material: Homogeneous solid sheets of filled plastic resin complying with material and performance requirements in ANSI Z124.3, for Type 5 or Type 6, without a precoated finish.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Corian; DuPont Polymers.
b. Surell; Formica Corporation.
c. Staron; Samsung.

F. Stainless Steel Trim and Edging:

1. Provide stainless steel sheet formed to shapes indicated on drawings and applied to wood substrate. Provide Type 302/304 stainless steel with No. 4 satin finish, 16 gauge unless indicated otherwise on drawings. Brake or form to profile indicated on drawings. Brakes shall be sharp, straight and true to line. Radii shall be true and smooth without waves and distortion. Use concealed anchors where items are exposed to view, no exposed fasteners permitted. Exposed edges shall be ground or filed to remove sharp edges and corners.

2. Stainless steel shall be adhesive bonded to wood back-up.

2.2 INSTALLATION MATERIALS

A. Furring, Blocking, Shims and Hanging Strips: Softwood or hardwood lumber, kiln-dried to less than 15 percent moisture content.

B. Anchors: Select the material, type, size and finish required for each substrate for secure anchorage. Provide non-ferrous metal or hot-dip galvanized anchors and inserts on inside face of exterior walls and elsewhere as required for corrosion resistance. Provide toothed-steel or lead expansion sleeves for drilled-in-place anchors.

2.3 FABRICATION, GENERAL

A. Provide Premium Grade interior woodwork complying with the referenced quality standard.

B. Wood Moisture Content: Comply with requirements of referenced quality standard for moisture content of lumber in relation to relative humidity conditions existing during time of fabrication and in installation areas.

C. Fabricate woodwork to dimensions, profiles, and details indicated. Ease edges to radius indicated for the following:

1. Corners of Cabinets and Edges of Solid Wood (Lumber) Members and Rails: 1/16 inch.

D. Complete fabrication, including assembly, finishing, and hardware application, before shipment to project site to maximum extent possible. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.

E. Factory-cut openings, to maximum extent possible, to receive hardware, appliances, plumbing fixtures, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Smooth edges of cutouts and, where located in countertops and similar exposures, seal edges of cutouts with a water-resistant coating.

2.4 CABINET HARDWARE AND ACCESSORY MATERIALS

A. General: Provide cabinet hardware and accessory materials associated with architectural cabinets.

B. Hardware Standard: Comply with ANSI/BHMA A156.9 "American National Standard for Cabinet Hardware" for items indicated by reference to BHMA numbers or referenced to this standard.

C. Exposed Hardware Finishes: For exposed hardware, provide finish that complies with ANSI/BHMA A156.18 for BHMA code number indicated.

1. Satin Stainless Steel, Stainless Steel Base: BHMA 630.

D. Butt Hinges: 2-3/4-inch (70-mm), 5-knuckle steel hinges made from 0.095-inch- (2.4-mm-) thick metal, and as follows:

1. Semiconcealed Hinges for Flush Doors: BHMA A156.9, B01361.
2. Semiconcealed Hinges for Overlay Doors: BHMA A156.9, B01521.

E. Back-Mounted Pulls: BHMA A156.9, B02011.

F. Wire Pulls: Back mounted, 4 inches (100 mm) long, 5/16 inches (8 mm) in diameter.

G. Catches: Magnetic catches, BHMA A156.9, B03141.

H. Adjustable Shelf Standards and Supports: BHMA A156.9, B04102; with shelf brackets, B04112.

I. Shelf Rests: BHMA A156.9, B04013.

J. Drawer Slides: Side-mounted, full-extension, zinc-plated steel drawer slides with steel ball bearings, BHMA A156.9, B05091, and rated for the following loads:

a. Box Drawer Slides: 100 lbf (440 N).
b. File Drawer Slides: 200 lbf (890 N).
c. Pencil Drawer Slides: 45 lbf (200 N).
d. Keyboard Slide: 75 lbf (330 N).
e. Trash Bin Slides: 200 lbf (890 N).

K. Aluminum Slides for Sliding Glass Doors: BHMA A156.9, B07063.

L. Door Locks: BHMA A156.11, E07121.

M. Drawer Locks: BHMA A156.11, E07041.

N. Grommets for Cable Passage through Countertops: 2-inch (51-mm) OD, black molded-plastic grommets and matching plastic caps with slot for wire passage.

a. Product: Subject to compliance with requirements, provide SG series by Doug Mockett and Co., Inc.

O. Paper Slots: 17 inches (432 mm) long by 1-3/4 inches (45 mm) wide by 1 inch (25 mm) deep; molded-plastic, paper-slot liner with 1/4-inch (6-mm) lip.

1. Product: Subject to compliance with requirements, provide Model "CP-2" by Doug Mockett and Co., Inc.

P. Exposed Hardware Finishes: For exposed hardware, provide finish that complies with BHMA A156.18 for BHMA finish number indicated.

1. Satin Stainless Steel: BHMA 630.

P. For concealed hardware provide manufacturer's standard finish that complies with product class requirements of ANSI/BHMA A156.9.

2.5 PLASTIC LAMINATE CLAD CABINETS

A. Quality Standard: Comply with AWI Section 400 requirements for laminate cabinets.

B. AWI Type of Cabinet Construction: Flush overlay. Provide stainless steel trim and edging as indicated on the drawings.

C. Laminate Cladding: High pressure decorative laminate complying with the following requirements:

1. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:

a. Provide selections made by Architect from laminate manufacturer's full range of standard colors and finishes on the Finish Schedule

2. Laminate Grade for Exposed Surfaces: Provide laminate cladding complying with the following requirements for type of surface and grade.

a. Horizontal Surfaces Other Than Tops: HGS.
b. Post-formed Surfaces: HGP.
c. Vertical Surfaces: HGS.
d. Edges: HGS.

3. Semi-exposed Surfaces: Provide surface materials indicated below:

a. High pressure laminate, VGS.

D. Provide dust panels of 1/4 inch plywood or tempered hardboard above compartments and drawers except where located directly under tops.

2.6 PLASTIC LAMINATE COUNTERTOPS

A. Quality Standard: Comply with AWI Section 400 requirements for high-pressure decorative laminate countertops.

B. High Pressure Decorative Laminate Grade: HGS.

C. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:

1. Provide Architect's selections from manufacturer's full range of colors and finishes.

D. Edge Treatment: Same as laminate cladding on horizontal surfaces.

E. Core Material: Exterior-grade plywood.

2.7 SOLID-SURFACING-MATERIAL CASEWORK COUNTERTOPS

A. Quality Standard: Comply with AWI Section 400 requirements for countertops.

1. Grade: Custom

B. Solid-Surfacing-Material Thickness: 1/2 inch unless noted otherwise.

C. Colors, Patterns, and Finishes: Provide materials and products that result in colors of solid-surfacing material complying with the following requirements:

1. Provide Architect's selections from manufacturer's full range of colors and finishes.

D. Fabricate tops in one piece with shop-applied backsplashes and edges, unless otherwise indicated. Comply with solid-surfacing-material manufacturer's written recommendations for adhesives, sealers, fabrication, and finishing.

E. Install integral sink bowls in countertops in shop.

F. Drill holes in countertops for plumbing fittings and soap dispensers in shop.

PART 3 - EXECUTION

3.1 PREPARATION

A. Condition woodwork to average prevailing humidity conditions in installation areas before installing.

B. Deliver concrete inserts and similar anchoring devices to be built into substrates well in advance of time substrates are to be built.

C. Before installing architectural woodwork, examine shop-fabricated work for completion and complete work as required, including back priming and removal of packing.

3.2 INSTALLATION

A. Quality Standard: Install woodwork to comply with AWI Section 1700 for same grade specified in Part 2 of this section for type of woodwork involved.

B. Install woodwork plumb, level, true, and straight with no distortions. Shim as required with concealed shims. Install to a tolerance of 1/8 inch in 8 feet - 0 inches for plumb and level (including tops) and with no variations in flushness of adjoining surfaces.

C. Scribe and cut woodwork to fit adjoining work and refinish cut surfaces or repair damaged finish at cuts.

D. Anchor woodwork to anchors or blocking built in or directly attached to substrates. Secure to grounds, stripping and blocking with countersunk, concealed fasteners and blind nailing as required for a complete installation. Except where prefinished matching fastener heads are

required, use fine finishing nails for exposed nailing, countersunk and filled flush with woodwork and matching final finish where transparent finish is indicated.

E. Cabinets: Install without distortion so that doors and drawers fit openings properly and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete the installation of hardware and accessory items as indicated.

1. Install cabinets with no more than 1/8 inch in 96-inch sag, bow, or other variation from a straight line.

2. Fasten wall cabinets through back, near top and bottom, at ends and not more than 16 inches o.c. with appropriate fasteners.

F. Countertops: Anchor securely by screwing through corner blocks of base cabinets or other supports into underside of countertop.

1. Align adjacent solid-surfacing-material countertops and form seams to comply with manufacturer's written recommendations using adhesive in color to match countertop. Carefully dress joints smooth, remove surface scratches, and clean entire surface.

2. Install countertops with no more than 1/8 inch in 96-inch sag, bow, or other variation from a straight line.

3. Caulk space between backsplash and wall with sealant specified in Division 7 Section "Joint Sealants."

G. Wall Panels: Anchor securely to wall with fabricated metal hanger clips. Install true and level with equally spaced reveals as shown on drawings.

3.3 ADJUSTMENT AND CLEANING

A. Repair damaged and defective woodwork where possible to eliminate defects functionally and visually; where not possible to repair, replace woodwork. Adjust joinery for uniform appearance.

B. Clean, lubricate, and adjust hardware.

C. Clean woodwork on exposed and semiexposed surfaces. Touch up factory-applied finishes to restore damaged or soiled areas.

3.4 PROTECTION

A. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and installer, that ensures that woodwork is being without damage or deterioration at time of Substantial Completion.

END OF SECTION 06 40 00

SECTION 071700 – BENTONITE WATERPROOFING

PART 1 – GENERAL

1.1 SUMMARY

A. The work of this section includes, but is not limited to the furnishing and installing the following materials, per project specifications and drawings, or as directed by bentonite waterproofing manufacturer:

1. Bentonite panel waterproofing membrane.
2. Bentonite geotextile waterproofing membrane.
3. Prefabricated drainage composite
4. All applicable accessory products.

1.2 SYSTEM DESCRIPTION

A. Provide bentonite waterproofing and prefabricated drainage composite system to prevent the passage of liquid water and install without defects, damage or failure.
B. Waterproofing shall consist of the following:

1. Biodegradable corrugated kraft board containing one pound per square foot of granular sodium bentonite.
2. Two high strength geotextiles interlocked encapsulating minimum 1.10-lbs per square foot granular sodium bentonite.

1.3 SUBMITTALS

A. Product Data: Submit manufacturer’s product data, with complete general and specific installation instructions, recommendations, and limitations.
B. Product Samples: Submit representative samples of the following for approval:

1. Panel waterproofing membrane
2. Geotextile waterproofing membrane
3. Prefabricated drainage composites

C. Waterproofing Warranty: Submit a sample copy of the Manufacturer’s Waterproofing warranty complete with all coverage’s, limitations, and conditions.
D. Material Certificates: Submit certificate(s) signed by manufacturer certifying materials comply with specified performance characteristics and physical requirements. Submit certification that waterproofing system and components, drainage and protection materials are supplied by a single-source manufacturer.
E. Contractor Certificate: Submit written certification that installer has current Approved Applicator status with waterproofing material manufacturer.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Installing company should have at least three (3) years experience in work of the type required by this section, who can comply with manufacturer's warranty requirements, and who is an Approved Applicator as determined by waterproofing/drainage system manufacturer.
B. Manufacturer Qualifications: Bentonite waterproofing and all accessory products shall be provided by a single manufacturer with a minimum of 30 years experience in the direct production of bentonite waterproofing systems. Manufacturer shall be capable of providing field service representation during construction, approving an acceptable installer, recommending appropriate installation methods of the bentonite waterproofing and

prefabricated drainage system applied.

C. Pre-Installation Conference: A pre-installation conference shall be held prior to commencement of field installation to establish procedures to maintain required working conditions and to coordinate this work with related and adjacent work. Verify that final waterproofing and waterstop details comply with waterproofing manufacturer's current installation requirements and recommendations. Pre-con meeting attendees should include representatives for the Owner, Architect, Contractor, waterproofing installer, concrete installer, excavating/backfill contractor, and mechanical and electrical contractors if work penetrates the waterproofing.

D. Materials: Obtain bentonite waterproofing products and prefabricated drainage materials from a single manufacturer.

E. Inspection: Manufacturer’s representative shall inspect waterproofing installation periodically during application to verify that waterproofing has been installed in accordance with manufacturer’s guidelines and recommendations.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Delivery and Handling: Deliver materials in factory sealed and labeled packaging. Sequence deliveries to avoid delays, while minimizing on-site storage. Handle and store following manufacturer's instructions, recommendations and material safety data sheets. Protect from construction operation related damage, as well as, damage from weather, excessive temperatures and prolonged sunlight. Remove damaged material from site and dispose of in accordance with applicable regulations.

B. Storage: Do not double-stack pallets during shipping or storage. Protect waterproofing materials from moisture, excessive temperatures and sources of ignition. Provide cover, top and all sides, for materials stored on-site, allowing for adequate ventilation.

1.6 PROJECT CONDITIONS

A. Substrate Condition: Proceed with work only when substrate construction and preparation work is complete and in condition to receive waterproofing system. All plumbing, electrical, mechanical and structural items to be under or passing through the waterproofing shall be positively secured in their proper positions prior to waterproofing system installation. Substrate preparation shall be per waterproofing manufacturer’s guidelines.

B. Weather Conditions: Perform work only when existing and forecasted weather conditions are within the guidelines established by the manufacturer of the waterproofing materials. Do not apply waterproofing materials in areas of standing or active water; or over ice and snow. The Contractor shall maintain site conditions to remove standing water from precipitation or ground water seepage in a timely manner. Should waterproofing materials be subjected to pre-hydration as a result of prolonged immersion, inspection of the material and written acceptance from manufacturer will be required prior to concrete or backfill placement.

1.7 WARRANTY

A. Waterproofing Warranty: Upon completion and acceptance of the work required by this section, the waterproofing materials manufacturer shall provide a written five (5) year material warranty. Issuance of Manufacturer's Material Warranty requires the following:

1. Manufacturer's Approved Applicator shall install bentonite waterproofing system and prefabricated drainage composite in full accordance with manufacturer’s requirements.
2. Bentonite Waterstop must be installed in all applicable horizontal and vertical concrete construction joints and around applicable penetrations.

B. Manufacturer's warranty shall be independent from any other warranties made by the Contractor under requirements of the Contract Documents and may run concurrent with said warranties.

PART 2 – PRODUCTS

2.1 MANUFACTURER

A. Provide bentonite waterproofing membrane and all applicable accessory products as manufactured by Colloid Environmental Technologies Company (CETCO), Arlington Heights, Illinois, or an approved substitution. Phone: (847) 392-5800; Fax: (847) 506-6195; Web-site: www.cetco.com.

B. Equal Product subject to compliance with requirements per Section 012500.

2.2 MATERIALS

A. Sodium Bentonite: Specially selected Wyoming granular sodium bentonite with 90% passing through a 20-mesh sieve and less than 10% passing through a 200-mesh sieve. Sodium bentonite shall have a 2 gram free swell minimum volume of 16 cc and a maximum fluid loss of 18 ml in de-ionized water.

B. Bentonite Panel Waterproofing

1. Type 1 Panels: 1 lb. per square foot of specially treated granular sodium bentonite contained inside a biodegradable, corrugated kraft board measuring 48" x 48" x 3/16" thick.
2. Type 1-C Panels: same as Type 1 panels with the printed side of the kraft board treated with a clear, water-resistant coating.
3. Bentonite Geotextile Waterproofing Membrane: 4’ x 15’ roll of interlocked geotextiles encapsulating a minimum 1.10-lbs per square foot of granular sodium bentonite. Composite shall consist of one woven and one nonwoven polypropylene geotextile, interlocked using a needle-punching process that produces several interlocks per square inch over the entire area of the product. Typical membrane performance properties:

PROPERTY	TEST METHOD	TYPICAL VALUE
Hydrostatic Pressure Resistance	ASTM D 5385 mod.	231 ft.
Permeability	ASTM D 5084	1 x 10-9 cm/sec.
Grab Tensile Strength	ASTM D 4632	95 lbs.
Puncture Resistance	ASTM D 4833	100 lbs.
Low Temperature Flexibility	ASTM D 1970	Unaffected at -25°F
Peel Adhesion to Concrete	ASTM D 903 mod.	15 lbs. /in.

C. Accessory Waterproofing Products: All accessory waterproofing materials shall be provided by the bentonite waterproofing manufacturer or shall have manufacturer’s written approval for substitution.

1. Bentonite Sealant: Trowel grade sodium bentonite compound used as a detailing mastic around penetrations, corner transitions and grade terminations.
2. Bentonite Tubes: 2” diameter x 2’ long, water soluble tube container filled with granular sodium bentonite.
3. Granular sodium bentonite.
4. Seam Tape: 2” wide butyl rubber sealant tape.
5. Termination Bar: Min. 1” wide aluminum bar with pre-punched holes on 12” centering for fastening.

D. Prefabricated Drainage Composite

1. Vertical: Aquadrain 15XP - 4-ft by 52-ft roll of a three-dimensional polypropylene drainage core with a nonwoven geotextile adhered to one side to allow water passage while restricting soil particles. Composite includes a thin polyethylene sheet on the back of the drainage core.

a. Compressive Strength: 15,000 psf
b. Water Flow Rate: 20 gpm/ft
c. Thickness: 7/16”

E. Deck Sub-Surface Drainage

1. Horizontal: Aquadrain 20H - 4-ft by 52-ft roll of a three-dimensional polypropylene drainage core with a nonwoven geotextile adhered to one side to allow water passage while restricting soil particles.

a. Compressive Strength: 21,000 psf
b. Flow Rate: 18 gpm/ft.
c. Thickness: 7/16”

PART 3 – EXECUTION

3.1 SUBSTRATE INSPECTION AND CONDITIONS

A. The installer shall examine conditions of substrates and other conditions under which this section work is to be performed and notify the contractor, in writing, of circumstances detrimental to the proper completion of the work. Do not proceed with work until unsatisfactory conditions are corrected and are acceptable for compliance with manufacturer's warranty requirements. General substrate conditions acceptable for the waterproofing installation are listed below. For conditions not covered in this Section, contact the waterproofing manufacturer for guidance.
B. Concrete Walls: Cast-in-place concrete to receive waterproofing shall be of sound structural grade with a smooth finish, free of debris, oil, grease, laitance, dirt, dust, or other foreign matter which will impair the performance of the waterproofing and drainage system and which do not comply with manufacturer's warranty requirements.

1. Form fins, ridges, and other protrusions shall be level and smooth with monolithic concrete surface. Honeycombing, aggregate pockets, tie-rod holes and other voids shall be completely filled with non-shrink cementitious grout and level with monolithic concrete wall surface.

C. Gravel Sub-Grade: Aggregate sub-grades shall consist of 3/4” stone or smaller and be rolled flat, free from any protruding sharp edges.
D. Mechanical Or Other Penetrations: Mechanical, structural, or architectural materials that will pass through the plane of the waterproofing membrane shall be properly installed and secured in their final position prior to installation of the waterproofing system.

3.2 SURFACE PREPARATION

A. Remove dirt, debris, oil, grease, cement laitance, or other foreign matter which will impair or negatively affect the performance of the waterproofing and drainage system.
B. Protect adjacent work areas and finish surfaces from damage or contamination from waterproofing products during installation operations.

3.3 GENERAL INSTALLATION GUIDELINES

A. Comply with contract documents and manufacturer's product data, including product application and installation instructions.
B. Prevent bentonite waterproofing products from hydrating before material is contained with backfill or concrete. When threat of rain is imminent, installed bentonite products not already contained by backfill should be covered with polyethylene sheeting to decrease the chance of hydration. Remove polyethylene prior to overburden or backfill operations. After any

precipitation, standing water should be pumped away from waterproofing as soon as possible.

3.4 BENTONITE PANEL INSTALLATION

A. Use Type 1 Panels or Type 1-C Panels (one-side coated).
B. Trowel Bentonite sealant over all concrete construction joints 1/8” thick by 3” wide. Form Tie holes or recesses shall be completely filled with non-shrink cementitious grout. Trowel bentonite sealant 1/8" thick over each grouted form tie hole.
C. Trowel 3/4" continuous fillet of bentonite sealant in all inside corner transitions.
D. Install bentonite panels with the printed side facing installer and the print oriented horizontally. Turn Panel with print vertically oriented when transitioning around inside and outside wall corners.
E. Starting at a wall base corner, bend Volclay Panel along 1/3 panel "Starter Line" (printed on panel) and install with the kraft board corrugations and print vertically oriented. Cut the Panel at the bottom edge of the "Starter Line" so that the Panel can be extended 6" onto the footing. Secure Panels with washer-head fasteners along each edge. After installing corner Panel, install all succeeding Panels with kraft board corrugations and print horizontally oriented - continuing Panel onto footing minimum 6". Overlap all adjoining edges minimum 1-1/2". When applicable, the base Panel course shall overlap the underslab waterproofing a minimum 6" to form a continuous waterproofing layer.
F. Stagger vertical Panel overlap joints of succeeding courses by folding the next courses corner Panel on the 2/3 panel "Lap Line" (printed on panel) and install overlapping lower Panel course minimum 1-1/2”. After installing corner Panel, install all succeeding Panels with kraft board corrugations and print horizontally oriented - overlapping adjoining edges minimum 1-1/2".
G. Penetration: On flat surface cut Panel to fit around penetration. Immediately seal cut Panel edge by applying water with cloth or sponge prior to panel installation. After Panel is installed around penetration, trowel 3/4" thick fillet of bentonite sealant around the penetration and extending onto Panel 1-1/2" at a 1/8” minimum thickness.

    1. Multiple Penetrations: Trowel 1/2" thick layer of bentonite sealant covering entire area between penetrations and extend layer outside of penetration area minimum 3" to allow Panels to overlap. At base of each penetration apply 3/4" fillet of bentonite sealant over the main bentonite sealant layer. Cut Panels and overlap bentonite sealant layer a minimum 1-1/2".

H. Continue Panels up to grade line. Terminate Panels at grade under a 12" wide strip of UV resistant flashing secured with a rigid termination bar fastened 12" on center. Seal top edge of termination detail with UV resistant caulk. Consult manufacturer’s representative or manufacturer when special conditions exist.
I. Repair any small Panel damage by applying a 1/2” thick layer of Bentonite sealant. Repair any large Panel damage by placing a new panel into position.

3.5 BENTONITE GEOTEXTILE WATERPROOFING MEMBRANE INSTALLATION

A. Place geotextile directly on properly prepared substrate (white geotextile side down; dark gray geotextile side up facing installer) with adjoining edges overlapped a minimum of 4”. Stagger sheet end seams a minimum of 24”. Mechanically fasten or staple geotextile membrane as required to prevent movement from construction operations or concrete placement. When the slab is poured in sections, extend geotextile a minimum 12" beyond the slab edge to enable proper overlapping.
B. Install waterproofing system where shown on drawings in accordance with manufacturer’s detail for specific project condition(s).
C. Slab Penetrations: For all pipe, rebar, structural or other penetrations install waterproofing system in accordance with manufacturer’s standard detail for specific project condition(s).
D. Inspect finished geotextile installation and repair any damaged material prior to concrete slab placement.

E. Before placing concrete, lay bentonite tubes against the inside face of the wall at the wall/footing transition. Bentonite tubes should be positioned end-to-end forming a continuous line. Manually place a shovel of concrete over bentonite tubes to hold them in position prior to main concreting operation.

3.6 PREFABRICATED DRAINAGE COMPOSITE INSTALLATION

A. Vertical

1. Install the bottom course of Aquadrain 15XP sheet drainage (plastic core side against the wall) with the 15XP bottom core edge in contact with the footing. Secure sheet drain to wall with washer-head fasteners.
2. Install subsequent courses of Aquadrain 15XP sheet drainage in a shingle overlap style to finished grade or as shown on the project drawings. Prior to subsequent course, seal top and side core edges by tucking the products extra fabric edge flap behind the core before securing with washer-head fasteners. Install drainage sheet panels overlapped, bottom edge of higher course installed to the outside of the lower course to shed water like a roof shingle. Seal all outward overlap core edges by securing extra fabric flap with tape or general construction adhesive to filter fabric of previously installed sheet.
3. Around penetrations and other details, cut sheet drainage composite to fit and wrap extra filter fabric around open core edge to prevent soil from entering core.
4. At the top of the sheet drain installation, wrap the filter fabric flap behind the exposed top core edge to prevent intrusion of soil into the core and secure sheet drain to wall with termination bar fastened 12" on center.

3.7 BACKFILL EXCAVATED CAST-IN-PLACE CONCRETE WALLS

A. Care should be used during backfill operation to avoid damage to the waterproofing system. Follow generally accepted practices for backfilling and compaction. Backfill should be added in 6" to 12" lifts and compacted to a minimum 85% Modified Proctor density. Protection course required with gravel backfill. Limit gravel backfill to <3/4” angular aggregate with fines.

3.8 CLEAN UP

A. Clean areas where adjacent finished surfaces are soiled by work of this Section. Remove all tools, equipment and remaining product on-site. Dispose of section work debris and damaged product following all applicable regulations.

END OF SECTION 071700

SECTION 07 18 13-PEDESTRIAN COATING SYSTEM

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Provide a complete polyurethane waterproofing coating system where indicated on the Drawings, including all applicable sealants and elastomeric flashings needed to ensure a complete waterproof and weathertight system for deck, ramp, stair and landing surfaces at locations indicated.

B. Related work:

1. Documents affecting work of this Section include, but are not necessarily limited to, General Conditions, Supplementary Conditions, and Sections in Division 1 of these Specifications.

1.02 SUBMITTALS

A. Comply with pertinent provisions of Section 013300.

B. Product data:

1. Materials list of items proposed to be provided under this Section;
2. Manufacturer's specifications and other data needed to prove compliance with the specified requirements;
3. Shop Drawings or catalog illustrations in sufficient detail to show installation and interface of the work of this Section with the work of adjacent trades;
4. Manufacturer's current recommended installation procedures which, when reviewed by Architect, will become the basis for accepting or rejecting actual installation procedures used on the Work.
5. Written documentation of applicator's qualifications, including reference projects of similar scope and complexity, with current phone contacts of architects and owners for verification.

1.03 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen thoroughly trained and experienced in the necessary crafts and completely familiar with the specified requirements and methods needed for proper performance of the work of this Section.

B. Applicator qualifications:

1. Applicator shall have at least three years experience in installing materials of types specified and shall have successfully completed at least three projects of similar scope and complexity.
2. Applicator shall designate a single individual as project foreman who shall be on site at all times during installation.

C. Convene a pre-installation job-site conference four weeks prior to commencing work of this Section:

1. Secure attendance by Architect, Contractor, applicator, and authorized representatives of the coating system manufacturer and interfacing trades.
2. Examine Drawings and Specifications affecting work of this Section, verify all conditions, review installation procedures, and coordinate scheduling with interfacing portions of the Work.

1.04 DELIVERY, STORAGE AND HANDLING

A. Deliver materials to job site in manufacturer's unopened containers with all labels intact and legible at time of use.
B. Maintain the products in accord with manufacturer's recommendations with proper precautions to ensure fitness of material when installed.
C. Comply with pertinent provisions of Section 01660.

1.05 SUBSTRATE CONDITIONS

A. General:
   1. Provide applicator with surfaces that are broom clean, dry, sound and free of voids, bugholes, rockpockets, honeycombs, protrusions, excessive roughness, foreign matter, frost, ice and other contaminants which may inhibit application or performance of the waterproofing coating system.
   2. Using suitable abrasive methods, remove residue of form release, curing compound, chemical retarders and other surface treatments, laitance, mortar smear, sawcutting residue, mill scale, rust, loose material and other contaminants from concrete, masonry and ferrous metal surfaces to receive the work of this Section.
B. Concrete: Where work of this Section will be applied to concrete, provide surfaces that are smooth with finish equal to one that is light steel troweled followed by a fine hair broom.
C. Plywood: Where work of this Section will be applied to plywood, provide exterior grade plywood, 5/8" thick minimum, with A-side up, fastened with ring-shank nails. Install blocking under all four edges to support plywood.
D. Decks:
   1. Slope deck surfaces to drains that have flanges at coating level which are flush with deck surfaces.
   2. Rigidly install pipe, vents and other surface protrusions, properly flash them, and cover to prevent entry of coating materials.
E. Metal flashings: Where metal flashings are substrate to waterproofing coating, set the flashings in continuous bedding bead of urethane sealant; install sealant S-bead between metal laps and mechanically fasten to substrate along leading edges at every 4" on center, staggered linearly, to lay flat without fishmouths.
F. Joints: Configuration shall be consistent with this Section and with all other requirements of the Contract Documents.

1.06 WARRANTY

A. Deliver to the Architect signed copies of the following written warranties against defective materials and workmanship for a period of two years following date of completion. Warrant that installed waterproof coating system shall be free of defects including adhesive failure, cohesive failure, weathering deficiencies and waterproofing failure resulting from substrate cracking up to 1/16 inch.
   1. Manufacturer's standard warranty covering materials;
   2. Applicator's standard warranty covering workmanship.

PART 2 PRODUCTS

NOTE: All Products Must Meet Sustainable Products Criteria:
   1. Provide all documentation as defined in 1.2.6
   2. All materials must meet the pertinent VOC levels as defined below:
      a. Membranes, coatings and their associated primers must be below 100 g/L unless supplied in < 1 gallon containers.
      b. Sealants must be below 4% by weight if supplied in less than 16 oz. package size or below 250g/L if supplied in greater than 16 oz. size.
      c. All non-porous sealant primers must be below 250g/L and primers for porous substrates less than 775 g/L.

2.01 GENERAL

A. Provide a complete liquid applied polyurethane waterproofing coating system having the following minimum attributes:
   1. System designed for waterproofing decks subject to pedestrian traffic;
   2. Complying with ASTM C957-91 and having a Class A fire rating on concrete substrates.
   3. Color to be selected by Architect from manufacturer's standard color range.
   4. Acceptable products:
      Vulkem 360NF/951NF uv exposed areas – (or approved equal)

2.02 ACCESSORIES

A. Primer: As recommended by coating system manufacturer.
B. Joint backing: Closed-cell, polyethylene rod as recommended by coating manufacturer.
C. Aggregate: 40-50 mesh silica sand; local aggregate approved by coating manufacturer
D. Sealant:
   1. Dymeric 240-FC
   2. Vulkem 227

2.03 OTHER MATERIALS

A. Provide other materials, not specifically described but required for a complete and proper installation, as selected by the Contractor and approved by the coating system manufacturer as compatible, subject to review of the Architect.

PART 3 EXECUTION

3.01 SURFACE CONDITIONS

A. Coordinate as required with other trades to assure proper and adequate provision in the work of those trades for interface with the work of this Section.
B. Applicator shall examine the areas and conditions under which work of this Section will be performed.
   1. Verify conformance with manufacturer's requirements;
   2. Report unsatisfactory conditions in writing to the Architect;
   3. Do not proceed until unsatisfactory conditions are corrected.

3.02 PREPARATION

A. Surface preparation and detailing procedures to be in accord with waterproof coating system manufacturer's instructions and recommendations except where more stringent requirements are indicated.
B. Clean all deck surfaces to receive coating system in accord with manufacturer's instructions; vacuum clean or blow clean with oil-free compressed air all surfaces to receive sealants, detailing materials or coatings immediately prior to installation.
C. Rout, clean, prepare and detail surface cracks in accord with manufacturer's instructions; install backer rod where required.
D. Clean metal surfaces to bright metal by wire brushing or mechanical etching; scuff-sand lead flashing and plastic surfaces.
E. Prime surfaces in accord with manufacturer's instructions.
F. Install 1/4" diameter backer rod into corner of all horizontal-to-vertical junctures subject to movement and cover with 1" detail cant of approved sealant; install 1" detail cants at projections, curbs and other horizontal-to-vertical junctures.
G. Install detail coats, joint and crack treatments, and liquid flashings in accord with manufacturer's instructions.
H. Allow detail applications to cure in accord with manufacturer's instructions prior to general application of coating.

3.03 APPLICATION

A. Install waterproof coating system in accord with manufacturer's recommendations and instructions as applies to the Work except where more stringent requirements are indicated.
   1. Grid deck surfaces to assure proper coverage rates and verify coating wet-film mil thickness with gauges as work progresses.
   2. Retain empty product containers during course of work to aid in determining whether completed coating system complies with manufacturers average thickness requirements.
B. Verify proper dry condition of substrate using method recommended by coating system manufacturer; perform adhesion checks prior to general application of coating system using field adhesion test method recommended by manufacturer.
C. Mask off adjoining surfaces not to receive coating system.

D. Wipe clean all detail coats with white rags wetted with Xylene solvent; do not saturate detail coat.
E. Apply coating base coat uniformly and allow to cure in accord with manufacturer's instructions.
F. Feather edge when entire area cannot be completed in one day; clean area 6" wide along edge of coating with Xylene solvent on clean white rags prior to startup on next working day; use interlaminary primer per manufacturer's instructions as needed; overlap existing work by 6" with new work.
G. Apply coating system finish coat in accord with manufacturer's instructions.
   1. Immediately broadcast aggregate into wet material at rate recommended by manufacturer and backroll to evenly distribute and totally encapsulate.
   2. Allow to cure per manufacturer's instructions.

3.04 PROTECTION AND CLEAN-UP

A. Promptly remove primer or coating material from adjacent surfaces with MEK, Toluene or Xylene; leave work area in broom clean condition.
B. Allow completed Work to cure 24 hours before opening to pedestrian traffic.

END OF SECTION 07 18 13

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SECTION 072100 – THERMAL INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. General: Provide all labor, material, equipment, related services and supervision required, including manufacturing, fabrication, erection and installation for building insulation in accordance with the requirement of the Contract Documents.

B. This Section includes the following:

1. Foundation wall insulation (supporting backfill).

2. Concealed building insulation.

3. Perimeter edges of slab fire-containment systems.

4. Spray-applied Insulation.

5. Roof Insulation.

C. Related Sections include the following:

1. Division 7, Section 075419 – POLYVINYL-CHLORIDE (PVC) ROOFING for insulation specified as part of roofing construction.

2. Division 7, Section 074113.16 -STANDING SEAM METAL ROOF PANELS for insulation specified as part of metal roofing construction.

3. Division 9, Section 092116 - GYPSUM BOARD ASSEMBLIES for insulation installed in metal-framed assemblies of insulation specified by reference to this section.

1.3 DEFINITIONS

A. Thermal Resistivity: Where the thermal resistivity of insulation products are designated by r-values, they represent the reciprocal of thermal conductivity (k-values). Thermal conductivity is the rate of heat flow through a homogenous material 1 inch thick. Thermal resistivities are expressed by the temperature difference in degrees F between the two exposed faces required to cause one BTU to flow through one square foot per hour at mean temperatures indicated.

1.4 SYSTEM DESCRIPTION

A. Design Requirements: All components of assemblies requiring a fire resistive rating shall be from a single manufacturer. All insulating materials shall be Class A.

1.5 SUBMITTALS

A. Product Data: For each type of product specified.

B. Samples for Verification: 6 inch by 6 inch square samples for each type of insulation. Wrap samples with clear plastic and attach permanent labels.

C. Quality Control:

1. Design Data: Provide insulation materials identical to those whose indicated fire performance characteristics have been determined per the ASTM test method indicated below, by UL or other testing and inspecting organizations acceptable to authorities having jurisdiction. Identify products with appropriate markings of applicable testing and inspecting organization.

a. Surface Burning Characteristic: ASTM E 84.
b. Fire Resistance Ratings: ASTM E 119.
c. Combustion Characteristics: ASTM E 136.
d. Insulation Board, Polyisocynurate: FSHH-I-1972.

2. Test Reports: Provided by a qualified independent testing laboratory evidencing compliance of insulation products with requirements including r-values (aged values for plastic foam insulations), fire performance characteristics, perm ratings, water absorption ratings, and other properties, based on comprehensive testing of current products.

a. Research/Evaluation Reports: For plastic insulation.

1.6 QUALITY ASSURANCE

A. Contractor's Quality Assurance Responsibilities: Contractor is solely responsible for quality control of the work.

B. Manufacturer's Qualifications: Firms shall be engaged in the manufacture of insulation of types and sizes required, and whose products have been in satisfactory use in similar service for not less than 10 years.

C. Installer's Qualifications: Firms shall have at least 5 years of successful installation experience with projects utilizing products similar to that required for this project.

D. Regulatory Requirements: Comply with applicable requirements of the laws, codes, ordinances and regulations of Federal, State and Municipal authorities having jurisdiction. Obtain necessary approvals from all such authorities.

1. Research reports or evaluation reports of the model code organization acceptable to authorities having jurisdiction that evidence compliance of plastic foam insulations with building code in effect for Project.

2. Fire Classification, ASTM E 108.

E. Single-Source Responsibility: Obtain each type of building insulation from a single manufacturer.

1.7 DELIVERY, STORAGE, AND HANDLING

A. General: Deliver and store materials in manufacturer's original packaging labeled to show name, brand, type, and grade. Store materials in protected dry location off ground in accordance with manufacturer's instructions. Do not open packaging nor remove labels until time for installation.

B. Protection from Deterioration: Do not allow insulation to become wet, soiled, or covered with ice or snow. Protect insulation from exposure to high temperatures, excessive exposure to sunlight, and contact with hot surfaces in excess of the safe temperature indicated by the manufacturer.

1. Protect plastic insulation as follows:

a. Do not expose to sunlight, except to extent necessary for period of installation and concealment.
b. Protect against ignition at all times.

1.8 PROJECT CONDITIONS

A. Weather Conditions: Do not proceed with the work during inclement weather nor when weather forecasts are unfavorable, unless the work will proceed in accordance with the manufacturer's requirements and instructions and any agreements or restrictions of the Pre-Installation Conference.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General: Provide insulating materials that comply with requirements and with referenced standards.

1. Preformed Units: Sizes to fit applications indicated; selected from manufacturer's standard thicknesses, widths, and lengths.

B. Extruded-Polystyrene Board Insulation: ASTM C 578, of type and density indicated below, with maximum flame-spread and smoke-developed indices of 75 and 450, respectively. Type IV, 1.60 lb/cu. ft. 5 year aged R-value of 5.0 at 75 degrees F.

1. Acceptable Products and Manufacturers

a. Square Edge (25 psi), Dow Chemical Company.
b. Foamular 250, Owens Corning.
c. Amofoam-CM, PACTIV (Tenneco Building Products).

C. Glass-Fiber Batt Insulation (Unfaced): ASTM C 553, Type I; with maximum flame-spread and smoke-developed indices of 25 and 50, respectively; and of the following properties:

1. Nominal density of not less than 1.5 lb/cu. ft. nor more than 1.7 lb/cu. ft., thermal resistivity of 4.13 deg F x h x sq. ft./Btu x in. at 75 deg F.

2. Combustion Characteristics: Passes ASTM E 136.

3. Acceptable Products and Manufacturers:

a. AcoustaTherm Batts (Unfaced), CertaPro, CertainTeed Corporation.
b. Thermal Batt (Unfaced), Owens Corning.
c. Thermal-Shield (Unfaced), Johns Manville.

D. Glass-Fiber Semi-Rigid Board Insulation: ASTM C 612, Type IA or Types IA and IB; with maximum flame-spread and smoke-developed indices of 25 and 50, respectively; and of the following properties:

1. Nominal density of 3 lb/cu. ft., thermal resistivity of 4.3 deg F x h x sq. ft./Btu x in. at 75 deg F.

2. Acceptable Products and Manufacturers (Unfaced):

a. CB300 (Unfaced), CertaPro Commercial Board, CertainTeed Corporation.
b. Type 703 (Unfaced), Series 700 Insulation, Owens Corning.
c. Insul-Shield 300 (Unfaced), Johns Manville.

3. Acceptable Products and Manufacturers (Foil Faced): Faced on one side with foil-scrim-kraft vapor retarder.

a. CB300 (FSK-Foil Scrim Kraft), CertaPro Commercial Board, CertainTeed Corporation.
b. Type 703 (FRK-Faced), Series 700 Insulation, Owens Corning.
c. Insul-Shield 300 (FSK-Faced), Johns Manville.

E. Slag-Wool-/Rock-Wool-Fiber Board Insulation (Foil-Faced): ASTM C 612; faced on one side with foil-scrim-kraft vapor retarder; maximum flame-spread and smoke-developed indices of 25 and 5, respectively; and of the following density, type and thermal resistivity:

1. Nominal density of 8 lb/cu. ft., Types IA and IB, thermal resistivity of 4 deg F x h x sq. ft./Btu x in. at 75 deg F.

2. Fiber Color: Regular color.

3. Acceptable Products and Manufacturers (Foil Faced): Faced on one side with foil-scrim-kraft vapor retarder.

   a. CW8 (FSK Faced), Curtainwall Insulation-MW, Owens Corning.
   b. CW90 (Foil Faced), Thermafiber Curtain Wall Insulation, United States Gypsum Company.

F. Sound Attenuation Blankets: ASTM C665, Type 1 and ASTM E136 unfaced with maximum flame-spread 25 and smoke-developed 50, respectively.

1. Acceptable Products and Manufacturer (Unfaced):

   a. AcoustaTherm Batts (Unfaced), CertaPro, CertainTeed Corporation.
   b. Sound Attenuation Batt Insulation (Unfaced), Owens Corning.
   c. Sound-Shield (Unfaced), Johns Manville.

G. Rock Wool Fiber Safing Insulation: Flexible batts, in thicknesses as required. ASTM C665 Type 1 and ASTM E136 with water-resistant binders, density 4 pcf. Maximum flame spread 15 and smoke-developed 0, respectively.

1. Acceptable Products and Manufacturers (Unfaced):

   a. Thermafiber Safing Insulation, United States Gypsum Company.
   b. Safing Insulation - MW, Owens Corning.

2. Acceptable Products and Manufacturers (Foil Faced): Faced on one side with foil-scrim-kraft vapor retarder.

   a. Thermafiber Safing Insulation (Foil Faced), United States Gypsum Company.
   b. Safing Insulation MW-(FSK-Foil Scrim Kraft), Owens Corning.

H. Perimeter Fire-Containment Systems: Where indicated for space between the perimeter edge of fire-resistance-rated floor assemblies and non-fire-resistance-rated exterior walls, provide a perimeter fire-containment system with the fire-test-response characteristics indicated, as determined by testing identical systems per UBC Standard 26-9 and UL 2079 by UL or another testing and inspecting agency acceptable to authorities having jurisdiction. Materials shall be identified with appropriate markings of applicable testing and inspecting agency.

1. Acceptable Products and Manufacturers:

   a. Gypsum Sheathing Curtain Wall Fire Containment System (UL Des. CW-S-1001) 2-hour, United States Gypsum Company.

I. Rigid Polyisocyanurate Roof Insulation

1. Acceptable Products and Manuacturers:

   a. E'NRG'Y – 2 By NRG Barriers, Inc.
   b. Ultra Gard Gold II by Schuller Roofing Systems.
   c. GAFTEMP Isotherm R by GAF.
   d. Approved Equivalent.

2. Qualities: Rigid, closed cell polyisocyanurate foam core bonded to heavy duty glass fiber mat facers.

   a. Thickness: 2.7 in.
   b. R-Value: Minimum 21.0.

3. Insulation board shall meet the following requirements

   a. UL, WH or FM listed under Roofing Systems.
   b. Federal Specification HH-I-1972, Class 1.

4. Physical Properties

Dimensional Stability	ASTM D-2126	2% max.
Compressive Strength	ASTM D-1621	25 psi min.
Vapor Permeability	ASTM E-96	1 perm max.
Foam Core Density	ASTM D-1622	2.0 pcf min.
Water Absorption	ASTM C-209	<1%
R-Factor HR per inch Thickness	ASTM C-518	5.6 (Design Value)

J. Perlite Roof Insulation

1. Acceptable Products and Manufacturers:

   a. Celotex
   b. Manville
   c. GAF Building Materials Corporation
   d. Approved Equivalent

2. Qualities: Rigid, Perlite insulation board, uncoated.

   a. Board Size: 2' x 4'
   b. Thickness: Minimum ½ in.

3. Insulation board shall meet the following requirements

   a. UL, WH, FM listed under Roofing Systems.
   b. Federal Specification HH-I-529-B.

4. Physical Properties

Dry Density	ASTM C-208	9 min.
Compressive Resistance	ASTM C-165	35 psi min.
Dimensional Stability	ASTM C-209	0.5% max.
Foam Core Density	ASTM C-1622	2.0 pcf min.
Water Absorption	ASTM C-208	1.5 max.

K. Tapered Perlite Roof Insulation

1. Acceptable Products and Manufacturers:

   a. Celotex
   b. Manville
   c. GAF Building Materials Corporation
   d. Approved Equivalent

2. Qualities: Rigid, Factory tapered perlite insulation board, uncoated.

   a. Taper Thickness: Minimum ½ in. at low points.
   b. Tapered Slope: 1/4 in per foot.
   c. Average R-Value: Minimum 5.56.

3. Insulation board shall meet the following requirements

   a. UL, WH, FM listed under following requirements
   b. Federal Specification HH-I-529-B.

4. Physical Properties

Dry Density	ASTM C-208	9 min.
Compressive Resistance	ASTM C-165	35 psi min.
Dimensional Stability	ASTM C-209	0.5% max.
Water Absorption	ASTM C-208	1.5 max.
R-Factor HR per inch Thickness	ASTM C-518	2.78 (Design Value)

5. Provide preformed saddles, crickets, tapered edge strips, and other insulation shapes where indicated for sloping to drain. Fabricate to slopes indicated or if not indicated, to appropriate slopes in order to maintain not less than a ¼" per foot slope.

L. Spray-Applied Insulation

1. Acceptable Products and Manufacturers:

   a. International Cellulose Corporation; K-13, color to be chosen from manufacturer's standard.

2. Apply at minimum thickness to provide R value of 11.

3. Comply with ASTM E-736 for field-tested bond strength; tested @ > 5 years:
   a. Not less than 400 psf
   b. Not less than 600 times it weight @ 1"

4. Comply with ASTM E-84/U.L. 723, Tested at a minimum of 5" thickness Class I, Class A
   Flame Spread: 5
   Smoke Development: 5

5. Comply with ASTM E-1042.

6. Non-corrosive per UMB-80.

7. Bond Deflection per ASTM E-759**:** 6" Deflection in 10' Span
   No Spalling or Delamination.

8. Cohesive Strength at time of application per Method WS-2000: >700 Grams.

2.2 ACCESSORIES

A. Adhesive for Bonding Insulation: Product with demonstrated capability to bond insulation securely to substrates indicated without damaging insulation and substrates.

B. Protection Board: Premolded, semirigid asphalt/fiber composition board, 1/4 inch thick, formed under heat and pressure, of standard sizes.

C. Safing Clips: Manufactured impaling 'Z' clips for support of safing insulation in tested edge of slab fire-containment systems on where safing is indicated.

D. Firestop Compound: Manufacturer's standard product for topping over safing insulation in tested edge of slab fire-containment systems.

1. Acceptable Products and Manufacturers:

a. Smoke Seal Compound and Fire Code Compound, United States Gypsum Company.

E. Supports and Anchors for Insulation: Provide type shown and as recommended by insulation manufacturer. Provide galvanized steel skewers or mechanically attached clips as recommended by the insulation manufacturer when insulation is applied to metal construction or concrete. Skewers not required for masonry cavity insulation and foundation insulation. Provide mechanically attached galvanized steel skewers or clips as recommended by the insulation manufacturer and when required to conform to published fire-rated assemblies as tested.

1. Factory Mutual Tested and Approved with 3 inch coated disc for 1-90 rating, length required to penetrate metal deck one inch.

2. Minimum pull out resistance of 800 lbs.

F. Adhesive-Applied Clips: Metal clips consisting of square, perforated, galvanized steel base plate and prong. Provide accessories and adhesive as recommended by manufacturer for the intended application. Do not use for fire-rated assemblies.

1. Acceptable Products and Manufacturers:

a. Series T TACTOO Insul-Hangers, AGM Industries.
b. Spindle Type, Gemco.
c. Stic-Klip Type N Eckel Industries Inc.

G. Fiber Cant and Tapered Edge Strips: Preformed insulation units of sizes/shapes indicated, matching insulation board or of perlite or organic fiberboard, as per the approved manufacturer.

1. Acceptable Manufacturers

a. The Garland Company, Inc.
b. Celotex
c. Schuller Roofing Systems
d. International Permalite, Inc.
e. Approved Equivalent.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for Sections in which substrates and related work are specified and other conditions affecting performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean substrates of substances harmful to insulations, including removing projections capable of puncturing vapor retarders or of interfering with insulation attachment.

B. Close off openings in cavities receiving poured-in-place insulation to prevent escape of insulation. Provide bronze or stainless-steel screens (inside) where openings must be maintained for drainage or ventilation.

C. For Spray-Applied Insulation:

1. Provide masking, drop cloths or other satisfactory coverings for materials/surfaces that are not to receive insulation to prevent damage from over-spray.
2. Coordinate installation of the sprayed cellulose fiber with work of other trades.
3. Prime surfaces as required by manufacturer’s instructions or as determined by examination.

3.3 INSTALLATION

A. Comply with insulation manufacturer's written instructions applicable to products and application indicated. If printed instructions are not available or do not apply to project conditions, consult manufacturer’s technical representative for specific recommendations before proceeding with installation of insulation.

B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed at any time to ice, snow or water.

C. Extend insulation in thickness indicated to envelop entire area to be insulated. Cut and fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.

D. Water-Piping Coordination: If water piping is located on inside of insulated exterior walls, coordinate location of piping to ensure that it is placed on warm side of insulation and insulation encapsulates piping.

E. Apply single layer of insulation to produce thickness indicated, unless multiple layers are otherwise shown or required to make up total thickness.

F. Installation of Perimeter and Under-Slab Insulation:

1. Protect below-grade insulation on vertical surfaces from damage during backfilling by applying protection board. Set in adhesive according to insulation manufacturer's written instructions.

2. Protect top surface of horizontal insulation from damage during concrete work by applying protection board.

G. Installation of General Building Insulation:

1. Apply insulation units to substrates, complying with manufacturer's written instructions. If no specific method is indicated, use mechanical anchorage to provide permanent placement and support of units.

2. Install mineral-fiber blankets in cavities formed by framing members according to the following requirements:

a. Use blanket widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill cavity, provide lengths that will produce a snug fit between ends.

b. Place blankets in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.

c. For metal-framed wall cavities where cavity heights exceed 96 inches, support unfaced blankets mechanically and support faced blankets by taping stapling flanges to flanges of metal studs.

H. Install board insulation in curtain-wall construction where indicated on drawings according to curtain-wall manufacturer’s written instructions.

I. Installation of Perimeter Edge of Slab Fire-Containment Systems: Install perimeter fire-containment systems to fill gap between edge of concrete floor slab and back of exterior curtain-wall systems to comply with fire-containment system manufacturer’s written instructions to produce installations with ratings matching those established during fire-test-response testing.

J. Attachment with Mechanical Fasteners (Metal Deck):

1. Approved insulation board shall be fully attached to the deck with an approved mechanical fastening system. As a minimum, the amount of fasteners shall be in accordance with manufacturer’s recommendation for FM 1-90 approved system. Otherwise, a minimum of one fastener per two square feet shall be installed.

2. Filler pieces of insulation require at least two fasteners per piece if size of insulation is less than four square feet.

3. Minimum penetration into deck shall be as recommended by the fastener manufacturer. There is a one inch (1”) minimum for metal.

3.4 ADJUSTING, CLEANING, AND PROTECTION

A. Upon completion of the work, repair surfaces that have been permanently stained, marred, or otherwise damaged. Replace work which is damaged or cannot be adequately cleaned as directed.

B. Upon completion of the work, remove unused materials, debris, containers and equipment from the project site. In addition to the initial cleaning procedure required, and before acceptance by the Owner, clean the work as recommended by the manufacturer.

C. Protect the work during the construction period so that it will be without any indication of use or damage at the time of acceptance.

1. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

END OF SECTION 072100

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SECTION 074113.16 – STANDING SEAM ROOF PANELS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this section.

1.2 SUMMARY

A. Work Included: Provide metal standing seam roofing system where shown on the Drawings, as specified herein, and as needed for a complete and proper installation, including but not necessarily limited to:

a. Prefabricated roof sheets:

b. Clips, cleats, anchors, and fasteners;

c. Flashing and gutters directly related to the metal standing seam roof;

d. Ice and water shield.

1.3 PERFORMANCE REQUIREMENTS

A. General: Provide manufactured roof panel assemblies complying with performance requirements indicated and capable of withstanding structural movement, thermally induced movement, and exposure to weather without failure or infiltration of water into the building interior.

B. Air Infiltration: Provide manufactured roof panel assemblies with permanent resistance to air leakage through assembly of not more than 0.09 cfm/sq. ft. of fixed roof area when tested according to ASTM E1680 at a static-air-pressure difference of 4.0 lbf/sq. ft.

C. Water Penetration: Provide manufactured roof panel assemblies with no water penetration as defined in the test method when tested according to ASTM E1646 at a minimum differential pressure of 20 percent of inward acting, wind-load design pressure of not less than 6.24 lb./sq. ft. and not more than 12.0 lb./sq. ft.

D. Wind-Uplift Resistance: Provide roof panel assemblies that meet requirements of Factory Mutual and are classified with a 1A-90 rating.

1.4 SUBMITTALS

A. Product Data: Include manufacturer's product specifications, standard details, certified product test results, and general recommendations, as applicable to materials and finishes for each component and for total panel assemblies.

B. Shop Drawings: Show layouts of panels on roofs, detail of edge conditions, joints, panel profiles, supports, anchorage, trim, flashing, underlayment, closures, snow guards, and special details. Distinguish between factory- and field-assembled work.

C. Samples for Verification: Provide sample panels 12 inches long by actual panel width, in the profile, style, color, and texture indicated. Include clips, caps, battens, fasteners, closures, and other exposed panel accessories.

D. Product Test Reports: Indicate compliance of manufactured roof panel assemblies and materials with performance and other requirements based on comprehensive testing of current products.

E. Calculations: Submit calculations with registered engineer seal, verifying roof panels and attachment methods resist loads as shown on drawings.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experienced installer certified by the roofing manufacturer with a minimum of five (5) years experience in the installation of metal roof panel projects similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance.

B. Testing Agency Qualifications: An independent testing agency with the experience and capability to conduct the testing indicated without delaying the Work, as documented according to ASTM E699.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver panels and other components so they will not be damaged or deformed. Package panels for protection against damage during transportation or handling.

B. Handling: Exercise care in unloading, storing, and erecting roof panels to prevent bending, warping, twisting, and surface damage.

C. Stack materials on platforms or pallets, covered with tarpaulins or other suitable weathertight and ventilated covering. Store panels to ensure dryness. Do not store panels in contact with other materials that might cause staining, denting, or other surface damage.

1.7 PROJECT CONDITIONS

A. Field Measurements: Verify location of structural members and openings in substrates by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1.8 WARRANTY

A. General Warranty: Special warranties specified in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.

B. Special Finish Warranty: Submit a written warranty, signed by manufacturer, covering failure of the factory-applied exterior finish on metal roof panels within the specified warranty period and agreeing to repair finish or replace roof panels that show evidence of finish deterioration. Deterioration of finish includes, but is not limited to, color fade, chalking, cracking, peeling, and loss of film integrity.

C. Finish Warranty Period: 20 years from date of Substantial Completion.

D. Special Weathertight Warranty: Submit a written warranty executed by manufacturer agreeing to repair or replace metal roof panel assembly that fails to remain weathertight within the specified warranty period.

E. Weathertight Warranty Period: 20 years from date of Substantial Completion.

F. Structural Warranty: Submit a written warranty executed by manufacturer agreeing to repair or replace metal roof panel assembly that fails to withstand wind loads as shown on drawings.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis of Design: the new metal roof system shall be: Cee-lock standing seam roof system as manufactured by Berridge Manufacturing Co., 1720 Maury St., Houston, Tx 77026. Panels shall be roll formed in continuous lengths. Seams shall be 1-1/2” inches high and spaced 16-1/2” inches on center. Extruded vinyl weatherseal to be factory/machine-installed shall be included at every seam. Certification shall be submitted, based on independent testing laboratory, indicating no measurable water penetration through the standing seam system when tested in accordance with ASTM E331-86 and E283-84. U.I. 90 listed. FMRC approved & 1-120 rated. Continuous corrosion resistant Cee-lock ribs. Except where shown in the documents or not realistically possible, all of the metal roof components shall be supplied by the same manufacturer, including such items as low profile ridge vent, valleys with 1 & 1/2 " center rib, edge fascia, equipment curbs / supports, preformed flashing collars. The basis of design is intended to establish the level of quality, function and appearance and is not intended to limit competition. Other manufacturers with equal products, subject to compliance with requirements, may be submitted for consideration. Any modifications to the work necessitated by the use of products other than the basis of design, shall be done at no additional cost to the Owner.

2.2 SHEET MATERIALS AND FINISHES

A. Prefinished Metal shall be Hot-Dipped Galvanized - ASTM A446-85 Grade C G90 Coating A525-86 24 Gauge core steel or prefinished Galvalume - ASTM A792-86 AZ-55. requirements:

1. Surface: Smooth, flat, mill finish.

2. Thickness: 24-ga, unless otherwise indicated.

3. High-Performance Organic Coating Finish: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations relative to applying and designating finishes. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturer's written instructions.

a. Fluoropolymer 2-Coat Coating System: Manufacturer's standard 2-coat, thermocured system composed of specially formulated inhibitive primer and fluoropolymer color topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight; complying with AAMA 1402, Test Method No. 7.

1) Color: Hartford Green, or as selected by the Owner from a list of standard Manufacturer’s available colors.

2.3 ROOF PANEL ASSEMBLIES

A. Standing-Seam Roof Panels: Manufacturer's standard factory-formed, standing-seam roof panel assembly designed for concealed mechanical attachment of panels to roof purlins or deck.

1. Clips: Provide 2-piece stainless-steel panel clips designed to meet negative-load requirements.

2.4 THERMAL INSULATION

A. Polyisocyanurate Board Insulation: Unfaced, preformed, rigid, cellular, polyisocyanurate thermal insulation complying with ASTM C591, Type 2, with aged thermal-resistance values for 1-inch thickness of 6.2 deg F x h x sq. ft./Btu at 75 deg F.

2.5 UNDERLAYMENT MATERIALS

A. Self-Adhering, Polymer-Modified, Bituminous Sheet Underlayment: ASTM D1970, minimum of 40 mils thick. Provide primer when recommended by underlayment manufacturer.

1. Products: Subject to compliance with requirements, provide one of the following:

a. WinterGuard; CertainTeed Corporation.

b. Bituthene Ice and Water Shield; Grace: W.R. Grace & Co.

c. Nordshield Ice and WaterGard; Nord Bitumi US, Inc.

2.6 MISCELLANEOUS MATERIALS

A. General: Provide materials and accessories required for a complete roof panel assembly and as recommended by panel manufacturer, unless otherwise indicated.

B. Thermal Spacers: Where panels attach directly to purlins, provide thermal spacers recommended by panel manufacturer.

C. Fasteners: Self-tapping screws, bolts, nuts, self-locking rivets and bolts, end-welded studs, and other suitable fasteners designed to withstand design loads.

1. Use aluminum or stainless-steel fasteners for exterior applications and aluminum or galvanized steel fasteners for interior applications.

2. Provide exposed fasteners with heads matching color of panel by means of factory-applied coating.

3. Provide metal-backed neoprene washers under heads of exposed fasteners bearing on weather side of panels.

4. Locate and space exposed fasteners in true vertical and horizontal alignment. Use proper tools to obtain controlled uniform compression for positive seal without rupture of neoprene washer.

D. Accessories: Unless otherwise specified, provide components required for a complete roof panel assembly including trim, copings, fasciae, mullions, sills, corner units, ridge closures, clips, seam covers, battens, flashing, gutters, sealants, gaskets, fillers, closure strips, and similar items. Match materials and finishes of panels.

1. Closure Strips: Closed-cell, self-extinguishing, expanded, cellular, rubber or cross-linked, polyolefin-foam flexible closure strips. Cut or premold to match configuration of panels. Provide closure strips where indicated or necessary to ensure weathertight construction.

2. Sealing Tape: Pressure-sensitive, 100 percent solids, polyisobutylene compound sealing tape with release paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape.

3. Elastomeric Joint Sealant: ASTM C920, of base polymer, type, grade, class, and use classifications required to seal joints in panel roofing and remain weathertight. Provide sealant recommended by panel manufacturer.

E. Bituminous Coating: Cold-applied asphalt mastic, SSPC-Paint 12, compounded for 15-mil dry film thickness per coat, unless otherwise indicated. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

F. Expansion-Joint Sealant: For hooked-type expansion joints that must be free to move, provide nonsetting, nonhardening, nonmigrating, heavy-bodied polyisobutylene sealant.

2.7 FABRICATION

A. General: Fabricate and finish panels and accessories at the factory to greatest extent possible, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.

B. Fabricate panel joints with captive gaskets or separator strips that provide a tight seal and prevent metal-to-metal contact, in a manner that will minimize noise from movements within panel assembly.

2.8 PANEL SUPPORTS AND ANCHORAGE

A. Secondary Framing: Provide components complying with the Light Gage Structural Institute's "Guide Specifications,".

1. Roof Purlins: C or Z-shaped sections fabricated from 0.0598-inch-thick, G-60 galvanized, shop-painted, roll-formed steel. Purlin spacers fabricated from 0.079-inch-thick, cold-formed, galvanized steel sections.

2. Base or Sill Angles: Fabricate from 0.079-inch-thick, cold-formed, G-60 galvanized steel sections.

3. Secondary structural members, except columns and beams, shall be manufacturer's standard sections fabricated from 0.079-inch-thick, cold-formed G-60 galvanized steel.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements indicated for conditions affecting performance of metal panel roofing.

1. Panel Supports and Anchorage: Examine roof framing to verify that purlins, angles, channels, and other secondary structural panel support members and anchorage have been installed according to written instructions of panel manufacturer.

2. Do not proceed with roof panel installation until unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Coordinate metal panel roofing with rain drainage work; flashing; trim; and construction of decks, parapets, walls, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

B. Promptly remove protective film, if any, from exposed surfaces of metal panels. Strip with care to avoid damage to finish.

C. Secondary Structural Supports: Install purlins, bracing, and other secondary structural panel support members and anchorage according to the Light Gage Structural Institute's "Guide Specifications,".

3.3 PANEL INSTALLATION

A. General: Comply with panel manufacturer's written instructions and recommendations for installation, as applicable to project conditions and supporting substrates. Anchor panels and other components of the Work securely in place, with provisions for thermal and structural movement.

1. Field cutting exterior panels by torch is not permitted.

2. Install panels with concealed fasteners, unless otherwise indicated. Where exposed fasteners are necessary in order to complete work, fasteners shall be prefinished to match panel finishes.

B. Accessories: Install components required for a complete roof panel assembly including trim, copings, fasciae, ridge closures, clips, seam covers, flashings, gutters, sealants, gaskets, fillers, closure strips, and similar items.

C. Separate dissimilar metals by painting each metal surface in area of contact with a bituminous coating, by applying rubberized-asphalt underlayment to each metal surface, or by other permanent separation as recommended by manufacturers of dissimilar metals.

D. Install bituminous sheet underlayment extended a minimum of 12 feet from both sides of expansion joint and 12 feet from roof edges.

E. Coat back side of metal panels with bituminous coating where it will contact wood, ferrous metal, or cementitious construction.

F. Joint Sealers: Install gaskets, joint fillers, and sealants where indicated and where required for weatherproof performance of panel assemblies. Provide types of gaskets, fillers, and sealants indicated or, if not otherwise indicated, types recommended by panel manufacturer.

1. Install weatherseal under ridge cap. Flash and seal panels at eave and rake with rubber, neoprene, or other closures to exclude weather.

2. Prepare joints and apply sealants to comply with requirements of Division 7, Section 079200 – JOINT SEALANTS.

G. Standing-Seam Roof Panel Assembly: Fasten panels to supports with concealed clip according to panel manufacturer's written instructions.

1. Install clips at each support with self-drilling/self-tapping fasteners.

2. Seaming: Complete seaming of panel joints by operating portable power-driven equipment of type recommended by panel manufacturer to provide a weathertight joint.

H. Installation Tolerances: Shim and align panel units within installed tolerance of 1/4 inch in 20 feet on slope and location lines as indicated and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

3.4 CLEANING AND PROTECTING

A. Damaged Units: Replace panels and other components of the Work that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

B. Cleaning: Remove temporary protective coverings and strippable films, if any, as soon as each panel is installed. On completion of panel installation, clean finished surfaces as recommended by panel manufacturer and maintain in a clean condition during construction.

END OF SECTION 074113.16

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SECTION 075419 - POLYVINYL-CHLORIDE (PVC) ROOFING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Adhered PVC membrane roofing system.
2. Vapor retarder.
3. Roof insulation.

1.2 DEFINITIONS

A. Roofing Terminology: See ASTM D 1079 and glossary in NRCA's "The NRCA Roofing and Waterproofing Manual" for definition of terms related to roofing work in this Section.

1.3 PERFORMANCE REQUIREMENTS

A. General Performance: Installed membrane roofing and base flashings shall withstand specified uplift pressures, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Membrane roofing and base flashings shall remain watertight.

B. Material Compatibility: Provide roofing materials that are compatible with one another under conditions of service and application required, as demonstrated by membrane roofing manufacturer based on testing and field experience.

C. Roofing System Design: Provide membrane roofing system that is identical to systems that have been successfully tested by a qualified testing and inspecting agency to resist uplift pressure calculated according to ASCE/SEI 7.

D. FM Approvals Listing: Provide membrane roofing, base flashings, and component materials that comply with requirements in FM Approvals 4450 and FM Approvals 4470 as part of a membrane roofing system, and that are listed in FM Approvals' "RoofNav" for Class 1 or noncombustible construction, as applicable. Identify materials with FM Approvals markings.

1. Fire/Windstorm Classification: Class 1A-90.
2. Hail Resistance: SH.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: For roofing system. Include plans, elevations, sections, details, and attachments to other work.

1. Base flashings and membrane terminations.
2. Tapered insulation, including slopes.
3. Roof plan showing orientation of steel roof deck and orientation of membrane roofing and fastening spacings and patterns for mechanically fastened membrane roofing.
4. Insulation fastening patterns for corner, perimeter, and field-of-roof locations.

C. Samples for Verification: For the following products:

1. Sheet roofing, of color specified, including T-shaped side and end lap seam.
2. Roof insulation.
3. 10 lb (4.5 kg) of aggregate ballast in gradation and color indicated.
4. Roof paver, full sized, in each color and texture required.
5. Walkway pads or rolls.
6. Metal termination bars.
7. Six insulation fasteners of each type, length, and finish.
8. Six roof cover fasteners of each type, length, and finish.

D. Qualification Data: For qualified Installer and manufacturer.

E. Manufacturer Certificates: Signed by roofing manufacturer certifying that roofing system complies with requirements specified in "Performance Requirements" Article.

1. Submit evidence of compliance with performance requirements.

F. Product Test Reports: Based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified testing agency, for components of membrane roofing system.

G. Research/Evaluation Reports: For components of membrane roofing system, from the ICC-ES.

H. Field quality-control reports.

I. Maintenance Data: For roofing system to include in maintenance manuals.

J. Warranties: Sample of special warranties.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer that is UL listed and FM Approvals approved for membrane roofing system identical to that used for this Project.

B. Installer Qualifications: A qualified firm that is approved, authorized, or licensed by membrane roofing system manufacturer to install manufacturer's product and that is eligible to receive manufacturer's special warranty.

C. Source Limitations: Obtain components including roof insulation and fasteners for membrane roofing system from same manufacturer as membrane roofing] or approved by membrane roofing manufacturer.

D. Exterior Fire-Test Exposure: ASTM E 108, Class A; for application and roof slopes indicated, as determined by testing identical membrane roofing materials by a qualified testing agency. Materials shall be identified with appropriate markings of applicable testing agency.

E. Fire-Resistance Ratings: Where indicated, provide fire-resistance-rated roof assemblies identical to those of assemblies tested for fire resistance per ASTM E 119 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

F. Preinstallation Roofing Conference: Conduct conference at Project site.

1. Meet with Owner, Architect, Owner's insurer if applicable, testing and inspecting agency representative, roofing Installer, roofing system manufacturer's representative, deck Installer, and installers whose work interfaces with or affects roofing, including installers of roof accessories and roof-mounted equipment.
2. Review methods and procedures related to roofing installation, including manufacturer's written instructions.
3. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
4. Examine deck substrate conditions and finishes for compliance with requirements, including flatness and fastening.
5. Review structural loading limitations of roof deck during and after roofing.
6. Review base flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that will affect roofing system.
7. Review governing regulations and requirements for insurance and certificates if applicable.
8. Review temporary protection requirements for roofing system during and after installation.
9. Review roof observation and repair procedures after roofing installation.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver roofing materials to Project site in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, approval or listing agency markings, and directions for storing and mixing with other components.

B. Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by roofing system manufacturer. Protect stored liquid material from direct sunlight.

1. Discard and legally dispose of liquid material that cannot be applied within its stated shelf life.

C. Protect roof insulation materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources. Store in a dry location. Comply with insulation manufacturer's written instructions for handling, storing, and protecting during installation.

D. Handle and store roofing materials and place equipment in a manner to avoid permanent deflection of deck.

1.7 PROJECT CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit roofing system to be installed according to manufacturer's written instructions and warranty requirements.

1.8 WARRANTY

A. Special Warranty: Manufacturer's standard or customized form, without monetary limitation, in which manufacturer agrees to repair or replace components of membrane roofing system that fail in materials or workmanship within specified warranty period.

1. Special warranty includes membrane roofing, base flashings, roof insulation, fasteners, cover boards, roofing accessories, roof pavers and other components of membrane roofing system.
2. Warranty Period: 15 years from date of Substantial Completion.

B. Special Project Warranty: Submit roofing Installer's warranty, on warranty form at end of this Section, signed by Installer, covering the Work of this Section, including all components of membrane roofing system such as membrane roofing, base flashing, roof insulation, fasteners, cover boards, substrate boards, vapor retarders, roof pavers, and walkway products, for the following warranty period:

1. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PVC MEMBRANE ROOFING

A. PVC Sheet: ASTM D 4434, Type III, fabric reinforced and fabric backed.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Carlisle SynTec, Incorporated. (Basis-of-Design)
b. Duro-Last Roofing, Inc.
c. GAF Materials Corporation.
d. GenFlex Roofing Systems.
e. Johns Manville.
f. Sarnafil Inc.
g. Stevens Roofing Systems.

2. Thickness: 80 mils (2.0 mm), nominal.
3. Exposed Face Color: White.

2.2 AUXILIARY MEMBRANE ROOFING MATERIALS

A. General: Auxiliary membrane roofing materials recommended by roofing system manufacturer for intended use, and compatible with membrane roofing.

1. Liquid-type auxiliary materials shall comply with VOC limits of authorities having jurisdiction.

B. Sheet Flashing: Manufacturer's standard sheet flashing of same material, type, reinforcement, thickness, and color as PVC sheet membrane.

C. Bonding Adhesive: Manufacturer's standard.

D. Slip Sheet: Manufacturer's standard, of thickness required for application.

E. Metal Termination Bars: Manufacturer's standard, predrilled stainless-steel or aluminum bars, approximately 1 by 1/8 inch (25 by 3 mm) thick; with anchors.

F. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening membrane to substrate, and acceptable to membrane roofing system manufacturer.

G. Miscellaneous Accessories: Provide pourable sealers, preformed cone and vent sheet flashings, preformed inside and outside corner sheet flashings, T-joint covers, lap sealants, termination reglets, and other accessories.

2.3 SUBSTRATE BOARDS

A. Substrate Board: ASTM C 1177/C 1177M, glass-mat, water-resistant gypsum substrate, Type X, 5/8 inch (16 mm) thick.

1. Products: Subject to compliance with requirements, provide the following:

a. Georgia-Pacific Corporation; Dens Deck.

B. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening substrate board to roof deck.

2.4 VAPOR RETARDER

A. Polyethylene Film: ASTM D 4397, 6 mils (0.15 mm) thick, minimum, with maximum permeance rating of 0.13 perm (7.5 ng/Pa x s x sq. m).

1. Tape: Pressure-sensitive tape of type recommended by vapor-retarder manufacturer for sealing joints and penetrations in vapor retarder.

2.5 ROOF INSULATION

A. General: Preformed roof insulation boards manufactured or approved by PVC membrane roofing manufacturer, selected from manufacturer's standard sizes suitable for application, of thicknesses indicated and that produce FM Approvals-approved roof insulation.

B. Polyisocyanurate Board Insulation: ASTM C 1289, Type II, Class 1, Grade 2, felt or glass-fiber mat facer on both major surfaces.

C. Tapered Insulation: Provide factory-tapered insulation boards fabricated to slope of 1/4 inch per 12 inches (1:48) unless otherwise indicated.

D. Provide preformed saddles, crickets, tapered edge strips, and other insulation shapes where indicated for sloping to drain. Fabricate to slopes indicated.

2.6 INSULATION ACCESSORIES

A. General: Furnish roof insulation accessories recommended by insulation manufacturer for intended use and compatibility with membrane roofing.

B. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening roof insulation and cover boards to substrate, and acceptable to roofing system manufacturer.

C. Cover Board: ASTM C 1177/C 1177M, glass-mat, water-resistant gypsum substrate, 5/8 inch (16 mm) thick, factory primed.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

   a. Georgia-Pacific Corporation; Dens Deck Prime.

D. Protection Mat: Woven or nonwoven polypropylene, polyolefin, or polyester fabric, water permeable and resistant to UV degradation, type and weight as recommended by roofing system manufacturer for application.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with the following requirements and other conditions affecting performance of roofing system:

   1. Verify that surface plane flatness and fastening of steel roof deck complies with requirements in Division 5 Section "Steel Decking."

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean substrate of dust, debris, moisture, and other substances detrimental to roofing installation according to roofing system manufacturer's written instructions. Remove sharp projections.

B. Prevent materials from entering and clogging roof drains and conductors and from spilling or migrating onto surfaces of other construction. Remove roof-drain plugs when no work is taking place or when rain is forecast.

C. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing system at the end of the workday or when rain is forecast. Remove and discard temporary seals before beginning work on adjoining roofing.

3.3 SUBSTRATE BOARD

A. Install substrate board with long joints in continuous straight lines, perpendicular to roof slopes with end joints staggered between rows. Tightly butt substrate boards together.

   1. Fasten substrate board to top flanges of steel deck according to recommendations in FM Approvals' "RoofNav" and FM Global Loss

Prevention Data Sheet 1-29 for specified Windstorm Resistance Classification.

3.4 VAPOR-RETARDER INSTALLATION

A. Polyethylene Film: Loosely lay polyethylene-film vapor retarder in a single layer over area to receive vapor retarder, side and end lapping each sheet a minimum of 2 inches (50 mm) and 6 inches (150 mm), respectively.

1. Continuously seal side and end laps with tape.

B. Completely seal vapor retarder at terminations, obstructions, and penetrations to prevent air movement into membrane roofing system.

3.5 INSULATION INSTALLATION

A. Coordinate installing membrane roofing system components so insulation is not exposed to precipitation or left exposed at the end of the workday.

B. Comply with membrane roofing system and insulation manufacturer's written instructions for installing roof insulation.

C. Install tapered insulation under area of roofing to conform to slopes indicated.

D. Install insulation under area of roofing to achieve required thickness. Where overall insulation thickness is 2.7 inches (68 mm) or greater, install two or more layers with joints of each succeeding layer staggered from joints of previous layer a minimum of 6 inches (150 mm) in each direction.

E. Trim surface of insulation where necessary at roof drains so completed surface is flush and does not restrict flow of water.

F. Install insulation with long joints of insulation in a continuous straight line with end joints staggered between rows, abutting edges and ends between boards. Fill gaps exceeding 1/4 inch (6 mm) with insulation.

1. Cut and fit insulation within 1/4 inch (6 mm) of nailers, projections, and penetrations.

G. Mechanically Fastened Insulation: Install each layer of insulation and secure to deck using mechanical fasteners specifically designed and sized for fastening specified board-type roof insulation to deck type.

1. Fasten insulation according to requirements in FM Approvals' "RoofNav" for specified Windstorm Resistance Classification and to resist uplift pressure at corners, perimeter, and field of roof.

H. Mechanically Fastened and Adhered Insulation: Install each layer of insulation and secure first layer of insulation to deck using mechanical fasteners specifically

designed and sized for fastening specified board-type roof insulation to deck type.

1. Fasten first layer of insulation according to requirements in FM Approvals' "RoofNav" for specified Windstorm Resistance Classification and to resist uplift pressure at corners, perimeter, and field of roof.
2. Set each subsequent layer of insulation in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.

3.6 ADHERED MEMBRANE ROOFING INSTALLATION

A. Adhere membrane roofing over area to receive roofing and install according to membrane roofing system manufacturer's written instructions.

1. Install sheet according to ASTM D 5036.

B. Start installation of membrane roofing in presence of membrane roofing system manufacturer's technical personnel.

C. Accurately align membrane roofing and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.

D. Bonding Adhesive: Apply to substrate and underside of membrane roofing at rate required by manufacturer and allow to partially dry before installing membrane roofing. Do not apply to splice area of membrane roofing.

E. In addition to adhering, mechanically fasten membrane roofing securely at terminations, penetrations, and perimeter of roofing.

F. Apply membrane roofing with side laps shingled with slope of roof deck where possible.

G. Seams: Clean seam areas, overlap membrane roofing, and hot-air weld side and end laps of membrane roofing and sheet flashings according to manufacturer's written instructions to ensure a watertight seam installation.

1. Test lap edges with probe to verify seam weld continuity. Apply lap sealant to seal cut edges of sheet membrane.
2. Verify field strength of seams a minimum of twice daily and repair seam sample areas.
3. Repair tears, voids, and lapped seams in roofing that does not comply with requirements.

H. Spread sealant bed over deck drain flange at roof drains and securely seal membrane roofing in place with clamping ring.

3.7 BASE FLASHING INSTALLATION

A. Install sheet flashings and preformed flashing accessories and adhere to substrates according to membrane roofing system manufacturer's written instructions.

B. Apply bonding adhesive to substrate and underside of sheet flashing at required rate and allow to partially dry. Do not apply to seam area of flashing.

C. Flash penetrations and field-formed inside and outside corners with cured or uncured sheet flashing.

D. Clean seam areas, overlap, and firmly roll sheet flashings into the adhesive. Hot-air weld side and end laps to ensure a watertight seam installation.

E. Terminate and seal top of sheet flashings and mechanically anchor to substrate through termination bars.

3.8 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Final Roof Inspection: Arrange for roofing system manufacturer's technical personnel to inspect roofing installation on completion.

C. Repair or remove and replace components of membrane roofing system where inspections indicate that they do not comply with specified requirements.

D. Additional inspections, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.9 PROTECTING AND CLEANING

A. Protect membrane roofing system from damage and wear during remainder of construction period. When remaining construction will not affect or endanger roofing, inspect roofing for deterioration and damage, describing its nature and extent in a written report, with copies to Architect and Owner.

B. Correct deficiencies in or remove membrane roofing system that does not comply with requirements; repair substrates; and repair or reinstall membrane roofing system to a condition free of damage and deterioration at time of Substantial Completion and according to warranty requirements.

C. Clean overspray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

3.10 ROOFING INSTALLER'S WARRANTY

A. WHEREAS <**Insert name**> of <**Insert address**>, herein called the "Roofing Installer," has performed roofing and associated work ("work") on the following project:

1. Owner: <**Insert name of Owner**>.
2. Address: <**Insert address**>.
3. Building Name/Type: <**Insert information**>.
4. Address: <**Insert address**>.
5. Area of Work: <**Insert information**>.
6. Acceptance Date: <**Insert date**>.
7. Warranty Period: <**Insert time**>.
8. Expiration Date: <**Insert date**>.

B. AND WHEREAS Roofing Installer has contracted (either directly with Owner or indirectly as a subcontractor) to warrant said work against leaks and faulty or defective materials and workmanship for designated Warranty Period,

C. NOW THEREFORE Roofing Installer hereby warrants, subject to terms and conditions herein set forth, that during Warranty Period he will, at his own cost and expense, make or cause to be made such repairs to or replacements of said work as are necessary to correct faulty and defective work and as are necessary to maintain said work in a watertight condition.

D. This Warranty is made subject to the following terms and conditions:

1. Specifically excluded from this Warranty are damages to work and other parts of the building, and to building contents, caused by:

   a. Lightning;
   b. Peak gust wind speed exceeding <**Insert wind speed**> mph (m/sec);
   c. Fire;
   d. Failure of roofing system substrate, including cracking, settlement, excessive deflection, deterioration, and decomposition;
   e. Faulty construction of parapet walls, copings, chimneys, skylights, vents, equipment supports, and other edge conditions and penetrations of the work;
   f. Vapor condensation on bottom of roofing; and
   g. Activity on roofing by others, including construction contractors, maintenance personnel, other persons, and animals, whether authorized or unauthorized by Owner.

2. When work has been damaged by any of foregoing causes, Warranty shall be null and void until such damage has been repaired by Roofing Installer and until cost and expense thereof have been paid by Owner or by another responsible party so designated.
3. Roofing Installer is responsible for damage to work covered by this Warranty but is not liable for consequential damages to building or building contents resulting from leaks or faults or defects of work.

4. During Warranty Period, if Owner allows alteration of work by anyone other than Roofing Installer, including cutting, patching, and maintenance in connection with penetrations, attachment of other work, and positioning of anything on roof, this Warranty shall become null and void on date of said alterations, but only to the extent said alterations affect work covered by this Warranty. If Owner engages Roofing Installer to perform said alterations, Warranty shall not become null and void unless Roofing Installer, before starting said work, shall have notified Owner in writing, showing reasonable cause for claim, that said alterations would likely damage or deteriorate work, thereby reasonably justifying a limitation or termination of this Warranty.
5. During Warranty Period, if original use of roof is changed and it becomes used for, but was not originally specified for, a promenade, work deck, spray-cooled surface, flooded basin, or other use or service more severe than originally specified, this Warranty shall become null and void on date of said change, but only to the extent said change affects work covered by this Warranty.
6. Owner shall promptly notify Roofing Installer of observed, known, or suspected leaks, defects, or deterioration and shall afford reasonable opportunity for Roofing Installer to inspect work and to examine evidence of such leaks, defects, or deterioration.
7. This Warranty is recognized to be the only warranty of Roofing Installer on said work and shall not operate to restrict or cut off Owner from other remedies and resources lawfully available to Owner in cases of roofing failure. Specifically, this Warranty shall not operate to relieve Roofing Installer of responsibility for performance of original work according to requirements of the Contract Documents, regardless of whether Contract was a contract directly with Owner or a subcontract with Owner's General Contractor.

E. IN WITNESS THEREOF, this instrument has been duly executed this <**Insert day**> day of <**Insert month**>, <**Insert year**>.

1. Authorized Signature: <**Insert signature**>.
2. Name: <**Insert name**>.
3. Title: <**Insert title**>.

END OF SECTION 075419

SECTION 076200 - SHEET METAL FLASHING AND TRIM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this section.

1.2 SUMMARY

A. General: Provide all labor, material, equipment, related services and supervision required, including manufacturing, erection and installation for sheet metal flashing and trim in accordance with the requirements of the Contract Documents.

B. The extent of sheet metal flashing and trim is shown on the drawings.

C. This section includes sheet metal flashing and trim in the following categories:

1. Exposed trim.

2. Metal flashing.

3. Miscellaneous sheet metal accessories.

D. Related Sections: The following sections contain requirements that relate to this section:

1. Division 7, Section 079200 – JOINT SEALANTS

2. Division 7, Section 075419- POLYVINYL-CHORIDE (PVC) ROOFING

3. Division 7, Section 074113.16- STANDING SEAM METAL ROOF PANELS.

1.3 PERFORMANCE REQUIREMENTS

A. General: Install sheet metal flashing and trim to withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failing.

B. Fabricate and install flashings at roof edges to comply with recommendations of FM Loss Prevention Data Sheet 1-49. Refer to the structural and architectural drawings for basic wind speed criteria.

1.4 SUBMITTALS

A. General: Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections.

B. Product Data including manufacturer's material and finish data, installation instructions, and general recommendations for each specified flashing material and fabricated product.

C. Shop Drawings of each item specified showing layout, profiles, methods of joining, and anchorage details.

D. Samples of sheet metal flashing, trim, and accessory items, in the specified finish. Where finish involves normal color and texture variations, include Sample sets composed of 2 or more units showing the full range of variations expected.

1. 8-inch-square Samples of specified sheet materials to be exposed as finished surfaces.

2. 12-inch-long Samples or 8-inch square Samples of factory-fabricated products exposed as finished work. Provide complete with specified factory finish.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experience Installer who has completed sheet metal flashing and trim work similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance.

1.6 PROJECT CONDITIONS

A. Coordinate work of this section with interfacing and adjoining work for proper sequencing of each installation. Ensure best possible weather resistance, durability of work, and protection of materials and finishes.

PART 2 - PRODUCTS

2.1 METALS

A. Aluminum: Alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated and with not less than the strength and durability of alloy and temper designated below:

1. Extruded Aluminum: ASTM B 221 (ASTM B 221M), alloy 6063-T52, with a minimum thickness of 0.080 inch for primary legs of extrusions that are anodized, unless otherwise indicated.

B. Stainless-Steel Sheet: ASTM A 167, Type 304, soft annealed, with No. 2D finish, except where harder temper is required for forming or performance; minimum 0.0187 inch thick, unless otherwise indicated.

C. Lead Sheet: ASTM B 749, Type L51121, copper-bearing lead sheet, with a minimum thickness of 0.0625 inch except not less than 0.0937 inch thick for applications where burning (welding) is involved.

2.2 CONCEALED SHEET METAL FLASHING

A. Refer to Section 042200 – CONCRETE UNIT MASONRY.

2.3 MISCELLANEOUS MATERIALS AND ACCESSORIES

A. Solder for Stainless Steel: ASTM B 32, Grade Sn60, used with an acid flux of type recommended by stainless-steel sheet manufacturer; use a noncorrosive rosin flux over tinned surfaces.

B. Stainless-Steel Welding Rods: Type recommended by stainless-steel sheet manufacturer for type of metal sheets furnished.

C. Fasteners: Same metal as sheet metal flashing or other noncorrosive metal as recommended by sheet metal manufacturer. Match finish of exposed heads with material being fastened.

D. Asphalt Mastic: SSPC-Paint 12, solvent-type asphalt mastic, nominally free of sulfur and containing no asbestos fibers, compounded for 15-mil (0.4-mm) dry film thickness per coat.

E. Mastic Sealant: Polyisobutylene; nonhardening, nonskinning, nondrying, nonmigrating sealant.

F. Elastomeric Sealant: Generic type recommended by sheet metal manufacturer and fabricator of components being sealed and complying with requirements for joint sealants as specified in Division 7, Section 079200 - JOINT SEALANTS.

G. Epoxy Seam Sealer: 2-part, noncorrosive, aluminum seam-cementing compound, recommended by aluminum manufacturer for exterior and interior nonmoving joints, including riveted joints.

H. Adhesives: Type recommended by flashing sheet metal manufacturer for waterproof and weather-resistant seaming and adhesive application of flashing sheet metal.

I. Paper Slip Sheet: 5-lb/square red rosin, sized building paper conforming to FS UU-B-790, Type I, Style 1b.

J. Polyethylene Underlayment: ASTM D 4397, minimum 6-mil-thick black polyethylene film, resistant to decay when tested according to ASTM E 154.

K. Metal Accessories: Provide sheet metal clips, straps, anchoring devices, and similar accessory units as required for installation of work, matching the material being installed; noncorrosive; size and thickness required for performance.

L. Gutter Screen: 1/4-inch hardware cloth installed in sheet metal frames. Fabricate screen and frame of same basic material as gutters and downspouts.

M. Roofing Cement: ASTM D 4586, Type I, asbestos free, asphalt based.

2.4 FABRICATION, GENERAL

A. Sheet Metal Fabrication Standard: Fabricate sheet metal flashing and trim to comply with recommendations of SMACNA's "Architectural Sheet Metal Manual" that apply to the design, dimensions, metal, and other characteristics of the item indicated.

B. Comply with details shown to fabricate sheet metal flashing and trim that fit substrates and result in waterproof and weather-resistant performance once installed. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal. Shop-fabricate work to the greatest extent possible.

C. Form exposed sheet metal work that is without excessive oil canning, buckling, and tool marks and that is true to line and levels indicated, with exposed edges folded back to form hems.

D. Seams: Fabricate nonmoving seams in aluminum with flat-lock seams. Form seams and seal with epoxy seam sealer. Use concealed fasteners for additional strength.

E. Expansion Provisions: Space movement joints at maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped or bayonet-type expansion provisions in work cannot be used or would not be sufficiently weatherproof and waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with mastic sealant (concealed within joints).

F. Sealed Joints: Form nonexpansion, but movable, joints in metal to accommodate elastomeric sealant to comply with SMACNA standards.

G. Separate metal from noncompatible metal or corrosive substrates by coating concealed surfaces at locations of contact with asphalt mastic or other permanent separation as recommended by manufacturer.

H. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of sheet metal exposed to public view.

I. Fabricate cleats and attachment devices from same material as sheet metal component being anchored or from compatible, noncorrosive metal recommended by sheet metal manufacturer.

1. Size: As recommended by SMACNA manual or sheet metal manufacturer for application but never less than thickness of metal being secured.

2.5 SHEET METAL FABRICATIONS

A. General: Fabricate sheet metal items in thickness or weight needed to comply with performance requirements but not less than that listed below for each application and metal.

B. Roof-Drain Flashing: Fabricate from the following material:

1. Lead: 4.0 lb/sq. ft., hard tempered.

C. Exposed Trim: Fabricate from the following material:

1. Aluminum: 0.050 inch thick.

D. Drip Edges: Fabricate from the following material:

1. Aluminum: 0.0320 inch thick.

2. Stainless Steel: 0.0156 inch thick.

2.6 ALUMINUM FINISHES

A. General: Comply with Aluminum Association's (AA) "Designation System for Aluminum Finishes" for finish designations and application recommendations.

B. High-Performance Organic Coating Finish: AA-C12C42R1x (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: acid chromate-fluoride-phosphate conversion coating; Organic Coating: as specified below). Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturer's instructions.

1. Fluoropolymer 2-Coat Coating System: Manufacturer's standard 2-coat, thermocured system composed of specially formulated inhibitive primer and

fluoropolymer color topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight; complying with AAMA 605.2.

a. Color and Gloss: Match adjacent surfaces.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions under which sheet metal flashing and trim are to be installed and verify that work may properly commence. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Unless otherwise indicated, install sheet metal flashing and trim to comply with performance requirements, manufacturer's installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Anchor units of work securely in place by methods indicated, providing for thermal expansion of metal units; conceal fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weatherproof.

B. Install exposed sheet metal work that is without oil canning, buckling, and tool marks and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and to result in waterproof and weather-resistant performance. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.

C. Roof-Edge Flashings: Secure metal flashings at roof edges according to FM Loss Prevention Data Sheet 1-49 for specified wind zone and cladding wind load, criteria indicated on the architectural drawings. Use most stringent requirements.

D. Expansion Provisions: Provide for thermal expansion of exposed sheet metal work. Space movement joints at maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped or bayonet-type expansion provisions in work cannot be used or would not be sufficiently weatherproof and waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with mastic sealant (concealed within joints).

E. Soldered Joints: Clean surfaces to be soldered, removing oils and foreign matter. Pretin edges of sheets to be soldered to a width of 1-1/2 inches, except where pretinned surface would show in finished work.

1. Do not solder aluminum.

2. Pretinning is not required for the following metals:

a. Lead.

3. Do not use torches for soldering. Heat surfaces to receive solder and flow solder into joint. Fill joint completely. Completely remove flux and spatter from exposed surfaces.

F. Sealed Joints: Form nonexpansion, but movable, joints in metal to accommodate elastomeric sealant to comply with SMACNA standards. Fill joint with sealant and form metal to completely conceal sealant.

1. Use joint adhesive for nonmoving joints specified not to be soldered.

G. Seams: Fabricate nonmoving seams in sheet metal with flat-lock seams. Tin edges to be seamed, form seams, and solder.

H. Seams: Fabricate nonmoving seams in aluminum with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.

I. Separations: Separate metal from noncompatible metal or corrosive substrates by coating concealed surfaces, at locations of contact, with asphalt mastic or other permanent separation as recommended by manufacturer.

1. Underlayment: Where installing stainless steel or aluminum directly on cementitious or wood substrates, install a slip sheet of red-rosin paper and a course of polyethylene underlayment.

2. Bed flanges of work in a thick coat of roofing cement where required for waterproof performance.

J. Roof-Penetration Flashing: Coordinate roof-penetration flashing installation with roofing and installation of items penetrating roof. Install flashing as follows:

1. Turn lead flashing down inside vent piping, being careful not to block vent piping with flashing.

2. Seal and clamp flashing to pipes penetrating roof, other than lead flashing on vent piping.

3.3 CLEANING AND PROTECTION

A. Clean exposed metal surfaces, removing substances that will cause corrosion of metal or deterioration of finishes.

B. Provide final protection and maintain conditions that ensure sheet metal flashing and trim work during construction is without damage or deterioration other than natural weathering at the time of Substantial Completion.

END OF SECTION 076200

SECTION 077100 –ROOF SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this section.

1.2 SUMMARY

A. General: Provide all labor, material, equipment, related services and supervision required, including manufacturing, erection and installation for manufactured roof specialties in accordance with the requirements of the Contract Documents.

B. The extent of manufactured roof specialties is shown on the drawings.

C. This section includes the following:

1. Copings.

2. Fascia (gravel stops).

3. Scuppers.

4. Counterflashing and Receivers.

D. Related sections include the following:

1. Division 7, Section 076200 - SHEET METAL FLASHING AND TRIM for shop- and field-fabricated metal flashing miscellaneous sheet metal accessories.

2. Division 7, Section 077200 - ROOF ACCESSORIES for manufactured curbs and roof hatches. Roof accessories installed integrally with roofing membrane are specified in roofing system sections as roofing work.

1.3 SUBMITTALS

A. Product Data: For each type of product specified. Include details of construction relative to materials, dimensions of individual components, profiles, and finishes.

B. Shop Drawings: Indicate layout, joining, profiles, accessories, anchorage, flashing connections, and relationship to supporting structure and to adjoining roof and wall construction.

C. Samples for Initial Selection: Manufacturer's sample finishes showing the full range of colors and textures available for units with factory-applied color finishes.

D. Samples for Verification: Of the following products, in manufacturer's standard sizes, showing the full range of color, texture, and pattern variations expected. Prepare Samples from the same material to be used for the work. Furnish straight Samples in lengths specified below or where corner pieces are required for project; furnish corner Samples with each leg in lengths specified below:

1. Copings: 8 inches long.

2. Gravel Stops: 8 inches long, including scuppers, if specified.

3. Counterflashing and Receivers: 8 inches long.

1.4 PERFORMANCE REQUIREMENTS

A. General: Provide manufactured roof specialties capable of withstanding wind loads, structural movement, thermally induced movement, and exposure to weather without failing.

B. Provide manufactured roofing specialties, incorporating roof edge treatment that complies with recommendations of FM Loss Prevention Data Sheet 1-49 for the following Wind Region:

1. Wind Region 119 mph.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain each type of manufactured roof specialty from one source and by a single manufacturer.

1.6 PROJECT CONDITIONS

A. Coordinate work of this section with adjoining work for proper sequencing of each installation to ensure best-possible weather resistance and protection of materials and finishes against damage.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturer's Basis of Design: The named manufacturer and associated products are the basis of design for the project, matching the existing airport construction. Other manufacturer's whose products may be incorporated into the work, subject to compliance with requirements, are also listed. The Contractor is responsible for any modifications to the work resulting from the use of materials other than the basis of design, at no additional cost to the Owner.

1. Formed Aluminum Copings: M and M Systems "Snap-Lok Coping Systems (SLC)≅ FM I-90; width as required for wall construction. Face and return height dimension to match existing copings; 20 year warranty.

2. Formed Aluminum Fascia (Gravel Stop): M and M Systems ASnap-Lok Fascia II (SLF)≅, FM I-90; 6-1/2 inches high; 20 year warranty; prefabricated for overflow scuppers.

3. Aluminum Fascia Spillout Scupper: M and M Systems.

4. Aluminum Counterflashing and Receivers: M and M Systems, ASnap-Tite Reglet and Counter-Flashing; RC-2 and RC-3"; FM I-90.

B. The following manufacturers with equal products are acceptable:

1. W.P. Hickman Co.

2. Petersen Aluminum Corp.

3. Architectural Products Co.

4. Merchant and Evans, Inc.

2.2 METALS

A. Aluminum Extrusions: ASTM B221 (ASTM B221M), 6063-T5 alloy and temper, or as recommended by manufacturer for use intended and as required for proper application of finish indicated.

B. Aluminum Sheet: ASTM B209 (ASTM B209M), alloy and temper recommended by aluminum producer and finisher for use intended and finish indicated, and with not less than the strength and durability of alloy and temper designated below:

1. Alloy 3003-H14, with a minimum thickness of 0.040 inch, unless otherwise indicated, for aluminum sheet with mill finish.

2. Alloy 5005-H14, with a minimum thickness of 0.050 inch, for aluminum sheet with other than mill finish.

2.3 COPINGS

A. Provide copings in shapes and sizes indicated, with shop-fabricated fully welded corners. Include anchor plates formed from at least 0.028-inch-thick, galvanized steel sheet; cleats or other attachment devices; concealed splice plates; and trim and other accessories indicated or required for complete installation, with no exposed fasteners.

B. Provide exposed coping components fabricated from formed-aluminum sheet, but not less than 0.050 inch thick.

2.4 FASCIA

A. Provide fascia in shapes and sizes indicated, with shop-mitered and -welded corners. Include water dams formed from at least 0.028-inch-thick, galvanized steel sheet; anchor plates; cleats or other attachment devices; concealed splice plates; and trim and other accessories indicated or required for complete installation, with no exposed fasteners.

1. Scuppers: Provide scuppers designed and manufactured for use with fascia and of the same material. Spill-out scupper with prefabricated core.

B. Provide exposed fascia components fabricated from the following metal:

1. Formed-aluminum sheet in thickness indicated, but not less than 0.050 inch.

2.5 COUNTERFLASHING AND RECEIVERS

A. Provide counterflashing fabricated from the following metal in thickness indicated:

1. Aluminum Sheet: 0.032 inch thick.

2.6 ACCESSORIES

A. General: Provide manufacturer's standard accessories designed and manufactured to match and fit roof edge treatment system indicated.

B. Exposed Fasteners: Stainless steel, nonmagnetic, of manufacturer's standard type and size for product and application indicated. Match finish of exposed heads with material being fastened.

C. Concealed Fasteners: Same metal as item fastened or other noncorrosive metal as recommended by manufacturer.

D. Galvanizing Repair Paint: High-zinc-dust-content paint for regalvanizing welds in steel, complying with SSPC-Paint 20.

E. Asphalt Mastic: SSPC-Paint 12, solvent-type asphalt mastic, nominally free of sulfur and containing no asbestos fibers, compounded for 15-mil dry film thickness per coat.

F. Mastic Sealant: Polyisobutylene; nonhardening, nonskinning, nondrying, nonmigrating sealant.

G. Adhesives: Type recommended by manufacturer for substrate and project conditions, and formulated to withstand minimum 60-lbf/sq. ft. wind-uplift force.

2.7 FINISHES

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations relative to applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipment.

C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are unacceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

D. Finish designations prefixed by AA conform to the system established by the Aluminum Association for designating aluminum finishes.

E. High-Performance Organic Coating Finish: AA-C12C42R1x (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: acid-chromate-fluoride-phosphate conversion coating; Organic Coating: as specified below). Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating or resin manufacturer's written instructions.

1. Fluoropolymer 2-Coat Coating System: Manufacturer's standard 2-coat, thermocured system composed of specially formulated inhibitive primer and fluoropolymer color topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight; complying with AAMA 1402, Test Method 7.

a. Color and Gloss: Provide custom color and finish to match existing construction for each component or location.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine walls, roof edges, and parapets for suitable conditions for roof edge system installation. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Promptly remove protective film, if any, from exposed surfaces of finished metals. Strip with care to avoid damage to finish.

B. Prepare concrete, concrete masonry block and similar surfaces to receive roof edge system specified. Install blocking, cleats, water dams, and other anchoring and attachment accessories and devices required.

3.3 INSTALLATION

A. General: Comply with manufacturer's written installation instructions. Coordinate with installation of roof deck and other substrates to receive work of this section and with vapor retarders, roofing insulation, roofing membrane, flashing, and wall construction, as required to ensure that each element of the work performs properly and that combined elements are waterproof and weathertight. Anchor products securely to structural substrates to withstand lateral and thermal stresses and inward and outward loading pressures.

B. Isolation: Where metal surfaces of units contact dissimilar metal or corrosive substrates, including wood, apply bituminous coating on concealed metal surfaces or provide other permanent separation as recommended by aluminum producer.

C. Expansion Provisions: Install running lengths to allow controlled expansion for movement of metal components in relation not only to one another but also to adjoining dissimilar materials, including flashing and roofing membrane materials, in a manner sufficient to prevent water leakage, deformation, or damage.

3.4 CLEANING AND PROTECTING

A. Clean exposed metal surfaces according to manufacturer's written instructions. Touch up damaged metal coatings.

B. Protection: Provide protective measures as required to ensure work of this section will be without damage or deterioration at the time of Substantial Completion.

END OF SECTION 077100

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SECTION 077200 - ROOF ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Roof hatches.

B. Related Sections include the following:

1. Division 5 Section "Metal Fabrications" for metal vertical ladders, ships' ladders, and stairs for access to roof hatches.
2. Division 6 Section "Rough Carpentry" for roof sheathing, wood cants, and wood nailers.
3. Division 7 Section "Sheet Metal Flashing and Trim" for shop- and field-fabricated metal flashing and counterflashing, roof expansion-joint covers, and miscellaneous sheet metal trim and accessories.
4. Division 7 Section "Roof Specialties" for fascia, copings, and gravel stops.

1.3 SUBMITTALS

A. Product Data: For each type of roof accessory indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Shop Drawings: Show fabrication and installation details for roof accessories. Show layouts of roof accessories including plans and elevations. Indicate dimensions, weights, loadings, required clearances, method of field assembly, and components. Include plans, elevations, sections, details, and attachments to other work.

C. Samples: For each type of exposed factory-applied finish required and for each type of roof accessory indicated, prepared on Samples of size to adequately show color.

D. Warranty: Manufacturer’s standard 5 year.

1.4 QUALITY ASSURANCE

A. Sheet Metal Standard: Comply with SMACNA's "Architectural Sheet Metal Manual" details for fabrication of units, including flanges and cap flashing to coordinate with type of roofing indicated.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Pack, handle, and ship roof accessories properly labeled in heavy-duty packaging to prevent damage.

1.6 PROJECT CONDITIONS

A. Field Measurements: Verify required openings for each type of roof accessory by field measurements before fabrication and indicate measurements on Shop Drawings.

1.7 COORDINATION

A. Coordinate layout and installation of roof accessories with roofing membrane and base flashing and interfacing and adjoining construction to provide a leakproof, weathertight, secure, and noncorrosive installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers listed in other Part 2 articles.

2.2 METAL MATERIALS

A. Aluminum Sheet: ASTM B 209 alloy and temper recommended by manufacturer for type of use and mill finish.

B. Aluminum Extrusions and Tubes: ASTM B 221 alloy and temper recommended by manufacturer for type of use, mill finished.

2.3 MISCELLANEOUS MATERIALS

A. Cellulosic-Fiber Board Insulation: ASTM C 208, Type II, Grade 1, 1 inch (25 mm) thick.

B. Wood Nailers: Softwood lumber, pressure treated with waterborne preservatives for aboveground use, complying with AWPA C2; not less than 1-1/2 inches (38 mm) thick.

C. Bituminous Coating: Cold-applied asphalt mastic, SSPC-Paint 12, compounded for 15-mil (0.4-mm) dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

D. Fasteners: Same metal as metals being fastened, or nonmagnetic stainless steel or other noncorrosive metal as recommended by roof accessory manufacturer. Match finish of exposed fasteners with finish of material being fastened. Provide nonremovable fastener heads to exterior exposed fasteners.

E. Gaskets: Manufacturer's standard tubular or fingered design of neoprene, EPDM, or PVC; or flat design of foam rubber, sponge neoprene, or cork.

F. Butyl Sealant: ASTM C 1311, single-component, solvent-release butyl rubber sealant, polyisobutylene plasticized, and heavy bodied for hooked-type expansion joints with limited movement.

G. Roofing Cement: ASTM D 4586, nonasbestos, fibrated asphalt cement designed for trowel application or other adhesive compatible with roofing system.

2.4 ROOF HATCHES

A. Roof Hatches: Basis of Design: Bilco Company; Type NB Roof Hatch including pull down aluminum ladder as described in architectural drawings. Fabricate roof hatches with insulated double-wall lids and insulated single wall curb frame with integral deck mounting flange and lid frame counterflashing. Fabricate with welded or mechanically fastened and sealed corner joints. Provide continuous weathertight perimeter gasketing and equip with stainless steel hardware.

1. Manufacturers:
   a. Bilco Company (The).
   b. Custom Curb, Inc.
   c. J. L. Industries, Inc.
   d. Metallic Products Corporation.
   e. Milcor Inc.; a Gibraltar Company.
   f. O'Keeffe's Inc.

2. Loads: Fabricate roof hatches to withstand 40-lbf/sq. ft. (1.9-kPa) and 20-lbf/sq. ft. (0.95-kPa) internal loads.

3. Type and Size: Single-leaf lid, 30 by 54 inches.

4. Curb and Lid Material: Aluminum sheet, 0.090 inch (2.28 mm) thick.

   a. Finish: Mill.

5. Insulation: Cellulosic-fiber board.

6. Interior Lid Liner: Manufacturer's standard metal liner of same material and finish as outer metal lid.

7. Exterior Curb Liner: Manufacturer's standard metal liner of same material and finish as metal curb.

8. Fabricate units to minimum height of 12 inches (300 mm), unless otherwise indicated.

9. Hardware: All hardware to be Type 316 Stainless Steel,

   a. Heavy pintle hinges shall be provided
   b. Cover shall be equipped with a spring latch with interior and exterior turn handles
   c. Roof hatch shall be equipped with interior and exterior padlock hasps.
   d. The latch strike shall be a stamped component bolted to the curb assembly.
   e. Cover shall automatically lock in the open position with a rigid hold open arm equipped with a 1” diameter red vinyl grip handle to permit easy release for closing.

f. Compression spring tubes shall be an anti-corrosive composite material and all other hardware shall be zinc plated and chromate sealed. Springs shall have an electrocoated acrylic finish for corrosion resistance.

g. Cover hardware shall be bolted into heavy gauge channel reinforcing welded to the underside of the cover and concealed within the insulation space.

10. Ladder Safety Post: Manufacturer's standard ladder safety post. Post to lock in place on full extension. Provide release mechanism to return post to closed position.

a. Height: 42 inches (1060 mm) above finished roof deck.

b. Material and Finish: Aluminum, mill finished.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions, and other conditions affecting performance of work.

1. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored and is ready to receive roof accessories.
2. Verify dimensions of roof openings for roof accessories.
3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Install roof accessories according to manufacturer's written instructions. Anchor roof accessories securely in place and capable of resisting forces specified. Use fasteners, separators, sealants, and other miscellaneous items as required for completing roof accessory installation. Install roof accessories to resist exposure to weather without failing, rattling, leaking, and fastener disengagement.

B. Install roof accessories to fit substrates and to result in watertight performance.

END OF SECTION 077200

SECTION 078100 – APPLIED FIREPROOFING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this section.

1.2 SUMMARY

A. General: Provide all labor, material, equipment, related services and supervision required, including manufacturing, fabrication, erection and installation for fireproofing in accordance with the requirements of the Contract Documents.

B. Extent of fireproofing as scheduled and/or indicated on the drawings.

C. This section includes the following:

1. Concealed sprayed fire-resistive materials.

2. Exposed sprayed fire-resistive materials.

3. Sealer.

D. Related sections include the following:

1. Division 5, Section 051200 - STRUCTURAL STEEL FRAMING for surface conditions required for structural steel receiving sprayed fire-resistive materials.

2. Division 7, Section 072100 - THERMAL INSULATION for fire-safing insulation.

3. Division 7, Section 078413 – PENETRACTION FIRESTOPPING for through-penetration firestopping systems.

1.3 DEFINITIONS

A. Concealed sprayed fire-resistive material is applied to surfaces that are concealed from view behind other construction when the work is completed.

B. Exposed sprayed fire-resistive material is applied to surfaces that are exposed to view when the work is completed.

1.4 SYSTEM DESCRIPTION

A. Performance Requirements: Provide fireproofing in accordance with requirements as specified herein. Use only the materials explicitly recommended by manufacturer for the application, as stated in the submitted product data and supplementary product literature.

1. Content: Fireproofing materials shall not contain asbestos fibers, mineral wool, or dust particles, nor other substance prohibited by law.

2. Bond Strength: ASTM E 736, not less than the specified bond strength listed in the manufacturer=s data.

3. Surface Burning Characteristics: ASTM E 84, ratings not exceeding flame spread 0 and smoke developed 0.

1.5 SUBMITTALS

A. General: Submit the following in accordance with Conditions of the Contract and Division 1 - General Requirements.

B. Product Data: Manufacturer's technical data for each fire-resistive product specified.

1. Materials List: Submit materials list scheduling each product and the areas proposed for use in the work.

C. Shop Drawings: Submit shop drawings in form of structural framing plans, minimum scale 1/16 inch equals 1 foot, indicating the following:

1. Where and what kinds of surface preparations are required before applying sprayed-on fireproofing.

2. Extent of sprayed-on fireproofing and material type for each different construction and fire resistance rating including the following:

a. Applicable fire-resistive design designations of inspecting and testing agency acceptable to authorize having jurisdiction.

b. Minimum thicknesses needed to achieve required fire resistance ratings of structural components and assemblies.

3. Treatment of sprayed-on fireproofing after its application.

D. Samples: Label samples to indicate product, characteristics and locations in the work. Samples will be reviewed for appearance only.

1. 6 inch by 6 inch samples, indicating average applied thickness, for each application, including sealer as scheduled. All samples shall be encased with a clear protective permanent wrapping and labeled.

E. Product Certificates: Signed by manufacturer of sprayed fire-resistive material certifying that the products furnished comply with requirements.

F. Installer Certificates: Signed by manufacturer certifying that installers comply with specified requirements.

G. Compatibility and Adhesion Test Reports: For primers and other coatings applied to structural steel. Provide reports from a qualified independent testing and inspecting agency engaged by Contractor. Confirm that primers and coatings proposed for application in shop or field are compatible with fire-resistive material. Instruct laboratory to determine compatibility according to requirements specified in "Quality Assurance" Article.

H. Product Test Reports: Indicate that physical properties of proposed sprayed fire-resistive materials comply with specified requirements based on comprehensive testing of current product formulations by a qualified testing and inspecting agency according to requirements specified in "Quality Assurance" Article.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experienced installer certified, licensed, or otherwise qualified by sprayed fire-resistive material manufacturer as having the necessary experience, staff, and training to install manufacturer's products according to specified requirements.

B. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in the jurisdiction where project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of sprayed fire-resistive materials that are similar to those indicated for this project in material, design, and extent.

C. Testing Agency Qualifications: An independent testing and inspecting agency with the experience and capability to conduct the testing indicated without delaying the work, as documented according to ASTM E699.

D. Testing of Fire-Resistive Materials: By a qualified testing and inspecting agency engaged by Contractor or manufacturer according to the following requirements:

1. Sprayed fire-resistive materials are randomly selected for testing from bags bearing the applicable classification marking of UL or another testing and inspecting agency acceptable to authorities having jurisdiction.

2. Testing is performed on specimens of sprayed fire-resistive materials that comply with laboratory testing requirements specified in PART 2 and are otherwise identical to installed fire-resistive materials, including application of accelerant, sealers, topcoats, tamping, troweling, rolling, and water overspray, if any of these are used in final application.

E. Testing for Compatibility and Adhesion: Engage a qualified testing and inspecting agency to prepare compatibility and adhesion test reports required in "Submittals" Article based on testing that complies with the following requirements:

1. Testing for bond per ASTM E736 and requirements specified in UL's "Fire Resistance Directory" about coating materials.

2. Verify that manufacturer of fire-resistive material has not found primers or coatings to be incompatible with fire-resistive material based on its own laboratory testing or field experience.

F. Source Limitations: Obtain each type of sprayed fire-resistive material from one source and by a single manufacturer.

G. Fire-Test-Response Characteristics: Provide sprayed fire-resistive materials and assemblies identical to those tested for the following fire-test-response characteristics per test method indicated below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify packages (bags) containing sprayed fire-resistive material with appropriate markings of applicable testing and inspecting agency.

1. Fire-Resistance Ratings: As indicated by reference to fire-resistive designs listed in UL's "Fire Resistance Directory," or in the comparable publication of another testing and inspecting agency acceptable to authorities having jurisdiction, for sprayed fire-resistive material serving as direct-applied protection, tested per ASTM E119.

2. Surface-Burning Characteristics: As indicated for each sprayed fire-resistive product required, tested per ASTM E84.

H. Minimum Beam and Column Sizes:

1. Fire resistance ratings for UL design assemblies are based upon minimum beam and column sizes. The means of establishing whether a beam of column is larger or smaller than the design minimum size is indicated in the UL Fire Resistance Directory Section AFire Resistance Ratings-ANSI/UL263 (BXUV)," Paragraph ABeams,≅ Subparagraph ABeam Size≅ and is expressed in terms of a W/D ratio where W is the weight of the beam per lineal foot and D is the perimeter of protection material at the interface between the steel section and the protection material. Beams and columns with W/D ratios greater than that of the minimum size specified are considered as larger and may be used in the design assembly.

2. Where beams and columns are considered smaller than the minimum size specified in the design assembly, fire resistance ratings may be increased to that required by use of the formulae listed in AFire Resistance Ratings-ANSI/UL263 (BXUV).≅ For beams, the referenced formula is in Paragraph ABeams," Subparagraph AAdjustment of Sprayed Protection Material Thickness for Unrestrained Beam Ratings for Various Beam Sizes.≅ For columns, the corresponding reference is in Paragraph AColumns.≅

3. Contractor is responsible to ensure that thicknesses of sprayed fire-resistance materials applied are sufficient to meet all UL design assembly requirements for the specified fire resistance ratings.

I. Provide products containing no detectable asbestos as determined according to the method specified in 40 CFR, Part 763, Subpart E, Appendix E, Section 1, "Polarized Light Microscopy."

J. Field Samples: Prior to the Pre-Installation Conference, provide a field sample for each type fireproofing in the building at areas to be designated by the Architect. Prepare a sample not less than 100 square feet in area, and representative of substrate conditions and each different fire rating, exposed fireproofing application and contours. Provide generally smooth finish with uniform texture. Utilize the same materials and installation methods in the sample as required for the final work. Schedule the installation with allowance for sufficient curing so that the sample may be examined, and any necessary adjustments made, at least one week prior to date scheduled for commencing installation of the work. When accepted, sample areas shall serve as the standard for materials, workmanship, and appearance for such work throughout the project and shall remain a part of the final work.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to project site in original, unopened packages with intact and legible manufacturers' labels identifying product and manufacturer; date of manufacture; shelf life, if applicable; and fire-resistance ratings applicable to project.

B. Use materials with limited shelf life within period indicated. Remove from project site and discard materials whose shelf life has expired.

C. Store materials inside, under cover, aboveground, so they are kept dry until ready for use. Remove from project site and discard materials that have been exposed to moisture or deteriorated.

1.8 PROJECT CONDITIONS

A. Environmental Limitations: Do not apply sprayed fire-resistive material when ambient or substrate temperatures are 40 degrees F or lower, unless temporary protection and heat is

provided to maintain temperatures at or above this level for 24 hours before, during, and for 24 hours after product application.

B. Ventilation: Ventilate building spaces during and after application of sprayed fire-resistive material. Use natural means or, where this is inadequate, forced-air circulation until fire-resistive material dries thoroughly.

1.9 SEQUENCING

A. Sequence and coordinate application of sprayed fire-resistive materials with other related work specified in other sections to comply with the following requirements:

1. Provide temporary enclosures for interior applications to prevent deterioration of fire-resistive material due to exposure to unfavorable environmental conditions.

2. Avoid unnecessary exposure of fire-resistive material to abrasion and other damage likely to occur during construction operations subsequent to its application.

3. Do not apply fire-resistive material to metal roof deck substrates until roofing has been completed; prohibit roof traffic during application and drying of fire-resistive material.

4. Do not begin applying fire-resistive material until clips, hangers, supports, sleeves, and other items penetrating fire protection are in place.

5. Defer installing ducts, piping, and other items that would interfere with applying fire-resistive material until application of fire protection is completed.

6. Do not install enclosing or concealing construction until after fire-resistive material has been applied, inspected, tested, and corrections have been made to defective applications.

1.10 WARRANTY

A. General Warranty: The special warranty specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.

B. Special Warranty: Submit a written warranty, executed by Contractor and cosigned by Installer, agreeing to repair or replace sprayed fire-resistive materials that fail within the specified warranty period.

1. Failures include, but are not limited to, cracking, flaking, eroding in excess of specified requirements; peeling; and delaminating of sprayed fire-resistive materials from substrates due to defective materials and workmanship within the specified warranty period.

2. Not covered under the warranty are failures due to damage by occupants and Owner's maintenance personnel, exposure to environmental conditions other than those investigated and approved during fire-response testing, and other causes not reasonably foreseeable under conditions of normal use.

C. Warranty Period: 2 years from date of Substantial Completion.

1.11 MAINTENANCE

A. Maintenance Manuals: Furnish complete manuals describing the materials and procedures to be followed in maintaining the work. Include manufacturers' brochures describing the actual materials used in the work.

PART 2 - PRODUCTS

2.1 CONCEALED SPRAYED FIRE-RESISTIVE MATERIALS

A. General: For concealed applications of sprayed fire-resistive materials, provide manufacturer's standard products complying with requirements indicated in this Article for material composition and physical properties representative of installed products.

B. Material Composition:

1. Cementitious sprayed fire-resistive material consisting of factory-mixed, dry formulation of gypsum or portland cement binders and lightweight mineral or synthetic aggregates mixed with water at project site to form a slurry or mortar for conveyance and application.

C. Physical Properties: Minimum values, unless otherwise indicated, or higher values required to attain designated fire-resistance ratings, measured per standard test methods referenced with each property listed as follows:

1. Dry Density: 15 lb/cu. ft. for average and individual densities regardless of density indicated in referenced fire-resistive design, or greater if required to attain fire-resistance ratings indicated, per ASTM E605 or AWCI Technical Manual 12-A, Appendix A, "Alternate Method for Density Determination."

2. Thickness: Provide minimum average thickness required for fire-resistive design indicated according to the following criteria, but not less than 0.375 inch, per ASTM E605.

a. Where the referenced fire-resistive design lists a thickness of 1 inch or greater, the minimum allowable individual thickness of sprayed fire-resistive material is the design thickness minus 0.25 inch.

b. Where the referenced fire-resistive design lists a thickness of less than 1 inch but more than 0.375 inch, the minimum allowable individual thickness of sprayed fire-resistive material is the greater of 0.375 inch or 75 percent of the design thickness.

c. No reduction in average thickness is permitted for those fire-resistive designs whose fire-resistance ratings were established at densities of less than 15 lb/cu. ft.

3. Bond Strength: 300 lbf/sq. ft. per ASTM E736 under the following conditions:

a. Field test sprayed fire-resistive material that is applied to flanges of wide-flange structural-steel members on surfaces matching those that will exist for remainder of steel receiving fire-resistive material.

b. If surfaces of structural steel receiving sprayed fire-resistive material are primed or otherwise painted, perform series of bond tests specified in UL's "Fire Resistance Directory" for coating materials.

c. Minimum thickness of sprayed fire-resistive material tested in laboratory shall be 0.75 inch.

4. Compressive Strength: 10 lbf/sq. in. as determined in the laboratory per ASTM E761. Minimum thickness of sprayed fire-resistive material tested shall be 0.75 inch and minimum dry density shall be as specified, but not less than 15 lb/cu. ft.

5. Corrosion Resistance: No evidence of corrosion per ASTM E937.

6. Deflection: No cracking, spalling, delamination, or the like per ASTM E759.

7. Effect of Impact on Bonding: No cracking, spalling, delamination, or the like per ASTM E760.

8. Air Erosion: Maximum weight loss of 0.025 g/sq. ft. in 24 hours per ASTM E859. For laboratory tests, minimum thickness of sprayed fire-resistive material is 0.75 inch, maximum dry density is 15 lb/cu. ft., test specimens are not prepurged by mechanically induced air velocities, and tests are terminated after 24 hours.

D. Fire-Test-Response Characteristics: Provide sprayed fire-resistive materials with the following surface-burning characteristics as determined by testing identical products per ASTM E84 by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.

1. Flame Spread: 10 or less.

2. Smoke Developed: 0.

E. Products: Subject to compliance with requirements, provide products by one of the following:

1. Cementitious Sprayed Fire-Resistive Material (Standard Density):

a. Monokote Type MK-6; Grace & Co., Construction Products Division.

b. Cafco 300; Isolatek International Corp., Cafco Products.

2.2 EXPOSED SPRAYED FIRE-RESISTIVE MATERIALS

A. General: For exposed applications of sprayed fire-resistive materials, provide manufacturer's standard products complying with requirements indicated for material composition and for minimum physical properties of each product listed, measured by standard test methods referenced with each property.

B. Cementitious Sprayed Fire-Resistive Material: Factory-mixed, dry, cement aggregate formulation, chloride-free formulation of portland cement binders, additives, and inorganic aggregates, mixed with water at project site to form a slurry or mortar for conveyance and application.

C. Physical Properties: Minimum values, unless otherwise indicated, or higher values required to attain designated fire-resistance ratings, measured per standard test methods referenced with each property listed as follows:

1. Dry Density: Values for average and individual densities as required for fire-resistance ratings indicated, per ASTM E605 or AWCI Technical Manual 12-A, Appendix A, "Alternate Method for Density Determination," but with an average density of not less than 39 lb/cu. ft.

2. Bond Strength: 3000 lbf/sq. ft. per ASTM E736.

3. Compressive Strength: 350 lbf/sq. in. per ASTM E761.

4. Corrosion Resistance: No evidence of corrosion per ASTM E937.

5. Deflection: No cracking, spalling, delamination, or the like per ASTM E759.

6. Air Erosion: Maximum weight loss of 0.025 g/sq. ft. per ASTM E859.

7. Combustion Characteristics: Passes ASTM E136.

D. Fire-Test-Response Characteristics: Provide sprayed fire-resistive materials with the following surface-burning characteristics as determined by testing identical products per ASTM E84 by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.

1. Flame Spread: 5 or less.

2. Smoke Developed: 0.

E. Products: Subject to compliance with requirements, provide one of the following:

1. Cementitious Sprayed Fire-Resistive Material: (Medium Density)

a. Monokote Type Z-106; Grace & Co., Construction Products Division.

b. Cafco 400; Isolatek International Corp., Cafco Products.

2.3 AUXILIARY FIRE-RESISTIVE MATERIALS

A. General: Provide auxiliary fire-resistive materials that are compatible with sprayed fire-resistive materials and substrates and are approved by UL or another testing and inspecting agency acceptable to authorities having jurisdiction for use in fire-resistive designs indicated.

B. Substrate Primers: For use on each substrate and with each sprayed fire-resistive product, provide primer that complies with one or more of the following requirements:

1. Primer's bond strength complies with requirements specified in UL's "Fire Resistance Directory" for coating materials based on a series of bond tests per ASTM E736.

2. Primer is identical to those used in assemblies tested for fire-test-response characteristics of sprayed fire-resistive material per ASTM E119 by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.

C. Adhesive for Bonding Fire-Resistive Material: Product approved by manufacturer of sprayed fire-resistive material.

D. Metal Lath: Expanded metal lath fabricated from material of weight, configuration, and finish required to comply with fire-resistive designs indicated and fire-resistive product manufacturer's written recommendations. Include clips, lathing accessories, corner beads, and other anchorage devices required to attach lath to substrates and to receive sprayed fire-resistive material.

E. Reinforcing Fabric: Glass-fiber fabric of type, weight, and form required to comply with fire-resistive designs indicated, approved by manufacturer of intumescent mastic fire-resistive material.

F. Reinforcing Mesh: Metallic mesh reinforcement of type, weight, and form required to comply with fire-resistive designs indicated, approved by manufacturer of intumescent mastic fire-resistive material. Include pins and attachment.

G. Sealer: Transparent-drying, water-dispensable protective coating by manufacturer of fire and resistive material. Nontoxic, odorless, nonflammable ready to use. Classified with ASTM E-119, ASTM E-84 Class-A, listed in UL Fire Resistance Directory.

1. Acceptable Products and Manufacturers:

a. “Firebond” Fiberlock Technologies, Inc.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer present, to determine whether they are in satisfactory condition to receive sprayed fire-resistive material. A substrate is in satisfactory condition if it complies with the following:

1. Substrates comply with requirements in the section where the substrate and related materials and construction are specified.

2. Substrates are free of oil, grease, rolling compounds, incompatible primers, loose mill scale, dirt, or other foreign substances capable of impairing bond of fire-resistive material with substrate under conditions of normal use or fire exposure.

3. Objects penetrating fire-resistive material, including clips, hangers, support sleeves, and similar items, are securely attached to substrates.

4. Substrates are not obstructed by ducts, piping, equipment, and other suspended construction that will interfere with applying fire-resistive material.

B. Conduct tests according to fire-resistive material manufacturer's written recommendations to verify that substrates are free of oil, rolling compounds, and other substances capable of interfering with bond.

C. Do not proceed with installation of fire-resistive material until unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean substrates of substances that could impair bond of fire-resistive material, including oil, grease, rolling compounds, incompatible primers, and loose mill scale.

B. For exposed applications, repair substrates to remove any surface imperfections that could affect uniformity of texture and thickness in finished surface of sprayed fire-resistive material. Remove minor projections and fill voids that would telegraph through fire-resistive products after application.

C. Cover other work subject to damage from fallout or overspray of fire-resistive materials during application. Provide temporary enclosure as required to confine spraying operations,

protect the environment, and ensure maintenance of adequate ambient conditions for temperature and ventilation.

3.3 INSTALLATION

A. Comply with fire-resistive material manufacturer's written instructions for mixing materials, application procedures, and types of equipment used to convey and spray on fire-resistive material, as applicable to particular conditions of installation and as required to achieve fire-resistance ratings indicated.

B. Apply sprayed fire-resistive material that is identical to products tested as specified in PART 1 in "Product Test Reports" in "Submittals" Article, with respect to rate of application, accelerator use, sealers, topcoats, tamping, troweling, water overspray, or other materials and procedures affecting test results.

C. Install metal lath, as required, to comply with fire-resistance ratings and fire-resistive material manufacturer's written recommendations for conditions of exposure and intended use. Securely attach lath to substrate in position required for support and reinforcement of fire-resistive material. Use anchorage devices of type recommended in writing by fire-resistive material manufacturer. Attach lathing accessories where indicated or required for secure attachment to substrate.

D. Coat substrates with adhesive before applying fire-resistive material where required to achieve fire-resistance rating or as recommended in writing by fire-resistive material manufacturer for material and application indicated.

E. Extend fire-resistive material in full thickness over entire area of each substrate to be protected. Unless otherwise recommended in writing by fire-resistive material manufacturer, install body of fire-resistive covering in a single course.

F. Spray apply fire-resistive materials to maximum extent possible. Following the spraying operation in each area, complete the coverage by trowel application or other placement method recommended in writing by manufacturer.

G. For applications over encapsulant materials, including lockdown (post-removal) encapsulants, apply sprayed fire-resistive material that differs in color from that of the encapsulant over which it is applied.

H. Installing Concealed Sprayed Fire-Resistive Materials:

1. Apply concealed fire-resistive material in thicknesses and densities indicated, but not less than those required to achieve fire-resistance ratings designated for each condition, and comply with requirements for thickness specified in PART 2 "Concealed Sprayed Fire-Resistive Materials" Article.

2. Apply clear sealer to concealed sprayed fire-resistive material adjacent to ceiling-mounted mechanical units.

I. Installing Exposed Sprayed Fire-Resistive Materials:

a. Apply exposed sprayed fire-resistive material in thicknesses and densities indicated, but not less than that required to achieve fire-resistance ratings designated for each condition, unless greater thicknesses and densities are indicated.

b. Apply 2 coats of sealer after hand rolling sprayed fire-resistive material.

J. Provide a uniform finish complying with description indicated for each type of material matching finish approved for field-erected mockup.

K. Apply sprayed fire-resistive material to produce on even spray-textured finish by rolling flat surfaces of fireproofed members with a damp paint roller to remove drippings and excessive roughness (for concealed and exposed applications).

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and to prepare test reports.

1. Testing and inspecting agency will interpret tests and state in each report whether tested work complies with or deviates from requirements.

B. Testing and inspecting of completed applications of sprayed fire-resistive material will take place in successive stages, in areas of extent and using methods as follows. Do not proceed with application of fire-resistive material for the next area until test results for previously completed applications of fire-resistive material show compliance with requirements.

1. Thickness measurement and acceptance criteria:

a. Twenty-five percent of the structural frame, columns and beams in each story shall be inspected for thickness determination in accordance with ASTM E605.

b. Ten percent of beams (other than structural frame members) on each floor shall be selected at random and shall be measured for thickness as required by these methods.

c. Floor thickness measurements, where required, shall be taken on a random basis for each 10,000 square feet of area.

d. The average thickness as determined by this procedure shall not be less than that specified in inches subject to a tolerance of $\pm$ 1/8 inch. The acceptance of measurements with a minus tolerance greater than 1/8 inch shall not be permitted. Measurements greater than 1/8 inch above the required shall not be used to determine the thickness average.

e. Where thicknesses are less than that required, the condition shall be corrected. The location of any uncorrected areas shall be reported to the building official.

2. Density Measurement and Acceptance Criteria:

a. There shall be density test specimens taken from a column, a beam and a deck for each 10,000 square feet of floor area or fraction thereof or from each floor if the floor area is smaller than 10,000 square feet in accordance with ASTM E605.

b. No density sample shall have a density less than 5 percent below the specified density. Where the density is less than the 5 percent tolerance allowed above, the work shall be corrected to the satisfaction of the building official.

3. When testing discovers applications of fire-resistive material not in compliance with requirements, testing and inspecting agency will perform additional random testing to determine extent of noncompliance.

C. Remove and replace applications of fire-resistive material where test results indicate that they do not comply with specified requirements for cohesion and adhesion or for density, or both.

D. Apply additional fire-resistive material per manufacturer's written instructions where test results indicate that thickness does not comply with specified requirements.

E. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.5 CLEANING, PROTECTING, AND REPAIR

A. Cleaning: Immediately after completing spraying operations in each containable area of project, remove material overspray and fallout from surfaces of other construction and clean exposed surfaces to remove evidence of soiling.

B. Cure exposed cementitious sprayed fire-resistive material according to product manufacturer's written recommendations to prevent premature drying.

C. Protect fire-resistive material, according to advice of product manufacturer and Installer, from damage resulting from construction operations or other causes so fire protection will be without damage or deterioration at the time of Substantial Completion.

D. Coordinate application of fire-resistive material with other construction to minimize the need to cut or remove fire protection. As installation of other construction proceeds, inspect fire-resistive material and patch any damaged or removed areas.

E. Repair or replace work that has not been successfully protected.

F. Provide material as scheduled, complying with fire-rating requirements.

1. Selection of appropriate UL design ratings shall be based on scheduled fire ratings and fireproofing manufacturers tested assemblies.

3.6 SCHEDULES

A. Fire Resistance Rating and Density Matrix: Provide sprayed fireproofing for steel beams and connections as scheduled.

Structural Members(5)		**Assembly Fire Rating(3)**	**Density(4)**	**Manufacturer's UL Design Numbers**
Steel Beams and Connections at Stairs, Elevator Shafts, Concrete floor steel support and connection, Wall panel to wall panel steel connections, CAB floor structure		2 Hour	MD(1) SD(2)	MD Grace-P732 Cafco-S721 SD Grace-P732 Cafco-P719

Legend:

MD - Medium Density
SD - Standard Density

Footnotes:
(1) Provide medium density fireproofing on exposed steel beams or steel joists in all rooms or spaces not scheduled to receive a suspended finished ceiling.
(2) Provide standard density fireproofing on steel beams or steel joists in all rooms or spaces scheduled to receive a suspended finished ceiling.
(3) Minimum required hourly fire rating.
(4) Abbreviation indicates type of sprayed fireproofing; i.e., Standard Density or Medium Density.
(5) Provide two coats of clear sealer on all exposed fireproofing. Adjacent to all mechanical equipment in concealed ceiling plenums (concealed fireproofing applications) provide two coats of clear sealer on fireproofing.

END OF SECTION 078100

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SECTION 078413 – PENETRATION FIRESTOPPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this section.

1.2 SUMMARY

A. Provide firestopping penetration sealing system which shall have a continuous bond between substrate and penetrating item to assure a positive and effective fire and smoke seal. Provide sealing system for all penetrations through floor slabs (not in protected enclosures), fire walls and other fire rated partitions or assemblies.

B. Typical use locations shall include but not be limited to penetrations made by the following:

1. Ducts.

2. Cables - power and telephone.

3. Conduit - steel and PVC.

4. Pipe - steel, glass, insulated and plastic.

5. Blank - penetrations.

6. Edge of slab/roof:

a. Perimeter (See attachment)
b. Interior

7. Head of wall terminations:

a. Gypsum board
b. CMU

C. Coordinate all sleeves (sizes and locations) specified in Divisions 21 thru 27 of these specifications.

1. Refer to Division 23 sections specifying duct and piping penetrations.

2. Refer to Division 26 & 27 sections specifying cable and conduit penetrations.

D. Sealing system must be installed by a licensed applicator and in strict accordance with the latest manufacturer's instructions and details.

1.3 SUBMITTALS

A. Submit manufacturer's product data for each type of seal and accessory to be used. Data shall include product characteristics, typical uses, performance and limitation criteria and test data.

B. Shop Drawings: For each through-penetration firestop system, show each kind of construction condition penetrated, relationships to adjoining construction, and kind of penetrating item.

1. Submit documentation, including illustrations, from a qualified testing and inspecting agency that is applicable to each through-penetration firestop system configuration for construction and penetrating items.

2. Include detail drawings of each proposed assembly identifying intended products and applicable UL, GA or FM system number or UL classified devices. Indicate which firestop materials will be used and thickness for different hourly ratings.

3. Where Project conditions require modification of qualified testing and inspecting agency's illustration to suit a particular through-penetration firestop condition, submit illustration, with modifications marked, approved by through-penetration firestop system manufacturer's fire-protection engineer.

C. Product Certificates: Signed by manufacturers of through-penetration firestop system products certifying that products furnished comply with requirements.

D. Material Safety Data Sheet (MSDS): Submit MSDS for each firestop product specified.

1.4 QUALITY ASSURANCE

A. Fire-Resistance Ratings: Provide assemblies that have been tested, approved and listed by UL, Factory Mutual, Omega, Warnock Hensey and other certified labs approved by the Architect.

B. ASTM Standards: Firestopping materials shall conform to both Flame (F) and Temperature (T) ratings as tested by nationally accepted test agencies per ASTM E814 or UL 1479 fire tests. The F rating and T rating must be a minimum of 1 hour but not less than the fire-resistance rating of the assembly being penetrated. The fire test shall be conducted with a minimum positive pressure differential of 0.03 inch of water column.

C. Firestopping shall be performed by an installer trained or approved by firestop manufacturer. Equipment used shall be in accordance with firestop manufacturer's written installation instructions. A manufacturerɔs willingness to sell its through-penetration firestop system products to Contractor or to an installer engaged by Contractor does not in itself confer qualification on buyer.

D. For through-penetration firestop systems exposed to view, traffic, moisture, and physical damage, provide products that after curing do not deteriorate when exposed to these conditions both during and after construction.

1. For piping penetrations for plumbing and wet-pipe sprinkler systems, provide moisture-resistant through-penetration firestop systems.

2. For floor penetrations with annular spaces exceeding 4 inches in width and exposed to possible loading and traffic, provide firestop systems capable of supporting floor loads involved either by installing floor plates or by other means.

3. For penetrations involving insulated piping, provide through-penetration firestop systems not requiring removal of insulation.

E. Source Limitations: Obtain through-penetration firestop systems, for each kind of penetration and construction condition indicated, from a single manufacturer.

F. Provide field mock-up of each type of firestopping. Do not proceed with remainder of firestopping until obtaining approval from Architect. Approved mock-ups may become part of final work.

G. Information on drawings referring to specific design designations of through-penetration firestop systems is intended to establish requirements for performance based on conditions that are expected to exist during installation. Any changes in conditions and designated systems require the Architectəs prior approval. Submit documentation showing that the performance of proposed substitutions equals or exceeds that of the systems they would replace and are acceptable to authorities having jurisdiction.

1.5 DELIVERY, STORAGE AND HANDLING

A. Deliver all materials in original unopened packages fully identified with manufacturer's name, trade name and UL label. Materials shall be stored off the ground and protected from environmental conditions as required by manufacturer.

1.6 PROJECT CONDITIONS

A. Environmental and Existing Conditions Limitations: Do not install through-penetration firestop systems when ambient or substrate temperatures are outside limits permitted by through-penetration firestop system manufacturers or when substrates are wet due to rain, frost, condensation, or other causes.

B. Ventilate through-penetration firestop systems per manufacturer's written instructions by natural means or, where this is inadequate, forced-air circulation.

1.7 COORDINATION

A. Coordinate construction of openings and penetrating items to ensure that through-penetration firestop systems are installed according to specified requirements.

B. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate through-penetration firestop systems.

1.8 WARRANTY

A. Provide written warranty, signed by manufacturer of firestopping materials and his authorized installer, agreeing to replace/repair defective materials and workmanship as required to maintain firestopping conditions. Warranty shall state that the firestopping materials have been installed and used properly and for the purpose which intended.

1. Warranty period is 2 years after date of substantial completion.

B. If products offered have a manufacturer's warranty that states that Owner/user shall test application/determine suitability then Contractor shall have independently monitored tests performed on conditions identical to proposed construction, and shall submit copies of these tests for review. Submittals made without this testing will not be considered or approved.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Provide products from or equal to one of the following:

1. 3M Fire Protection Products.

2. Thermal Ceramics.

3. Dow Corning.

4. Hilti Firestop Systems.

5. Bio Fireshield Inc.

6. IPC - International Protective Coatings.

7. STI - Specified Technologies Inc.

8. Cafco Through Penetration Systems; Isolatek International.

2.2 FIRESTOPPING, GENERAL

A. Compatibility: Provide through-penetration firestop systems that are compatible with one another, with the substrates forming openings, and with the items, if any, penetrating through-penetration firestop systems, under conditions of service and application, as demonstrated by through-penetration firestop system manufacturer based on testing and field experience.

B. Accessories: Provide components for each through-penetration firestop system that are needed to install fill materials and to comply with specified requirements. Use only components specified by through-penetration firestop system manufacturer and approved by the qualified testing and inspecting agency for firestop systems indicated. Accessories include, but are not limited to, the following items:

1. Permanent forming/damming/backing materials, including the following:

a. Slag-/rock-wool-fiber insulation.
b. Sealants used in combination with other forming/damming/backing materials to prevent leakage of fill materials in liquid state.
c. Fire-rated form board.
d. Fillers for sealants.

2. Temporary forming materials.

3. Substrate primers.

4. Collars.

5. Steel sleeves.

C. Penetration seals shall be of the type and shape required to continuously fill the annular space between the pipe, conduit, cable, etc., and the wall or floor opening with or without sleeves.

D. Seal shall be constructed to provide electrical insulation between the pipe and wall, thus reducing the chances of cathodic reaction between these members.

E. Provide materials as required for all blank openings through floor and walls where a fire rating is required.

F. Provide metal sleeves, collars and plates not specified in other sections as required to meet the fire resistance ratings in which the penetrations occur.

2.3 FILL MATERIALS FOR THROUGH-PENETRATION FIRESTOP SYSTEMS

A. Ceramic-Fiber and Mastic Coating: Ceramic fibers in bulk form formulated for use with mastic coating, and ceramic fiber manufacturer's mastic coating.

B. Ceramic-Fiber Sealant: Single-component formulation of ceramic fibers and inorganic binders.

C. Endothermic, Latex Compound Sealant: Single-component, endothermic, latex formulation.

D. Intumescent, Latex Sealant: Single-component, intumescent, latex formulation.

E. Intumescent Putty: non-hardening, dielectric, water-resistant putty containing no solvents, inorganic fibers, or silicone compounds.

F. Intumescent Wrap Strips: Single-component, elastomeric sheet with aluminum foil on one side.

G. Job-Mixed Vinyl Compound: Prepackaged vinyl-based powder product for mixing with water at Project site to produce a paintable compound, passing ASTM E136, with flame-spread and smoke-developed ratings of zero per ASTM E84.

H. Mortar: Prepackaged dry mix composed of a blend of inorganic binders, fillers, and lightweight aggregate formulated for mixing with water at Project site to form a nonshrinking, homogenous mortar.

I. Pillows/Bags: Re-usable, heat-expanding pillows/bags composed of glass-fiber cloth cases filled with a combination of mineral-fiber, water-insoluble expansion agents and fire-retardant additives.

J. Silicone Foam: Two-component, silicone-based liquid elastomer that, when mixed, expands and cures in place to produce a flexible, nonshrinking foam.

K. Silicone Sealant: Moisture-curing, single-component, silicone-based, neutral-curing elastomeric sealant of grade indicated below:

1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces and non-sag formulation for openings in vertical and other surfaces requiring a non-slumping/ gunnable sealant, unless indicated firestop system limits use to non-sag grade for both opening conditions.

L. Solvent-Release-Curing Intumescent Sealant: Solvent-release- curing, single-component, synthetic-polymer-based sealant of grade indicated below:

1. Grade: Pourable (self-leveling) formulation for openings in horizontal surfaces and non-sag formulation for openings in vertical and other surfaces requiring a non-slumping/gunnable sealant, unless indicated firestop system limits use to non-sag grade for both opening conditions.

2.4 FIRE-RESISTIVE ELASTOMERIC JOINT SEALANTS

A. Elastomeric Sealant Standard: Provide manufacturer's standard chemically curing, elastomeric sealants of base polymer indicated that complies with ASTM C920 requirements, including those referenced for Type, Grade, Class, and Uses, and requirements specified in this Section applicable to fire-resistive joint sealants.

B. Sealant Colors: Provide color of exposed joint sealants to comply with the following:

1. Provide colors selected by Architect from manufacturerɔs standards.

C. Single-Component, Neutral-Curing Silicone Sealant: Type S; Grade NS; Class 25; exposure-related Use NT, and joint-substrate-related Uses M, G, A, and (as applicable to joint substrates indicated) O.

1. Additional Movement Capability: Provide sealant with the capability to withstand the following percentage changes in joint width existing at time of installation, when tested for adhesion and cohesion under maximum cyclic movement per ASTM C719, and remain in compliance with other requirements of ASTM C920 for uses indicated:

a. 100 percent movement in extension and 50 percent movement in compression for a total of 150 percent movement.

D. Multi-component, Non-sag, Urethane Sealant: Type M; Grade NS; Class 25; exposure-related Use NT, and joint-substrate-related Uses M, A, and (as applicable to joint substrates indicated) O.

1. Additional Movement Capability: Provide sealant with the capability to withstand the following percentage change in joint width existing at time of installation, when tested for adhesion and cohesion under maximum cyclic movement per ASTM C719, and remain in compliance with other requirements of ASTM C920 for uses indicated:

a. 50 percent movement in both extension and compression for a total of 100 percent movement.

E. Single-Component, Non-sag, Urethane Sealant: Type S; Grade NS; Class 25; and Uses NT, M, A, and (as applicable to joint substrates indicated) O.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine all penetrations and verify that all sleeves and openings are of the proper size. Examine substrates and conditions with installer present for compliance with requirements for opening configurations, penetrating items, substrates and other conditions, affecting performance of firestop systems. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean surfaces and substrates of dirt, oil, loose materials and other foreign materials which may affect the proper bond or installation of the firestops in strict accordance with manufacturer's written instructions.

3.3 INSTALLING THROUGH-PENETRATION FIRESTOPS

A. General: Comply with the through-penetration firestop manufacturer's installation instructions and drawings pertaining to products and applications indicated.

B. Install forming/damming materials and other accessories of types required to support fill materials during their application and in the position needed to produce the cross-sectional shapes and depths required to achieve fire ratings of designated through-penetration firestop systems. After installing fill materials, remove combustible forming materials and other accessories not indicated as permanent components of firestop systems.

C. Install fill materials for through-penetration firestop systems by proven techniques to produce the following results:

1. Completely fill voids and cavities formed by openings, forming materials, accessories, and penetrating items.

2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.

3. For fill materials that will remain exposed after completing Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

D. Any material found to be defective shall be removed and replaced by the applicator.

3.4 INSTALLING FIRE-RESISTIVE JOINT SEALANTS

A. General: Comply with the "System Performance Requirements" article in Part 1, with ASTM C 1193, and with the sealant manufacturer's installation instructions and drawings pertaining to products and applications indicated.

B. Install joint fillers to provide support of sealants during application and at position required to produce the cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability and develop fire-resistance rating required.

C. Install sealants by proven techniques that result in sealants directly contacting and fully wetting joint substrates, completely filling recesses provided for each joint configuration, and providing uniform, cross-sectional shapes and depths relative to joint width that optimum sealant movement capability. Install sealants at the same time joint fillers are installed.

D. Tool non-sag sealants immediately after sealant application and prior to the time skinning or curing begins. Form smooth, uniform beads of configuration indicated or required to produce fire-resistance rating, as well as to eliminate air pockets, and to ensure contact and adhesion of sealants with sides of joint. Remove excess sealant from surfaces adjacent to joint. Do not use tooling agents that discolor sealants or adjacent surfaces or are not approved by sealant manufacturer.

E. Any material found to be defective shall be removed and replaced by the applicator.

3.5 CLEANING AND PROTECTION

A. Clean off excess fill materials adjacent to openings as Work progresses by methods and with cleaning materials that are approved in writing by through-penetration firestop system manufacturers and that do not damage materials in which openings occur.

B. Provide final protection and maintain conditions during and after installation that ensure through-penetration firestop systems are without damage or deterioration at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated through-penetration firestop systems immediately and install new materials to produce through-penetration firestop systems complying with specified requirements.

C. Add protective sheeting to cover installed joints and remove after joints are inspected and when the cavity is ready for concealment (installation of interior partitions).

END OF SECTION 078413

SECTION 079200 – JOINT SEALANTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes joint sealants for coordination with systems specified in Section 033000 and for use at the following locations:

1. Exterior joints in vertical surfaces and non-traffic horizontal surfaces as indicated below:

a. Joints between different material.
b. Perimeter joints between materials and frames of doors.
c. Control and expansion joints in ceiling and overhead surfaces.
d. Other joints as indicated.

2. Interior joints in vertical surfaces and horizontal non-traffic surfaces as indicated below:

a. Control and expansion joints on exposed interior surfaces of exterior walls.
b. Perimeter joints of exterior openings where indicated.
c. C.M.U. control and expansion joints.
d. Vertical control joints on exposed surfaces of interior unit masonry walls and partitions.
e. Perimeter joints between interior wall surfaces and frames of interior doors.
f. Other joints as indicated.

B. For Precast and Cast in Place Concrete joints – See Section 033000.

1.3 SYSTEM PERFORMANCE REQUIREMENTS

A. Provide elastomeric joint sealants that have been produced and installed to establish and to maintain watertight and airtight continuous seals without causing staining or deterioration of joint substrates.

B. Provide joint sealants for interior applications that have been produced and installed to establish and maintain airtight continuous seals that are water resistant and cause no staining or deterioration of joint substrates.

1.4 SUBMITTALS

A. General: Submit the following according to Conditions of contract and Division 1 Specification Sections.

B. Product data from manufacturers for each joint sealant product required.

C. Samples for initial selection purposes in form of manufacturer's standard bead samples, consisting of strips of actual products showing full range of colors available, for each product exposed to view.

D. Samples for verification purposes of each type and color of joint sealant required. Install joint sealant samples in 1/2-inch-wide joints formed between two 6-inch-long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.

E. Certificates from manufacturers of joint sealants attesting that their products comply with specification requirements and are suitable for the use indicated.

F. Compatibility and adhesion test reports from elastomeric sealant manufacturer indicating that materials forming joint substrates and joint sealant backings have been tested for compatibility and adhesion with joint sealants. Include sealant manufacturer's interpretation of test results relative to sealant performance and recommendations for primers and substrate preparation needed to obtain adhesion.

G. Product test report for each type of sealants indicated, evidencing compliance with requirements specified.

H. Preconstruction field test reports indicating which products and joint preparation methods demonstrate acceptable adhesion to joint substrates.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experienced Installer who has completed joint sealant applications similar in material, design, and extent to that indicated for this project that have resulted in construction with a record of successful in-service performance.

B. Single Source Responsibility for Joint Sealant Materials: Obtain joint sealant materials from a single manufacturer for each different product required.

C. Preconstruction Compatibility and Adhesion Testing: Submit to joint sealant manufacturers samples of materials that will contact or affect joint sealants for compatibility and adhesion testing as indicated below.

1. Use test methods standard with manufacturer to determine if priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.

2. Testing will not be required when joint sealant manufacturer is able to submit joint preparation data required above that are acceptable to Architect and are based on previous testing of current sealant products for adhesion to, and compatibility with, joint substrates and other materials matching those submitted.

D. Product Testing: Provide comprehensive test data for each type of joint sealant based on tests conducted by a qualified independent testing laboratory on current product formulations within a 24-month period preceding date of contractor's submittal of test results to Architect.

1. Test elastomeric sealants for compliance with requirements specified by reference to ASTM C 920. Include test results for hardness, stain resistance, adhesion and cohesion under cyclic movement (per ASTM C 719), at low-temperature flexibility, modulus of elasticity at 100 percent strain, effects of heat aging, and affects of accelerated weathering.

E. Preconstruction Field Testing: Prior to installation of joint sealants, field-test their adhesion to joint substrates as follows:

1. Locate test joints where indicated or, if not indicated, as directed by Architect.

2. Conduct field tests for each application indicated below:

   a. Each type of elastomeric sealant and joint substrate indicated.
   b. Each type of non-elastomeric sealant and joint substrate indicated.

3. Notify Architect one week in advance of the dates and times when mock-ups will be erected.

4. Test Method: Test joint sealants by hand pull method described below:

   a. Install joint sealants in 5-feet joint lengths using same materials and methods for joint preparation and joint sealant installation required for completed work. Allow sealants to cure fully before testing.
   b. Make knife cuts horizontally from one side of joint to the other followed by 2 vertical cuts approximately 2 inches long at side of joint and meeting horizontal cut at top of 2-inch cuts. Place a mark 1 inch from top of 2-inch piece.
   c. Use fingers to grasp 2-inch piece of sealant just above 1-inch mark; pull firmly down at a 90-degree angle or more while holding a ruler along side of sealant. Pull sealant out of joint to the distance recommended by sealant manufacturer for testing adhesive capability, but not less than that equaling specified maximum movement capability in extension; hold this position for 10 seconds.

5. Report whether or not sealant in joint connected to pulled-out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each type of product and joint substrate.

6. Evaluating of Field Test Results: Sealants not evidencing adhesive failure from testing, in absence of other indications of noncompliance with requirements, will be considered satisfactory. Do not use sealants that fail to adhere to joint substrates during testing.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to project site in original unopened containers or bundles with labels indicating manufacturer, product name and designation, color, expiration period for use, pot life, curing time, and mixing instructions for multi-component materials.

B. Store and handle materials in compliance with manufacturer's recommendations to prevent their deterioration or damage due to moisture, high or low temperatures, contaminants, or other causes.

1.7 PROJECT CONDITIONS

A. Environmental Conditions: Do not proceed with installation of joint sealants under the following conditions:

1. When ambient and substrate temperature conditions are outside the limits permitted by joint sealant manufacturer.

2. When joint substrates are wet.

B. Joint Width Conditions: Do not proceed with installation of joint sealants where joint widths are less than allowed by joint sealant manufacturer for application indicated.

C. Joint Substrate Conditions: Do not proceed with installation of joint sealants until contaminants capable of interfering with their adhesion are removed from joint substrates.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

A. Compatibility: Provide joint sealants, joint fillers, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.

B. Colors: Provide color of exposed joint sealants to comply with the following:

1. Provide selections made by Architect from manufacturer's full range of standard colors for products of type indicated.

2.2 ELASTOMERIC JOINT SEALANTS

A. Elastomeric Sealant Standard: Provide manufacturer's standard chemically curing elastomeric sealants that comply with ASTM C 920, including those requirements referencing ASTM C 920 classifications for Type, Grade, Class, and Uses.

B. Products: Subject to compliance with requirements, provide one of the products specified.

2.3 SOLVENT-RELEASE-CURING JOINT SEALANTS

A. Acrylic Sealant: Manufacturer's standard one-part, nonsag, solvent-release-curing acrylic terpolymer sealant complying with AAMA 808.3 or FS TT-S-00230 or both, with capability when tested for adhesion and cohesion under maximum cyclic movement per ASTM C 719, to withstand the following percentage change in joint width existing at time of application and remain adhered to joint substrates indicated for this project without failing cohesively:

1. 7-1/2 percent movement in both extension and compression for a total of 15 percent.

B. Butyl Sealant: Manufacturer's standard one-part, non-sag, solvent-release-curing, polymerized butyl sealant complying with ASTM C 1085 and formulated with minimum of 75 percent solids to be non-staining, paintable, and have a tack-free time of 24 hours or less.

C. Pigmented Narrow Joint Sealant: Manufacturer's standard, solvent-release-curing, pigmented synthetic rubber sealant complying with AAMA 803.3 and formulated for sealing joints 3/16 inch or smaller in width.

D. Available Products: Subject to compliance with requirements, provide one of the following:

1. Acrylic Sealant:

a. "60+Unicrylic," Pecora Corp.
b. "PTI 738," Protective Treatments, Inc.
c. "PTI 767," Protective Treatments, Inc.
d. "Mono," Tremco, Inc.

2. Butyl Sealant:

a. "BC-158," Pecora Corp.
b. "PTI 757," Protective Treatments, Inc.
c. "Sonneborn Multi-Purpose Sealant," Sonneborn Building Products Div., ChemRex, Inc.
d. "Tremco Butyl Sealant," Tremco, Inc.

3. Pigmented Narrow Joint Sealant:

a. "PTI 200," Protective Treatments, Inc.

2.4 LATEX JOINT SEALANT

A. General: Provide manufacturer's standard one-part, non-sag, mildew-resistant, paintable latex sealant of formulation indicated that is recommended for exposed applications on interior and protected exterior locations and that accommodates indicated percentage change in joint width existing at time of installation without failing either adhesively or cohesively.

B. Acrylic-Emulsion Sealant: Provide product complying with ASTM C 834 that accommodates joint movement of not more than 5 percent in both extension and comprehension for a total of 10 percent.

C. Silicone Emulsion Sealant: Provide product complying with ASTM C 834, and, except for weight loss measured per ASTM C 792, with ASTM C 920 that accommodates joint movement of not more than 25 percent in both extension and compression for a total of 50 percent.

D. Products: Subject to compliance with requirements, provide one of the following:

1. Acrylic-Emulsion Sealant:

a. "AC-20", Pecora Corp.
b. "Sonolac", Sonneborn Building Products Division, ChemRex, Inc.
c. "Tremco Acrylic Latex 824, "Tremco", Inc.

2. Silicone-Emulsion Sealant:

a. "Trade Mate Paintable Glazing Sealant", Dow Corning Corp.

2.5 JOINT SEALANT BACKING

A. General: Provide sealant backings of material and type that are non-staining; are compatible with joint substrates, sealants, primers and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.

B. Plastic Foam Joint Fillers: Performed compressive, resilient, non-staining, non-waxing, non-extruding strips of flexible plastic foam of material indicated below and of size, shape,

and density to control sealant depth and otherwise contribute to producing optimum sealant performance.

1. Closed-cell polyethylene foam, nonabsorbent to liquid water and gas, non-outgassing in unruptured state.

C. Elastomeric Tubing Joint Fillers: Neoprene, butyl, EPDM, or silicone tubing complying with ASTM D 1056, nonabsorbent to water and gas, capable of remaining resilient at temperatures down to -26 degrees F (-32 degrees C). Provide products with low compression set and of size and shape to provide a secondary seal, to control sealant depth, and otherwise contribute to optimum sealant performance.

D. Bond-Breaker Tape: Polyethylene tape or other plastic tape as recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint filler materials or joint surfaces at back of joint where such adhesion would result in sealant failure. Provide self-adhesive tape where applicable.

2.6 MISCELLANEOUS MATERIALS

A. Primer: Material recommended by joint sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint sealant-substrate tests and field tests.

B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming in any way joint substrates and adjacent nonporous surfaces, and formulated to promote optimum adhesion of sealants with joint substrates.

C. Masking Tape: Non-staining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine joints indicated to receive joint sealants, with Sub-Contractor present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint sealant performance. Do not proceed with installation of joint sealants until unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with recommendations of joint sealant manufacturer and the following requirements:

1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.

2. Clean concrete, masonry, unglazed surfaces of ceramic tile, and similar porous joint substrate surfaces by brushing, grinding, blast cleaning, mechanical abrading, or a combination of these methods to produce a clean, sound substrate

capable of developing optimum bond with joint sealants. Remove loose particles remaining from above cleaning operations by vacuuming or blowing out joints with oil-free compressed air.

3. Remove laitance and form release agents from concrete.

4. Clean metal, glass, glazed surfaces of ceramic tile, and other nonporous surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants.

B. Joint Priming: Prime joint substrates where indicated or where recommended by joint sealant manufacturer based on preconstruction joint sealant-substrate tests or prior experience. Apply primer to comply with joint sealant manufacturer's recommendations. Confine primers to areas of joint sealant bond; do not allow spillage or migration onto adjoining surfaces.

C. Masking Tape: Use masking tape where required to prevent contact of sealant with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.3 INSTALLATION OF JOINT SEALANTS

A. General: Comply with joint sealant manufacturer's printed installation instructions applicable to products and applications indicated, except where more stringent requirements apply.

B. Sealant Installation Standard: Comply with recommendations of ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

C. Installation of Sealant Backings: Install sealant backings to comply with the following requirements:

1. Install joint fillers of type indicated to provide support of sealants during application and at position required to produce the cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.

a. Do not leave gaps between ends of joint fillers.

b. Do not stretch, twist, puncture, or tear joint fillers.

c. Remove absorbent joint fillers that have become wet prior to sealant application and replace with dry material.

2. Install bond breaker tape between sealants where backer rods are not used between sealant and joint fillers or back of joints.

D. Installation of Sealants: Install sealants by proven techniques that result in sealants directly contacting and fully wetting joint substrates, completely filling recesses provided for each joint configuration, and providing uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability. Install sealants at the same time sealant backings are installed.

E. Tooling of Non-sag Sealants: Immediately after sealant application and prior to time skinning or curing begins, tool sealants to form smooth, uniform beads of configuration

indicated, to eliminate air pockets, and to ensure contact and adhesion of sealant with sides of joint. Remove excess sealants from surfaces adjacent to joint. Do not use tooling agents that discolor sealants or adjacent surfaces or are not approved by sealant manufacturer.

1. Provide concave joint configuration per Figure 5A in ASTM C 1193, unless otherwise indicated.

2. Provide flush joint configuration, per Figure 5B in ASTM C 1193, where indicated.

   a. Use masking tape to protect adjacent surfaces of recessed tooled joints.

3. Provide recessed joints configuration, per Figure 5C in ASTM C 1193, of recessed depth and at locations indicated.

3.4 CLEANING

A. Clean off excess sealants or sealant smears adjacent to joints as work progresses by methods and with cleaning materials approved by manufacturer's of joint sealants and of products in which joints occur.

3.5 PROTECTION

A. Protect joint sealants during and after curing period from contact with contaminating substances or from damage resulting from construction operations or other causes so that they are without deterioration or damage at time of substantial completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately so that and installations with repaired areas are indistinguishable from original work.

END OF SECTION 079200

SECTION 081113 – HOLLOW METAL DOORS AND FRAMES

PART I - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following products manufactured in accordance with SDI Recommended Standards:

1. Doors: Flush, hollow or composite construction standard steel doors for interior and exterior locations.

2. Frames: Pressed steel frames for doors, transoms, mullions, panels and other interior and exterior openings of following type:

a. Welded unit type.

3. Assemblies: Provide standard steel door and frame assemblies as required for the following:

a. Labeled and fire rated.
b. Provide "Temperature Rise" doors at all stairwells in accordance with SBC.

4. Provide factory primed doors and frames to be field painted.

B. Painting primed doors and frames is specified in Division 9 Section "Painting."

C. Door hardware is specified in another Division 8 Section.

D. Glass and Glazing are specified in another Division 8 Section.

1.3 SUBMITTALS

A. General: Submit the following according to Conditions of Contract and Division 1 Specification Sections.

B. Product data for each type of door and frame specified, including details of construction, materials, dimensions, hardware preparation, core, label compliance, sound ratings, profiles, and finishes.

C. Shop drawings showing fabrication and installation of standard steel doors and frames. Include details of each frame type, elevations of door design types, conditions at openings, details of construction, location and installation requirements of door and frame hardware and reinforcements, and details of joints and connections. Show anchorage and accessory items.

1. Provide schedule of doors and frames using same reference numbers for details and openings as those on the drawings.

2. Indicate and coordinate glazing frames and stops with glass and glazing requirements.

1.4 QUALITY ASSURANCE

A. Provide doors and frames complying with Steel Door Institute "Recommended Specifications Standard Steel Doors and Frames" ANSI/SDI-100 and as herein specified.

B. Fire-Rated Door Assemblies: Units that comply with NFPA 80, are identical to door and frame assemblies whose fire resistance characteristics have been determined per ASTM E 152 and which are labeled and listed by UL, Factory Mutual, Warnock Hersey, or other testing and inspecting organization acceptable to authorities having jurisdiction.

C. Smoke-Control Door Assemblies: Comply with NFPA 105 or UL 1784.

D. Pre-installation Conference: Conduct conference at Project site.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver doors and frames cardboard-wrapped or crated to provide protection during transit and job storage. Provide additional protection to prevent damage to finish of factory-finished doors and frames.

B. Inspect doors and frames upon delivery for damage. Minor damages may be repaired provided refinished items are equal in all respects to new work and acceptable to Architect; otherwise, remove and replace damaged items as directed.

C. Store doors and frames at building site under cover. Place units on minimum 4-inches high wood blocking. Avoid use of non-vented plastic or canvas shelters which could create humidity chamber. If cardboard wrapper on door becomes wet, remove carton immediately. Provide 1/4-inches spaces between stacked doors to promote air circulation.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Manufacturer: Subject to compliance with requirements, provide standard steel doors and frames by one of the following:

1. Standard Steel Doors and Frames:

a. Ceco Corp.
b. Curries Company.
c. Steelcraft Manufacturing Co.

2.2 MATERIALS

A. Doors and frames and frame components shall be manufactured from cold-rolled steel conforming to ASTM specification A366; <u>or</u> hot-dipped galvanized steel having an A60 zinc coating conforming to ASTM specification A525, A 526, or A642. Galvanized steel shall be treated to insure proper paint adhesion. All component parts used in galvanized doors and/or frames shall meet the galvanize specification. Stainless steel shall be fabricated from type 304 or 316 stainless steel polished to a number 4 matte finish.

2.3 DOORS

A. Exterior doors shall be 14-gage galvanized. Medallion (MS).

B. Interior doors shall be 16-gage cold-rolled steel. Medallion (MS).

C. Construction of Doors

1. Doors shall be full-flush seamless construction, fabricated from cold-rolled steel or hot-dipped galvanized steel (see Section 2.01A 16 or 14 gage for 1-3/4" doors. Doors shall be reinforced, steel stiffened with 22 gage steel stiffeners places 6" apart and welded every 5" along their length. Factory install fiberglass between stiffeners for sound deadening.

   Doors shall have continuous vertical mechanical interlocking joints at lock and hinge edges with visible edge seams or with edge seam welded and ground smooth. The internal portion edge seams or with edge seam filled and ground smooth. The internal portion of the seam shall be sealed with epoxy. An intermittent fastening along the seam is not permitted. Doors shall have beveled (1/8" in 2") hinge and lock edges. Top and bottom steel reinforcement channels shall be 14-gage and spot welded to both panels. Hinge reinforcements shall be 7-gage. Closer reinforcements shall be 12 gage steel plate. Door end channels shall be minimum of 16 gage.

5. Temperature rise doors shall be fabricated from steel as required and shall be insulated to produce the 450-degree temperature rise rating. All exterior swing-out doors shall have the tops closed to eliminate moisture penetration. Door tops shall not have holes or openings, supply doors with steel enclosure cap, plastic caps are not permitted.

2.4 FRAMES

A. Exterior frames shall be 12 Gage Galvanized.

B. Interior frames shall be 14 Gage Cold Rolled Steel.

C. ALL FRAMES INSTALLED IN CONCRETE OR MASONRY SHALL BE GALVANIZED.

D. Construction of Frames

1. Flush frames shall be formed from 14 or 12-gage cold-rolled or galvanized steel (see Section 2.01A).

   Frames shall have 2" faces. 16 and 14-gage frames shall be set-up and back welded. Miter corners shall have reinforcements with four integral tabs for secure and easy interlocking jambs to head.

   12-Gage frames shall be arc-welded at the corners.

   18, 16 and 14-gage frames shall be supplied with factory installed inserted type rubber bumpers, (3) per strike jamb and (2) per head, for pair of doors. Stick on bumpers shall not be permitted. 12-Gage frames shall be supplied with loose pressure sensitive bumpers for field application.

   Frames for 1-3/4" doors shall have 7-gage steel hinge reinforcements. Strike reinforcements shall be16-gage and prepared for an ANSI-A115.1-2 strike.

Frames for 1-3/8" doors shall have 10-gage steel hinge reinforcements. Strike jambs shall have a 14-gage reinforcement and preparation for cylindrical ANSI-A115.3 strikes.

Metal plaster guards shall be provided for all mortised cutouts.

All hinge and strike reinforcements shall be projection welded to the door frame.

Reinforcements for surface closer shall be 12-gage steel. Adequate reinforcements shall be provided for other hardware when required. Frames shall have full sleeve closer reinforcements spot welded inside
header.

Galvanized frames shall have galvanized hardware reinforcements.

Frames shall be furnished with a minimum of six wall anchors and two adjustable base anchors of manufacturer's standard design.

2. Stainless steel frame series shall be the same construction as specified in paragraph C-1 except frames shall be manufactured of 16-gage stainless steel (see Section 2.01A). Hinge reinforcements shall be 1/8'' stainless steel. Strike reinforcements shall be 16-gage stainless steel.

All hinge and strike reinforcements shall be projection welded to the door frame.

6. Frames shall be supplied:

a. Set up with faces arc-welded and ground smooth. Miters of frames shall be back-welded. Weld shall penetrate the outside face. Faces shall be dressed smooth. Filler materials are not permitted.

2.5 PROTECTIVE COATINGS

A. The inside of all frames shall be fully grouted or, when an anti-freeze agent is used, shell be coated with a fibered asphalt coating. Coating shall be field applied by the contractor to a minimum thickness of 1/16" thickness.

2.6 FINISH

A. All doors, frames and frame components shall be cleaned, phosphatized and finish as standard with one coat of baked-on rust inhibiting prime paint in accordance with the ANSI A224.1 "Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames".

B. Finished painted doors and frames shall be cleaned, phosphatized and finished with baked-on rust inhibiting paint capable of passing a 200-hour salt spray and 500-hour humidity test in accordance with ASTM test method B117 and D1735. Finished paint shall have a dry film thickness of 1.50 mils with a tolerance of plus or minus .25 mils. Gloss shall be 20 plus or minus 5 degrees conforming to ASTM test method D523. Color or colors shall be selected from manufacturer's standard colors.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Install standard steel doors, frames, and accessories in accordance with final Shop Drawings, manufacturer's data, and as herein specified.

B. Placing Frames: Comply with provisions of SDI-105 "Recommended Erection Instructions For Steel Frames," unless otherwise indicated.

1. Place frames prior to construction of enclosing walls and ceilings. Set frames accurately in position, plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is completed, remove temporary braces and spreaders leaving surfaces smooth and undamaged.

2. In masonry construction, locate 3 wall anchors per jamb adjacent to hinge location on hinge jamb and at corresponding heights on strike jamb. Acceptable anchors include masonry wire anchors and masonry Tee anchors.
3. In metal stud partitions, install at least 3 wall anchors per jamb at hinge and strike levels. In closed steel stud partitions, attach wall anchors to studs with screws.

C. Door Installation: Fit hollow metal doors accurately in frames, within clearances specified in ANSI/SDI-100.

1. Install fire-rated doors with clearances as specified in NFPA Standard No. 80.

3.2 ADJUST AND CLEAN

A. Prime Coat Touch-up: Immediately after erection, sand smooth any rusted or damaged areas of prime coat and apply touch-up of compatible air-drying primer.

B. Protection Removal: Immediately prior to final inspection, remove protective plastic wrappings from prefinished doors.

C. Final Adjustments: Check and re-adjust operating hardware items, leaving steel doors and frames undamaged and in complete and proper operating condition.

END OF SECTION 081113

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SECTION 081416 – FLUSH WOOD DOORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract including General and Supplementary Conditions and Division 1–Specification sections, apply to work specified in this Section.

B. Section 087100: DOOR HARDWARE

C. Section 081113: HOLLOW METAL DOORS AND FRAMES

1.2 REFERENCE STANDARDS (most recent edition)

A. WDMA IS 1A - Window and Door Manufacturers Association (WDMA)

B. AWI - Quality Standards of the Architectural Woodwork Institute (AWI)

C. NFPA 80 - Fire Doors and Windows

D. NFPA 252 - Standard Methods of Fire Tests for Door Assemblies

E. Underwriters' Laboratories - UL 10B (neutral pressure) and UL 10C (positive pressure) - Fire Tests of Door Assemblies

F. ITS (Warnock Hersey) - Certification Listings for Fire Doors

G. ASTM E90-90 - Measurement of Airborne Sound Transmission Loss of Building Partitions

H. FSC - Forest Stewardship Council guidelines for environmentally certified wood doors

1.3 SUMMARY

A. This section includes:

1. Solid-core flush wood doors with wood-veneer, medium density overlay (MDO), paint-grade faces.

2. Factory pre-fitting, pre-machining for hardware, detailing, and factory prefinishing.

1.4 SUBMITTALS

A. Product Data: Submit door manufacturer's product construction data, hardware attachment performance data, specifications and installation instructions for each type of wood door, including details of core and edge construction, trim for lite openings and similar components.

B. Specific Product Warranty: The door shall be warranted by the manufacturer to be free of manufacturing defects for the life of the original installation. Warranty provide for repair or replacement of the door as originally furnished. Manufacturer shall elect to repair or replace defective door(s), and will assume reasonable costs associated with same. Manufacturer may, per its discretion, elect to use either its own or third party resources to resolve warranty claims.

C. Shop Drawings: Provide the following information:

1. Door type.

2. Door size.

3. Fire Rating.

   a) Neutral pressure - UL 10B/UBC43-2 or 7-2-94.
   b) Positive pressure - UL 10C/UBC7-2-97.

4. Hardware types and locations.

5. Hardware blocking requirements and location.

6. Vision panel or louver cutout size and location.

7. Prefinish system type and approved color(s).

D. Samples:

1. Color samples for factory prefinishing. Manufacturer must submit samples of not less than 4" x 6" size on representative veneer or paintable surface, with sample date indicated.

2. Construction samples. Corner sections with door faces, edges, and core representative of the specified door type(s). Corner samples to be not less than 6" x 6".

1.5 QUALITY ASSURANCE

A. Manufacturer: Company specializing in manufacturing products specified in Section with a minimum of five years documented experience. All doors must be supplied through one Company.

B. Quality Standard: Doors to comply with WDMA IS 1A (Window and Door Manufacturers Association).

C. Fire Ratings Compliance: Fire-rated wood doors to comply with NFPA-80 requirements according to building code standards having local jurisdiction.

1. Neutral Pressure Testing - UBC 43-2 or 7-2-94; or UL10B.

2. Positive Pressure Testing UBC 7-2-97 or UL10C.

D. Label Certification: All doors requiring fire-rating will carry either UL or ITS (Warnock Hersey) label. Manufacturer's certification labels may be used for door size variations if approved by AHJ (Authority Having Jurisdiction).

E. Environmental Certification: All doors requiring environmental certification will be marked with Forest Stewardship Council (FSC) authorized certification, e.g. Smartwood approval and certificate number. Environmental certification ensures that wood components come from certified forests and are processed by chain-of-custody manufacturers.

F. Delivery/Storage/Handling: Store and protect doors in accordance with manufacturer's recommendations and WDMA. Following are general guidelines. For more specific information refer to WDMA's Appendix Section “Care and Installation at Job Site.”

1. Store doors flat and off the floor on a level surface in a dry, well-ventilated building. Do not store on edge. Protect doors from dirt, water and abuse.

2. Certain wood species are light sensitive. Protect doors from exposure to light (artificial or natural) after delivery.

3. Do not subject interior doors to extremes in either heat or humidity. HVAC systems should be operational and balanced, providing a temperature range of 50 to 90 degrees Fahrenheit and 30% to 50% relative humidity.

4. When handling doors, always lift and carry. Do not drag across other doors or surfaces. Handle with clean hands or gloves.

5. Each door will be marked on top rail with opening number.

1.6 WARRANTY

A. Manufacturer's signed warranty covering manufacturing or material defects for life of original installation, including repair, replacement, machining, detailing and/or prefinishing, is a required part of the manufacturer's warranty for interior doors. Exterior applications per manufacturer.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers are subject to evaluation and inclusion by architect/specifier. Listed below are primary manufacturers of 5 Ply - Hot Press wood doors:

1. Algoma Hardwoods, Inc.

2. Eggers Industries

3. Marshfield Door Systems

2.2 DOOR CONSTRUCTION, GENERAL

A. ENVIRONMENTALLY CERTIFIED DOORS - Environmentally certified doors carry a certification authorized under authority of the Forest Stewardship Council (FSC) and are certified to meet FSC requirements as pertaining to certified sourcing, content and chain-of-ownership requirements for materials used in construction of the door.

Certification Specified: *No Environmental Certification Required*

B. SPECIAL FUNCTION DOORS

Special Function Doors Specified: *No Special Function Doors*

1. Sound Transmission Class (STC) - As identified by door schedule, doors to carry an acoustical rating for sound transmission class. STC ratings are determined through testing to comply with ASTM E90-90 methods. All accessories required for acoustical rating compliance supplied by door manufacturer with door.

STC Rating Specified: *No STC Doors Required*

2. Lead-Lined – As identified by door schedule, doors to have continuous lead sheeting from edge to edge between the cross banding and the core. Lead thickness as specified below.

Lead-Lined Doors Specified: *No Lead Lined Doors Required*

3. Bullet Resistant **–** Bullet resistant doors to be manufactured with special ballistic rated materials within the core assembly per door manufacturer's construction. Protection levels per UL752 Bullet Resisting Equipment as specified below.

Bullet Resistant Doors Specified**:** *No Bullet Resistance*

C. NON-FIRE-RATED DOORS

1. General Grade Specification – Refer to WDMA IS 1A for more specific grade definitions.

2. Premium - The highest grade commercially available in both material and workmanship. Intended for the finest commercial, industrial and institutional buildings.

3. Custom - The typical and normal grade in both material and workmanship. This grade is intended for high-quality work.

Grade Specified*: Premium Grade*

D. Construct using WDMA Five (5) Ply construction, using Hot Press method for laminating door materials. Select construction (refer to Section (2) for specific information). Stiles and rails must be securely bonded to the core and then abrasively planed prior to veneering.

E. Core is one of the following three types:

1. Particleboard Core (PC-5) to comply with ANSI Stnd. A208.1- 1989 LD-2, with screw holding power of 125 lbs., modulus of rupture of 800 psi, modulus of elasticity of 150,000 psi and density of 30-35 lbs. per cubic foot.

2. Stave Lumber Core (SLC-5) may be a combination of solid, low-density hardwood lumber blocks or strips not more than 2-1/2" wide of one species of wood between 6% to 9% moisture content. Joints to be tight and staggered in adjacent rows. Lumber density is 25 to 27 lbs. per cubic foot.

3. Structural Composite Lumber Core (SCLC-5) is an engineered hardwood composite sometimes referred to as LSL (Laminated Strand Lumber). The material complies with WDMA minimum performance levels for interior applications with screw holding power of 540 lbs., modulus of rupture of 6,500 psi, modulus of elasticity of 1,300,000 psi and density of 38 lbs per cubic foot.

Core Materials Specified: *Particleboard Core (PC-5)*

F. Crossbands are wood-based composites of a minimum thickness of 1/16". Crossbands and face veneers are laminated to the core with Type 2 interior use glue using the Hot Press process. Crossbands must extend the full width of the door. Minimum properties include internal bond of 100 psi and density of 50 lbs. per cubic foot.

G. Stiles (Vertical Edges**)** - Stiles are hardwood, one piece, laminated or veneered. Constructions with laminated edges may use structural composite lumber as an inner stile

component.

1. Compatible - Similar in overall color, grain, character and contrast as the face veneer.

2. Matching - Same species as face veneer.

3. Closed Grain Hardwood - Manufacturer's option for painted stile edges.

Stile Type Specified: *Matching*

H. Rails (Horizontal Edges) - Rails are solid wood, structural composite lumber meeting the minimum requirements of WDMA, or medium density fiberboard meeting requirements of ANSI 208.2 (Medium Density Fiberboard for Interior Use).

I. Hardware Blocking (eliminates through-bolting and improves screw withdrawal resistance for heavy-use areas) - Specify minimum 5" top rail for specialized hardware and/or 5" bottom rail for specialized hardware or undercutting flexibility.

Blocking Requirements Specified**:** *Minimum 5" Top and 5" Bottom Rail*

J. Veneers**:**

Face Grade Specified: *"A"*

Veneer Cut Specified**:** *Sliced*

Veneer Species Specified: White Maple

Veneer Match Specified: *Book*

Veneer Assembly Specified: *Balance*

K. Pair and Set Match

1. For openings with more than one door, door faces must be pair or set matched. This includes doors separated by a mullion.

Matching Requirements: *Matching*

L. Transom and Side Panels

1. Fabricate matching panels with same construction, exposed surfaces, and finish specified for associated doors.

Matching Requirements : *Matching*

M. Fire-Rated Doors

1. Construct using WDMA Five (5) Ply construction, using Hot Press method for laminating door materials. Select construction (refer to Section (2) for specific information):

Fire Rating Specified: *Mineral Core (FD 3/4, FD 1, FD 1-1/2)*

N. Category A Positive Pressure openings have all the intumescent required for compliance

contained within the door and require no additional installation of intumescent strips.

O. Category B Positive Pressure openings require the addition of intumescent strips to the door and/or frame.

Neutral/Positive Pressure Specified**:** *Neutral Pressure*

P. Core is one of the following four types:

1. Particleboard Core to comply with ANSI Stnd. A208.1-1989 LD-2 with screw holding power of 125 lbs., modulus of rupture of 800 psi, modulus of elasticity of 150,000 psi and density of 30-32 lbs. per cubic foot. For use only with 1/3 hour rated doors.

2. Stave Lumber Core may be a combination of solid, low-density hardwood lumber blocks or strips not more than 2-1/2" wide of one species of wood at 6% to 9% moisture content. Joints to be tight and staggered in adjacent rows. Lumber density is 25 to 27 lbs. per cubic foot. For use only with 1/3 hour rated doors.

3. Structural Composite Lumber Core is an engineered hardwood composite sometimes referred to as LSL (Laminated Strand Lumber). The material complies with WDMA minimum performance levels for interior applications with screw holding power of 540 lbs., modulus of rupture of 6,500 psi, modulus of elasticity of 1,300,000 psi and density of 38 lbs per cubic foot. For use only with 1/3 hour rated doors.

4. Mineral Core is a non-combustible mineral composite material that is necessary for higher hourly ratings per manufacturer’s approval(s).

Q. Crossbands are wood-based composites of a minimum thickness of 1/16". Crossbands and face veneers are laminated to the core with Type 2 interior use glue using the Hot Press process. Crossbands must extend the full width of the door. Minimum properties include internal bond 100 psi and density of 50 lbs. per cubic foot.

R. Stiles (Vertical Edges**)** - Provide one piece hardwood stile edge construction with improved screw-holding capability and split resistance. Both inner and outer stiles cannot contain salt treating.

1. Compatible - Similar in overall color, grain, character and contrast as the face veneer.

2. Matching - Same species as face veneer.

3. Closed Grain Hardwood - Manufacturer's option for painted stile edges.

Stile Type Specified**:** *Matching*

S. Rails (Horizontal Edges**)** - Rails are solid wood or other material contained in manufacturer's fire door approvals.

T. Hardware Blocking (eliminates through-bolting and improves screw withdrawal resistance for heavy-use areas) - Specify minimum 5" top rail for specialized hardware and/or 5" bottom rail for specialized hardware or undercutting flexibility and/or blocking for lockset installation.

Blocking Requirements Specified**:** *Minimum 5 1/2" Top and 5 1/2" Bottom Rail*

U. Veneers**:**

Face Grade Specified**:** *"A"*

Veneer Cut Specified**:** *Sliced*

Veneer Species Specified**:** *White Maple*

Veneer Match Specified: *Book*

Veneer Assembly Specified**:** *Balance*

V. Pair and Set Match

1. For openings with more than one door, door faces must be pair or set matched. This includes doors separated by a mullion.

Matching Requirements: *Matching*

W. Transom and Side Panels

1. Fabricate matching panels with same construction, exposed surfaces, and finish specified for associated doors.

Matching Requirements**:** *Matching*

2.3 DOOR FABRICATION

A. Factory-prefit and bevel doors (3°) to suit frame sizes indicated, with 3/16" prefit in width, + 0"/- 1/32", tolerances. Prefit top of door 1/8" +1/16"/-0", and undercut as designated by floor condition. For fire-rated doors comply with NFPA 80 for prefits and undercuts.

B. Factory pre-machine doors for hardware that is not surface applied. Locations and hole patterns to comply with specified hardware requirements as per NFPA 80 standards for doors specified; and to maintain door manufacturer's warranty.

1. Specific locations for hardware will be coordinated between frame and door manufacturers.

2. Specific hardware preps will be per hardware schedule(s) provided. Hardware preps to be neatly and cleanly squared as required per hardware templates.

3. Metal astragals and channels to be supplied where fire-ratings will not allow metal-free edge(s).

C. Factory Preparation for Light Openings and Louvers - Cut and trim openings through doors to comply with NFPA 80 requirements where indicated; and to maintain door manufacturer's warranty.

1. Wood beads and wood louvers to be compatible with face veneer. Profiles and installation per door manufacturer's standard(s).

2. Metal vision panels and louvers supplied primed and/or painted.

Vision Panels/Louvers Specified**:** *Wood*

D. Surface Applied Mouldings - Factory applied moulding frames to be compatible with face

veneer. Profile and configuration per door manufacturers standard. Moulding frames to be applied with both glue and nail(s).

2.4 FACTORY FINISHING

A. Finish Location

1. Factory Finishing – All doors (including beading and mouldings) to be finished at the factory, with UV cured system with performance properties equivalent to TR-6 or OP-6 Catalyzed Polyurethane per AWI Section 1500. Premium grade. Factory pre-finished doors to be individually protected with either transparent or opaque (cherry, mahogany, teak, walnut) poly-wrap at the factory. Final color, build, and sheen to be approved by architect based on actual review samples.

2. Field Finishing – All doors (including beading and mouldings) to be field finished. Proper procedures are critical to ensure satisfactory results. Additional preparatory work is required and should be in compliance with WDMA Industry Standards IS 1A. (For additional information see WDMA Publication *How To Store, Handle, Finish, Install and Maintain Wood Doors.*) Also refer to Division 9–Finishes, for this project, to ensure proper compliance with finishing requirements.

Finish Location Specified**:** *Factory Finishing*

B**.** Finish Type

1. Transparent - Transparent finishes provide a clear protective coating over the wood, allowing the natural color and grain of the selected wood species to provide the appearance desired by the specifier and owner. Stain is often applied to the wood surface underneath the transparent clear finish to add more color and design flexibility.

2. Opaque - Opaque finishes are essentially solid colors used over paint grade veneers or medium density overlay.

3. Factory Priming - A solid color priming coat for doors that will be painted a solid color in the field.

Finish Type Specified**:** *Transparent*

PART 3 - EXECUTION

3.1 EXAMINATION

A. Confirm that frames comply with type, size, location and swing requirements and that they are installed plumb and square.

B. Inspect doors for any damage, manufacturing defects or prefinish inconsistency, e.g. wrong color or poor finish.

C. If frames and doors pass inspections (see A and B above), proceed to installation. If there are any issues in either frames or doors, do not proceed to installation. Contact appropriate supplier to correct unsatisfactory conditions, and proceed with installation only after corrections have been made.

3.2 INSTALLATION

A. Installation of wood doors to comply with WDMA IS 1A, specific door manufacturers specific instructions, and NFPA 80.

3.3 ADJUSTING AND PROTECTING

A. After installation of door in frame, operate door to ensure that the door swings freely and that all hardware functions correctly. If not, make adjustments as required to provide an operable opening.

B. If required, protect doors following installation from damage that may occur as a result of project completion.

END OF SECTION 081416

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SECTION 084113 - ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes: Exterior Aluminum Storefront Systems (windows), including perimeter trims, stools, accessories, shims and anchors, and perimeter sealing of storefront units

1.3 PERFORMANCE REQUIREMENTS

A. General Performance: Aluminum-framed systems shall withstand the effects of the following performance requirements without exceeding performance criteria or failure due to defective manufacture, fabrication, installation, or other defects in construction:

1. Movements of supporting structure indicated on Drawings including, but not limited to, story drift and deflection from uniformly distributed and concentrated live loads.
2. Dimensional tolerances of building frame and other adjacent construction.
3. Failure includes the following:

   a. Deflection exceeding specified limits.
   b. Thermal stresses transferring to building structure.
   c. Framing members transferring stresses, including those caused by thermal and structural movements to glazing.
   d. Noise or vibration created by wind and by thermal and structural movements.
   e. Loosening or weakening of fasteners, attachments, and other components.
   f. Sealant failure.
   g. Failure of operating units.

B. Structural Loads:

1. Wind Loads: As indicated on Drawings.

C. Deflection of Framing Members:

1. Deflection Normal to Wall Plane: Limited to edge of glass in a direction perpendicular to glass plane shall not exceed L/175 of the glass edge length for each individual glazing lite or an amount that restricts edge deflection of individual glazing lites to 3/4 inch, whichever is less.
2. Deflection Parallel to Glazing Plane: Limited to L/360 of clear span or 1/8 inch (3.2 mm), whichever is smaller.

D. Structural-Test Performance: Provide aluminum-framed systems tested according to ASTM E 330 as follows:

1. When tested at positive and negative wind-load design pressures, systems do not evidence deflection exceeding specified limits.
2. When tested at One hundred and Fifty (150) percent of positive and negative wind-load design pressures, systems, including anchorage, do not evidence material failures, structural distress, and permanent deformation of main framing members exceeding 0.2 percent of span.
3. Test Durations: As required by design wind velocity, but not fewer than 10 seconds.

E. Air Infiltration: Provide aluminum-framed systems with maximum air leakage through fixed glazing and framing areas of 0.06 cfm/sq. ft. of fixed wall area when tested according to ASTM E 283 at a minimum static-air-pressure difference of 1.57 lbf/sq. ft..

F. Water Penetration under Static Pressure: Provide aluminum-framed systems that do not evidence water penetration through fixed glazing and framing areas when tested according to ASTM E 331 at a minimum static-air-pressure difference of 20 percent of positive wind-load design pressure, but not less than 6.24 lbf/sq. ft..

G. Thermal Movements: Provide aluminum-framed systems that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.
2. Test Performance: No buckling; stress on glass; sealant failure; excess stress on framing, anchors, and fasteners; or reduction of performance when tested according to AAMA 501.5.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for aluminum-framed systems.

B. Shop Drawings: For aluminum-framed systems. Include plans, elevations, sections, details, and attachments to other work.

1. Include details of provisions for system expansion and contraction and for drainage of moisture in the system to the exterior.

C. Samples for Verification: For each type of exposed finish required, in manufacturer's standard sizes.

D. Qualification Data: For qualified Installer.

E. Preconstruction Test Reports: For sealant.

F. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for aluminum-framed systems, indicating compliance with performance requirements.

G. Submit drawings and calculations signed and sealed by a licensed engineer in the State of Virginia showing complete details of the proposed setting methods, mullion details, edge blocking, size of openings, frame details and materials, and types and thickness of glass.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.

B. Testing Agency Qualifications: Qualified according to ASTM E 699 for testing indicated.

C. Product Options: Information on Drawings and in Specifications establishes requirements for systems' aesthetic effects and performance characteristics. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction. Performance characteristics are indicated by criteria subject to verification by one or more methods including preconstruction testing, field testing, and in-service performance.

D. Source Limitations for Aluminum-Framed Systems: Obtain glaze and frame from single source from single manufacturer.

E. Structural-Sealant Joints: Design reviewed and approved by structural-sealant manufacturer.

F. Welding Qualifications: Qualify procedures and personnel according to AWS D1.2, "Structural Welding Code - Aluminum."

1.6 PROJECT CONDITIONS

A. Field Measurements: Verify actual locations of structural supports for aluminum-framed systems by field measurements before fabrication and indicate measurements on Shop Drawings.

1.7 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of aluminum-framed systems that do not comply with requirements or that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures including, but not limited to, excessive deflection.
b. Noise or vibration caused by thermal movements.
c. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
d. Water leakage through fixed glazing and framing areas.
e. Failure of operating components.

2. Warranty Period: Ten (10) years from date of Substantial Completion.

B. Special Finish Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components on which finishes do not comply with requirements or that fail in materials or workmanship within specified warranty period. Warranty does not include normal weathering.

1. Warranty Period: Ten (10) years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A.. Basis-of-Design Product: Kawneer Company, Inc.
a. Kawneer Aluminum Storefront System; Series: Trifab® VG 451T (thermal) Storefront System; Framing Member Profile: 2" x 4-1/2" nominal dimension; Front, Center, Back, Multi-Plane, Weatherseal Glazed (Type B); Screw Spline, Shear Block, Stick Fabrication.

B. Alternate: Alternative products shall meet or exceed all requirements as indicated herein and must receive prior written approval by the architect or designer.

2.2 MATERIALS

A. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.

1. Sheet and Plate: ASTM B 209.
2. Extruded Bars, Rods, Profiles, and Tubes: ASTM B 221.
3. Extruded Structural Pipe and Tubes: ASTM B 429.
4. Structural Profiles: ASTM B 308/B 308M.
5. Welding Rods and Bare Electrodes: AWS A5.10/A5.10M.

B. Steel Reinforcement: Manufacturer's standard zinc-rich, corrosion-resistant primer, complying with SSPC-PS Guide No. 12.00; applied immediately after surface preparation and pretreatment. Select surface preparation methods according to recommendations in SSPC-SP COM and prepare surfaces according to applicable SSPC standard.

1. Structural Shapes, Plates, and Bars: ASTM A 36/A 36M.

2.3 FRAMING SYSTEMS

A. Framing Members: Manufacturer's standard extruded-aluminum framing members of thickness required and reinforced as required to support imposed loads and to meet specified performance requirements.

1. Construction: Thermal.
2. Glazing System: Retained mechanically with gaskets on four sides.
3. Glazing Plane: As indicated.

B. Tolerances: tolerances for wall thickness and other cross-sectional dimensions of storefront members shall comply with AA Aluminum Standards and Data.

C. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.

D. Fasteners and Accessories: Stainless Steel fasteners and accessories compatible with adjacent materials.

1. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
2. Reinforce members as required to receive fastener threads.

E. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts, complying with ASTM A 123/A 123M or ASTM A 153/A 153M.

F. Concealed Flashing: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding flashing compatible with adjacent materials.

G. Framing System Gaskets and Sealants: Manufacturer's standard, recommended by manufacturer for joint type.

H. Thermal Barrier: Kawneer IsoLock® Thermal Break or approved equal with a 1/4" separation consisting of a two-part chemically curing, high-density polyurethane, which is mechanically and adhesively joined to aluminum storefront sections.

a. Thermal Break shall be designed in accordance with AAMA TIR-A8 and tested in accordance with AAMA 505.

2.4 GLAZING SYSTEMS

A. Glazing: As specified in Division 8 Section 088000 "Glazing."

B. Glazing Gaskets: Manufacturer's standard compression types; replaceable, molded or extruded, of profile and hardness required to maintain watertight seal.

C. Spacers and Setting Blocks: Manufacturer's standard elastomeric type.

2.5 ACCESSORY MATERIALS

A. Joint Sealants: For installation at perimeter of aluminum-framed systems, as specified in Division 7 Section "Joint Sealants."

B. Bituminous Paint: Cold-applied, asphalt-mastic paint complying with SSPC-Paint 12 requirements except containing no asbestos; formulated for 30-mil thickness per coat.

2.6 FABRICATION

A. Form or extrude aluminum shapes before finishing.

B. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.

C. Framing Members, General: Fabricate components that, when assembled, have the following characteristics:

1. Profiles that are sharp, straight, and free of defects or deformations.
2. Accurately fitted joints with ends coped or mitered.
3. Means to drain water passing joints, condensation within framing members, and moisture migrating within the system to exterior.
4. Physical and thermal isolation of glazing from framing members.
5. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
6. Provisions for field replacement of glazing from exterior.
7. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.

D. Mechanically Glazed Framing Members: Fabricate for flush glazing without projecting stops.

E. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

2.7 ALUMINUM FINISHES

F. Factory Finishing: Fluropon® (70% PVDF), AAMA 2605, Fluoropolymer Coating. Color: TBD (Match airport standards).

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General:

1. Comply with manufacturer's written instructions.
2. Do not install damaged components.
3. Fit joints to produce hairline joints free of burrs and distortion.
4. Rigidly secure nonmovement joints.
5. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration.
6. Seal joints watertight unless otherwise indicated.

B. Metal Protection:

1. Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or applying sealant or tape, or by installing nonconductive spacers as recommended by manufacturer for this purpose.

2. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

C. Install components to drain water passing joints, condensation occurring within framing members, and moisture migrating within the system to exterior.

D. Set continuous sill members and flashing in full sealant bed as specified by manufacturer's drawings to produce weathertight installation.

E. Install components plumb and true in alignment with established lines and grades, and without warp or rack.

F. Install glazing as specified in Division 8 Section "Glazing."

G. Install perimeter joint sealants as specified in Division 7 Section "Joint Sealants" to produce weathertight installation.

3.3 ERECTION TOLERANCES

A. Install aluminum-framed systems to comply with the following maximum erection tolerances:

1. Location and Plane: Limit variation from true location and plane to 1/8 inch in 12 feet; 1/4 inch over total length.
2. Alignment:

a. Where surfaces abut in line, limit offset from true alignment to 1/16 inch.
b. Where surfaces meet at corners, limit offset from true alignment to 1/32 inch.

B. Diagonal Measurements: Limit difference between diagonal measurements to 1/8 inch.

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Contractor to engage a qualified independent testing and inspecting agency to perform field tests and inspections.

B. Testing Services: Testing and inspecting of representative areas to determine compliance of installed systems with specified requirements shall take place as follows and in successive phases as indicated on Drawings. Do not proceed with installation of the next area until test results for previously completed areas show compliance with requirements.

1. Structural-Sealant Compatibility and Adhesion: Structural sealant shall be tested according to recommendations in ASTM C 1401.

a. Destructive Test Method A, "Hand Pull Tab (Destructive)," in ASTM C 1401, Appendix X2, shall be used.

1) A minimum of four (4) areas on each building face shall be tested.
2) Repair installation areas damaged by testing.

2. Air Infiltration: Areas shall be tested for air leakage of 1.5 times the rate specified for laboratory testing under "Performance Requirements" Article, but not more than 0.09 cfm/sq. ft. of fixed wall area when tested according to ASTM E 783 at a minimum static-air-pressure difference of 1.57 lbf/sq. ft. (75 Pa)] [6.24 lbf/sq. ft..

3. Water Penetration: Areas shall be tested according to ASTM E 1105 at a minimum uniform and cyclic static-air-pressure difference of 0.67 times the static-air-pressure difference specified for laboratory testing under "Performance Requirements" Article, but not less than 4.18 lbf/sq. ft., and shall not evidence water penetration.

4. Water Spray Test: Before installation of interior finishes has begun, a minimum area of 75 feet by 1 story of aluminum-framed systems designated by Architect shall be tested according to AAMA 501.2 and shall not evidence water penetration.

C. Repair or remove work if test results and inspections indicate that it does not comply with specified requirements.

D. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

E. Aluminum-framed assemblies will be considered defective if they do not pass tests and inspections.

F. Prepare test and inspection reports.

END OF SECTION 084113

SECTION 084413 - GLAZED ALUMINUM CURTAIN WALLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to this section.

1.2 SUMMARY

This section covers the Glazed Aluminum Curtain Wall for the Control Tower Cab Glass. All other aluminum windows are in Section 084113 “Aluminum-Framed Entrances and Storefronts”.

A. Primary components of the glazed curtain wall system include:

1. Factory fabricated aluminum curtain wall framing system with cap glazing and structural silicon sealant.
2. Internal steel reinforcement.
3. Glazing gaskets.
4. Sills, copings, trim, and similar border and filler items.
5. Interior curtain wall that matches the exterior curtain wall.
6. Anchors, shims, fasteners, inserts, accessories, and support brackets.
7. Insulation and firestopping within the curtain wall system.
8. Glass and glazing included as part of the curtain wall system; refer to Division 8, Section 088000 – GLAZING for requirements.
9.. Testing: Standard systems by preapproved listed manufacturers, which have prior test data of similar scope and magnitude to that specified are not required to perform the testing required in the Quality Assurance article if prior data is approved by the Architect. Any substitute manufacturer or system shall perform specified testing.

1.3 SYSTEM DESCRIPTION

A. Aluminum Factory Fabricated Frame System: Unitized or factory fabricated knock-down system. The glazed aluminum curtain wall system shall consist of internally reinforced individual members. Major components consist of aluminum mullions, rails, and matching glazed insulated spandrel panels and vision glass. Stick built, site fabricated and shop fabricated systems are not acceptable.

1.4 SYSTEM PERFORMANCE REQUIREMENTS

A. General: Provide the manufacturer's stock curtain wall system, adapted to the application indicated, that complies with performance requirements specified as demonstrated by testing the manufacturers corresponding stock systems according to test methods indicated. The system includes the glass as well as all structural members, components, anchorages, fasteners and attachments required to meet the performance criteria specified. The Contractor's Engineer shall design the system and analyze support elements in their entirety to resist the required loadings and transfer the reactions to adequate support elements included for the main building structure. The mullions shall be extended through all wall and ceiling construction above, below and beside to these support elements.

B. Air and Water Infiltration: Design and install the glazed curtain wall system for permanent resistance to air and water leakage through the system in accordance with the following:

7. Air Infiltration: Air leakage through the curtain wall system shall not exceed 0.06 cfm per square foot of wall area when tested in accordance with ASTM E283 at a minimum static air pressure differential of 6.24 lbf per square foot.

2. Water Penetration: There shall be no uncontrolled water leakage through the curtain wall system, as defined in AAMA 501, when tested in accordance with ASTM E331 at a minimum differential pressure of 20 percent of inward design wind load but not less than 6.24 lbf per square foot or more than 12 lbf per square foot.

C. Structural Performance: Design, engineer, fabricate, and install the glazed aluminum curtain wall system to withstand the effects of all wind loads as required by the Virginia Construction Code, 2012 Edition when tested in accordance with ASTM E330, with no material failures or permanent deformation of structural members. Where required, provide internal structural reinforcement.

1. Virginia Building Code parameters to be utilized include the following:

a. Basic Wind Velocity: See Drawings

b. Nature of occupancy Importance Factor: See Drawings

c. Building location classification: See Drawings

d. Grade to Mean Roof Height: See Drawings

e. All factors and pressure coefficients based on the above to determine pressures both inward and outward and acting normal to the plane of the wall, including soffits and return surfaces

2. Structural test pressure shall be equal to 150 percent of the inward and outward acting design wind pressures.

3. Deflections: The curtain wall system shall be capable of withstanding building movements including wind loading and of performing within the following limitations:

a. Deflection of framing members perpendicular to the plane of the wall shall not exceed 1/175 of its clear span. Where indicated deflections exceed 3/4 inch verify and certify that the magnitude will not be detrimental to the performance of the system and all surrounding construction, or further limit the deflections accordingly.

b. Deflection of members parallel to the plane of the wall, when carrying its full dead load, shall not exceed an amount that will reduce glass bite by less than 75 percent of the design dimension and shall not reduce edge clearance between itself and the panel, glass, or other fixed member immediately below to less than 1/8 inch.

D. Thermal Test (“U” value): Perform test in accordance with AAMA 1503.1 procedure. Thermal transmittance (“U”) maximum 0.65 Btu/hr/sf/degrees F. Coordinate design with Insulated Cab Glazing performance guidelines.

E. Thermal Movements: The glazed aluminum curtain wall system shall be capable of withstanding thermal movements resulting from an ambient temperature differential of 120 degrees F, which may result in a metal surface temperature range of 180 degrees F within the curtain wall framing without causing buckling, stresses on glass, failure of joint sealants,

damaging loads on fasteners, or other detrimental effects. Coordinate with Insulated Cab Glazing as designed.

F. Condensation Requirements: The glazed aluminum curtain wall system shall be of thermal-break construction that has been tested in accordance with AAMA 1502.7 and certified by the manufacturer to meet the following criteria: No (0 percent) condensation with indoor conditions of 70 degrees F, 30 percent relative humidity and outside conditions of -20 degrees F.

G. Sound Transmission: The average sound transmission loss through the glazed aluminum curtain wall system shall be a minimum of 30 db for the standard frequency range of 125 to 4000 Hz when tested in accordance with ASTM E90 with the glass type indicated.

1.5 SUBMITTALS

A. General: Submit the following in accordance with Conditions of the Contract and Division 1 Specification sections.

B. Product Data: Include manufacturer's specifications for materials and fabrication, installation instructions, and recommendations for maintenance. Include test reports showing compliance with project requirements where test method is indicated.

C. Shop Drawings: Show adaptation of manufacturer's glazed aluminum curtain wall system to the project; include typical unit elevations at 1/2 inch scale and details at 3 inch scale. Show dimensions, profiles of members, anchorage system, interface with building construction, and glazing.

1. Include setting drawings, templates, and directions for the installation of anchor bolts and other anchorages installed as a unit of work under other sections.

2. Indicate where and how the system deviates from contract drawings and specifications.

3. Provide computations, prepared, signed, and sealed by a professional engineer licensed to practice in the jurisdiction where the project is located. Show loadings, section properties of loadbearing members, material properties, calculations of stresses and deflections and reactions and allowable loadings for all connections, anchrages and attachments.

D. Samples: Provide pairs of samples of each aluminum finish type and color on 12 inch long sections of extrusions or formed shapes and on 6 inch squares of aluminum sheet or plate. Include 2 or more units in each sample set showing the extreme limits of variations expected in color and texture of finish.

1. The Architect reserves the right to require fabrication samples showing the following:

a. Prime members.

b. Joinery.

c. Anchorage.

d. Expansion provisions.

e. Glazing and similar details.

f. Profiles.

g. Intersections.

E. Installer certificates signed by the manufacturer certifying that the installers of the glazed aluminum curtain wall system comply with requirements indicated, and that the thermally broken glazed aluminum curtain wall system, as designed, is compatible and will work as a system without problems with the insulated cab glazing.

F. Test Reports: Provide test reports from a qualified independent testing laboratory that show compliance of the glazed aluminum curtain wall system with performance requirements indicated based on comprehensive testing of the system by the laboratory. Tests of manufacturer's stock glazed curtain wall system shall be within the last 5 years of production by the manufacturer.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Engage an installer with at least 10 years documented experience who has successfully completed installation of glazed curtain wall systems similar in material, design, and extent to that indicated for the Project and who is acceptable to the curtain wall manufacturer.

B. Testing Laboratory Qualifications: To qualify for acceptance, an independent testing laboratory must demonstrate to the Architect's satisfaction, based on evaluation of laboratory-submitted criteria conforming to ASTM E699, that it has the experience and capability to conduct satisfactorily the testing indicated without delaying the progress of the work.

C. Performance Testing:

1. If listed manufacturers standard curtain wall complies with requirements as listed in System Performance Requirements subsection and has been tested in accordance with specified tests, as listed in Testing Mock-Up; provide test reports.

2. Any substitute manufacturer or system shall perform testing as defined below.

a. Testing Mock-Up: A testing mock-up complete in all respects shall be fabricated and erected at the Construction Research Laboratory in Miami, Florida.

1) Mock-up shall accurately represent actual project conditions including joints, sealants, glazing, anchors and finishes.

2) The testing agency will be responsible for designing, conducting and recording the tests, shall state whether or not the tests specimen conforms to requirements of the Contract and shall specifically note any deviations therefrom.

3) All testing fees and expenses shall be paid for by the curtain wall Subcontractor.

4) The design pressure for the mock-up shall be the maximum design pressure for the building.

5) Probability of breakage must not exceed 8/1000 for vertical glass.

6) Size of mock-up shall be equivalent to one structural bay along column line D.

b. Performance Requirement:

1) Basic wind velocity at project site is 120 mph. Nature of occupancy of building requires an importance factor of 1.15. The building location is classified as Exposure C. Height of building from grade to mean roof is 91 feet-6 inches. For factors and pressure coefficient refer to Virginia Building Code. Design wind pressure, both inward and outward and acting normal to the plane of the wall (including soffits and return surfaces) shall comply with the requirements of the Virginia Building Code including all applicable modifying factors and information above.

2) Wind loadings shall be in accordance with the Structural Performance paragraph.

3) Dead load shall be the actual weight of materials supported by the curtain wall.

4) For the above pressures and loads, limit deflections and stresses as follows:

a) Panel deflection shall not exceed 1/60 of the span of the short dimension.

b) Normal to the plane of the wall, deflection of framing members shall not exceed 1/175 of span length or 3/4 inch, whichever is less. Where a sealant joint occurs between a curtain wall member and a relatively stiff building element, deflection of the curtain wall member shall not exceed 1/2 of the joint width, or less if required by sealant manufacturer.

c) In the plane of the wall, deflection of framing members shall not reduce the glass or panel bit below 75 percent of the design dimension and shall not reduce the glass or panel edge clearance below 25 percent of the design dimension or 1/8 inch, whichever is greater. Restrict deflection further if required for assembly and fit of components.

d) At connection points of framing members to anchors, including cantilever braces, kickers, etc., anchor deflection in any direction shall not exceed 1/16 inch. Where connection points are not clearly defined, maximum anchor point deflection which is used to determine span of element, shall not exceed 1/16 inch.

e) Stresses must take into account interaction and shall not exceed the allowable values established by the specifications listed under "References." In no case shall allowable values exceed the yield stress.

f) Tensile or shear stress in structural silicone sealant joints shall not exceed 20 pounds per square inch with a 5:1 safety factor.

5) At 1-1/2 times design pressure, net permanent deflections of framing members must not exceed 1/1000 of span length and components must not experience failure or gross permanent distortion. At connection points of framing members to anchors, anchor deflection in any direction shall not exceed 1/8 inch and permanent set shall not exceed 1/16 inch. Where connection points are not clearly defined, maximum anchor point deflection and permanent set which is used to determine span of element shall not exceed 1/8 inch and 1/16 inch, respectively.

6) Provide clearance for thermal movement within a surface temperature range of 0 degrees F to +180 degrees F. Provide additional clearance as required to accommodate erection tolerance, slab and beam deflection and long-term creep of structural frame. All components of the curtain wall including panels, adhesives, sealants, etc., shall be capable of withstanding a combined design wind and thermal load.

7) When tested in accordance with ASTM E283, air infiltration must not exceed 0.06 CFM per square foot of fixed wall area. Air infiltration at operating doors must not exceed 0.25 CFM per foot of door perimeter.

8) Water Infiltration:

a) Water infiltration, in this specification, is defined as the appearance of uncontrolled water other than condensation on the room side face of any part of the wall.

b) Provision shall be made in the design to drain to the exterior face of the wall any leakage of water occurring at joints and/or any condensation taking place within the construction.

c) No water infiltration under static pressure in accordance with ASTM E331 at a differential static pressure of 10 PSF (1.92 inch H_2O).

d) No water infiltration under dynamic pressure in accordance with AAMA 1502.7. Minimum pressure for paragraph 4.5.4 shall be 10 PSF with a minimum slip stream velocity of 100 mph.

D. Field Testing: Field water tests in accordance with AAMA 501.3 may be performed on completed portions of the wall at the Architect's option. In the event that such testing should result in uncontrolled leakage, eliminate the causes of such leakage at no additional cost to the Owner. Remedial measures must maintain standards of quality and durability and are subject to approval. Provide powered scaffold, hose and sufficient personnel to operate scaffold and hose, to perform up to 5 successful tests under the Architect's supervision.

E. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in the jurisdiction project is located and who is experienced in providing engineering

services of the kind indicated. Engineering services are defined as those performed for installations of glazed aluminum curtain wall systems that are similar to those indicated for this project in material, design and extent.

F. Glazing Standards: Comply with recommendations of Flat Glass Marketing Association (FGMA) "Glazing Manual" and "Sealant Manual" except where more stringent requirements are indicated. Refer to those publications for definitions of glass and glazing terms not otherwise defined in this section or referenced standards.

G. Insulating Glass Certification Program: Provide insulating glass units permanently marked either on spacers or on one component pane of units with the appropriate certification label of inspecting and testing organization indicated below.

1. Insulating Glass Certification Council (IGCC).

2. Associated Laboratories Inc. (ALI).

H. Single-Source Responsibility: Provide glazed aluminum curtain wall system for the project from one source from a single manufacturer.

I. Design Criteria: The drawings indicate sizes, profiles, and dimensional requirements of the curtain wall system. Curtain wall systems having equal performance characteristics with deviations from indicated dimensions and profiles may be considered, provided deviations do not change the design concept of intended performance.

1. The burden of proof for equality of the curtain wall systems is on the proposer.

J. Preinstallation Conference: Before beginning curtain wall installation, conduct a preinstallation conference at the Project site with the curtain wall system manufacturer, installer, and other interested parties to review procedures, schedules, and coordination of the curtain wall installation with other elements of the work.

1.7 PROJECT CONDITIONS

A. Field Measurements: Take field measurements before fabrication; show recorded measurements on final shop drawings. Coordinate fabrication schedule with construction progress to avoid delay.

1.8 SEQUENCING AND SCHEDULING

A. Schedule installation of the glazed aluminum curtain wall system in sequence with related elements of the work specified in other sections to ensure that wall assemblies, including flashing, trim, and joint sealers, are protected against damage from effects of weather, age, corrosion, and other causes.

1.9 WARRANTY

A. General: Submit a written warranty signed by authorized representatives of the Contractor and installer warranting that portions of the work involving glazed aluminum curtain wall are of good quality, free from defects, and in conformance with the requirements of the Contract Documents and further promising to repair or replace defective work during a 10-year period following completion of that portion of the work.

1. Defective is defined to include the following:

a. Glass breakage.

b. Failure of operational parts to function normally.

c. Deterioration or discoloration of finishes.

d. Failure of the system to meet performance requirements.

B. The Warranty submitted under this section shall not deprive the Owner of other rights or remedies that the Owner may have under other provisions of the Contract Documents and is in addition to and runs concurrent with other warranties made by the Contractor under requirements of the Contract Documents.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products of one of the following:

1. (B.O.D) Kawneer Co., Inc.; Aluminum Curtain Wall System: 1600 Wall Applied System 1.

2. Wausau Metals Corporation.

3. Vistawall Architectural Products.

2.2 MATERIALS

A. Aluminum: Provide alloy, temper, and thickness recommended by the manufacturer for the type of use and finish indicated and with not less than the strength and durability properties of the alloy and temper designated below for each aluminum form required.

1. Extruded Bar, Rod, Tubes and Shapes: Comply with requirements of ASTM B221.

2. Plate and Sheet: Comply with requirements of ASTM B209.

3. Extruded Structural Pipe and Tubes: Comply with requirements of ASTM B429.

B. Glass: The frame shall be bonded to the glass to provide an airtight, waterproof, and vapor proof seal. Refer to Division 8, Section 088000 – GLAZING.

C. Glazing Gaskets: Manufacturer's standard sealed-corner pressure- glazing or wedge-lock dry glazing system of black, resilient elastomeric glazing gaskets, setting blocks and shims or spacers as required, hardness as selected by manufacturer.

1. Gasket Material: Extruded or molded neoprene gaskets complying with requirements of ASTM D2000, classification as selected by the manufacturer for performance and permanence.

D. Glazing sealants and fillers: Comply with requirements in Division 8, Section 088000 – GLAZING.

E. Framing System Gaskets and Joint Fillers: Manufacturer's standard permanent framing system gaskets and joint fillers, depending on joint movement and sealing requirements, such as sliding joints, compression joint translation, or non-moving joints.

F. Sealants and joint fillers, both for joints within the curtain wall construction and for joints at the interface of curtain wall construction and other work, shall comply with requirements specified in Division 7, Section 079200 – JOINT SEALANTS.

G. Concealed Flashing: Dead-soft 26 gage stainless steel, complying with ASTM A666, concealed flashing of type selected for compatibility by the manufacturer.

H. Firestopping Materials: Provide mineral fiber insulation or other noncombustible materials suitable for permanent placement and that comply with governing regulations.

I. Panel Insulation: Rigid glass-fiber insulating board core with an r-value of 4.13 at 57 degrees F.

2.3 COMPONENTS

A. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum units.

1. Brackets not exposed to weather or abrasion may be hot-dip galvanized steel complying with ASTM A386.

2. Provide nonstaining, nonferrous shims for installation and alignment of curtain wall work.

B. Fasteners and Accessories: Provide manufacturer's standard non- corrosive fasteners and accessories compatible with materials used in the framing system and with exposed portions that match finish of the curtain wall system. Where movement is expected, provide slip-joint linings of sheets, pads, shims, or washers of fluorocarbon resin or a similar material recommended by the manufacturer.

C. Concrete or Masonry Inserts: Cast-iron, malleable iron or hot-dip galvanized steel inserts complying with ASTM A386.

2.4 FABRICATION

A. General: Fabricate curtain wall system at the manufacturer's shop to the fullest extent possible and before applying finishes.

B. Fabricate glazed aluminum curtain wall system according to Shop Drawings. Fabricate components that, when assembled, will have accurately fitted joints with ends coped or mitered to produce hairline joints free of burrs and distortion. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings. Match exposed work to produce continuity of line.

C. Forming: Form shapes with sharp profiles, straight and free of defects or deformations, before finishing.

D. Prepare components to receive concealed fasteners and anchor and connection devices.

E. Fabricate components to drain water passing joints, condensation occurring in glazing channels, condensation occurring within framing members, and moisture migrating within the system to the exterior.

F. Metal Protection: Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape recommended by manufacturer for this purpose. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

2.5 FINISHES

A. General: Comply with the NAAMM "Metal Finishes Manual" for recommendations relative to application and designations of finishes.

B. Finish designations prefixed by "AA" conform to the system established by the Aluminum Association for designating aluminum finishes.

C. High-Performance Organic Coating: AA-C12C42R1x (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: chemical conversion coating, acid chromate-fluoride-phosphate pretreatment; Organic Coating: as specified below). Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturer's instructions.

1. Fluorocarbon 2-Coat Coating System: Manufacturer's standard 2-coat thermocured system, complying with AAMA 605.2, composed of specially formulated inhibitive primer and fluorocarbon color topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight. Color: TBD from a list of manufacturer’s available colors.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of glazed aluminum curtain wall system. Do not proceed with installation until unsatisfactory conditions have been corrected or accommodations acceptable to Architect have been made.

3.2 PREPARATION

A. Furnish inserts at proper times for setting in concrete formwork, masonry, and similar work indicated to support curtain wall work.

3.3 INSTALLATION

A. Comply with manufacturer's instructions for protecting, handling, and installing fabricated curtain wall components, with particular care and attention to preservation of applied finishes. Discard or remove and replace damaged members.

B. Anchor components securely in place in the manner indicated. Shim and allow for movement resulting from changes in thermal conditions. Provide separators and isolators to prevent corrosion, electrolytic deterioration, and freeze-up of moving joints.

C. Firestopping: Clean debris from behind curtain wall during erection and provide temporary closures to prevent accumulation of debris. Install firestopping to comply with governing regulations and AAMA TIR-A3. Install firestopping with securely anchored metal flanges or make equivalent provisions to prevent dislocation. Comply with requirements of Division 7, Section 078413 – PENETRATION FIRESTOPPING.

D. Glazing: Comply with requirements specified in Division 8, Section 088000 – GLAZING.

E. Sealants and joint fillers: Comply with requirements specified in Division 7, Section 079200 – JOINT SEALANTS.

F. Erection Tolerances: Install components plumb, level, accurately aligned, and located in reference to column lines and floor levels. Adjust work to conform to the tolerances indicated below. Tolerances indicated below are maximum and are not cumulative.

1. Plumb: 1/8 inch in 20 feet; 1/4 inch in 40 feet.

2. Level: 1/8 inch in 20 feet; 1/4 inch in 40 feet.

3. Alignment: Limit offset of member alignment to 1/16 inch where surfaces are flush or less than 1/2 inch out of flush and separated by less than 2 inches by a reveal or protruding work; otherwise limit offsets to 1/8 inch.

4. Location: 3/8 inch maximum deviation from the measured theoretical location of any member at any location.

3.4 FIELD QUALITY CONTROL

A. On-site Tests (Installed Curtain Wall)

1. On-site tests shall be conducted on three sections of each system identified in Subsection 1.4 of this specification section for both air and water infiltration with the window manufacturer's representative present. Owner's representatives will select sections to be tested. Section shall be full height of system by 8 feet wide.

2. Those tested units not meeting the specified requirements and any or all units having similar deficiencies as identified by the Architect shall be corrected and retested by the window contractor to meet the specified criteria at no cost to the Owner.

3. All costs for all tests, both original and retest, shall be paid by window contractor.

4. Testing shall be conducted by a qualified testing agency approved by the Architect and window manufacturer in accordance with AAMA 502.90.

a) Air infiltration tests on windows shall be in accordance with ASTM E783.

1) Allowable air infiltration may be 1.5 times amounts allowed in Section 084413, Subparagraph 1.4.B.1

b) Water infiltration tests on windows shall be in accordance with ASTM E1105 at the static pressure of 10.0 psif differential with water rate of 5 gallons/hour/square foot.

1) No uncontrolled water to appear on interior surfaces.

3.5 CLEANING

A. Clean the completed system, inside and out, promptly after erection and installation of glass and sealants, allowing for nominal curing of liquid sealants. The installer shall advise the Contractor of proper and adequate procedures for protection and cleaning during the remainder of the construction period so that the system will be without damage and deterioration at the time of acceptance.

B. At the time of substantial completion, clean curtain wall system thoroughly and polish glass. Demonstrate proper cleaning methods and materials to the Owner's maintenance personnel.

END OF SECTION 084413

SECTION 087100 – DOOR HARDWARE

PART 1 - GENERAL

1.1 WORK INCLUDES**:**

A. Finish Hardware
Aluminum Door Hardware
Thresholds
Weather-stripping

1.2 RELATED WORK

A.	Hollow Metal Doors and Frames	Section 081113
	Flush Wood Doors	Section 081416
	Electrical	Division 26
	Security	Division 26 and 27

1.3 QUALITY ASSURANCE

A. STANDARDS: Manufacturers and model numbers listed are to establish a standard of quality. Similar items by approved manufacturers, unless otherwise noted, that are equal in design, finish and quality will be accepted upon prior approval of the architect and provided required data and physical samples are submitted at least ten (10) days prior to date of bid. Products listed as “No Substitute” are specified as such to match existing or by the Owners request.

B. SUPPLIER QUALIFICATIONS: Hardware supplier must be engaged regularly in contracting work and be staffed to expedite work, the firm shall have been furnishing hardware on similar projects for not less than five years. Supplier shall be an authorized distributor of Intellikey Programmable Electronic Cylinders.

C. INSTALLER QUALIFICATIONS: Hardware for the project shall be installed by factory authorized personnel who have successfully completed factory training courses and shall be certified for the installation of locksets, door closers and exit devices. Prior to installation, the installer shall inspect all door frames for proper plum and square condition. General Contractor shall be notified of frames found out of square, plum or unsuitable for door installation at the installation meeting. Intellikey Electronic Cylinders shall be installed by an authorized factory trained Intellikey installer at the direction of the Lynchburg Regional Airport (LYH) Security Department.

D. FIELD INSPECTION: Inspection of existing doors, frames and hardware is required to evaluate compliance with the Americans with Disabilities Act, (ADA) the operation of the door hardware and the compatibility of new hardware with existing doors and frames. A written report detailing any deficiencies or incompatibility shall be forwarded to the Architect ten (10) business days prior to bid of project.

E. ELECTRONIC/ELECTRIC HARDWARE: It shall be the responsibility of supplier to coordinate with the approved manufacturer and the electrical contractor / security / fire systems contractor all electronic / electrical finish hardware items covered within this section via factory wiring diagram showing point to point connections, riser diagram and system schematic. Factory wiring diagram shall be furnished with hardware submittals (See 1.5). Refer to Security wiring diagrams for coordination of electro-mechanical hardware with access control and life safety systems. Door Hardware submittals will not be reviewed without factory wiring diagrams.

F. PREINSTALLATION CONFERENCE FOR MECHANICAL HARDWARE: Conduct conference at Project site to comply with requirements in Division 1 Section “Project Meetings.” Review methods and procedures related to mechanical door hardware, including but not limited to the following:

1. Review and finalize construction schedule and verify availability of materials, installer’s personnel, equipment and facilities needed to make progress an avoid delays.
2. Present General Contractor with a written report of the condition of door frames in terms of squareness and any other condition that may impede the installation and operation of the doors and hardware.
3. Review installer’s responsibilities for testing, inspecting and adjusting doors and hardware in accordance with Part 3 EXECUTION.

G. PREINSTALLTION CONFERENCE FOR ELECTRIFIED HARDWARE: Conduct conference prior to electrical Rough-in for electro-mechanical hardware components. Review methods and procedures related to electrified door hardware including, but not limited to the following:

1. Discuss electrical rough-in requirements, factory wiring diagrams and other preparatory work to be performed by other trades.
2. Review sequence of operation for each type of electrical door hardware.
3. Review and finalize construction schedule and verify availability of materials, installer’s personnel, equipment and facilities needed to make progress an avoid delays.
4. Review installer’s responsibilities for testing, inspecting and adjusting doors and hardware in accordance with Part 3 EXECUTION.
5. Meet with designated owner’s representative to set up Intellikey Electronic Cylinder training for the Lynchburg Regional Airport (LYH) Security Department.

H. VIRGINIA WIND AND IMPACT REQUIREMENTS: All hardware shall meet or exceed requirements for Wind Pressure and Impact ratings. Furnish copies of Notice of Acceptance as required by the Architect.

1.4 REFERENCES

A. ANSI/BHMA designations where used in schedules to describe hardware items or to define quality or function are derived from the following standards and requirements specified elsewhere in this section.

1. Butts and Hinges:	ANSI A156.1	(BHMA 101)
2. Locks and Lock Trim:	ANSI A156.2	(BHMA 601)
3. Exit Devices:	ANSI A156.3	(BHMA 701)
4. Door Controls: Closers:	ANSI A156.4	(BHMA 301)
5. Auxiliary Locks:	ANSI A156.5	(BHMA 501)
6. Architectural Door Trim:	ANSI A156.6	(BHMA 1001)
7. Template Hinge Dimensions:	ANSI A156.7	
8. Door Controls: Overhead Holders:	ANSI 156.8	(BHMA 311)
9. Interconnected Locks & Latches:	ANSI A156.12	(BHMA 311)
10. Mortise Locks & Latches:	ANSI A156.14	(BHMA 401)
11. Sliding & Folding Door Hardware:	ANSI A156.14	(BHMA 401)
12. Closer Holder Release Devices:	ANSI A156.16	(BHMA 1201)
13. Self Closing Hinges & Pivots:	ANSI A156.17	(BHMA 1101)
14. Materials and Finishes:	ANSI A156.18	(BHMA 1301)

1.5 SUBMITTALS

A. GENERAL REQUIREMENTS: Submit manufacturer's product data for each item of hardware. Include whatever information may be necessary to show compliance with requirements, and instructions for installation and maintenance of operating parts and exposed finishes.

B. SCHEDULES: Submit six (6) copies of the finish hardware schedule for approval. Schedule format shall be similar to the one included at the end of Part 3 of this section. Submit a Factory Wiring Diagram for ALL electrical hardware components for the approval of the project Electrical Engineer.

C. SAMPLES: At the request of the architect, submit samples of products for approval of design, finish, etc.

D. TEMPLATES: Whenever required, furnish templates to the necessary fabricators of other related work, which is to receive finish hardware, such as door and steel door frames and or aluminum doors and frames.

E. CATALOG CUTS: Submit six (6) copies of catalog cuts of all products listed in the finish hardware schedule.

F. KEYING SCHEDULE: The specific keying requirements should be noted elsewhere in this schedule. If these requirements are not noted then, it is the supplier's responsibility to submit a keying schedule based on the format listed in the DHI annual Keying Procedures, Systems and Nomenclature.

1.6 DELIVERY STORAGE AND HANDLING

A. MARKING & PACKAGING: Hardware should be required to be sent to the job site in the manufacturers original packages marked to correspond with the approved hardware schedule.

B. Some items of hardware may have to be delivered to fabricators for factory installation. (i.e.: Aluminum Storefront).

C. Storage and protection of the materials is the responsibility of the General Contractor. Proper storage methods are advised as protection of the material and finish as necessary.

1.7 WARRANTIES

A. All door closers shall have a ten (10) year warranty against defects in material and workmanship from the date of occupancy of the project.

B. Power supplies and power controllers shall be warranted for the life of the installation.

C. Exit hardware shall be warranted for a period of three (3) years against defects material and workmanship.

D. All other products shall have a one (1) year warranty against defects in the material and workmanship from the date of occupancy of the project

PART 2 - PRODUCTS

2.1 ACCEPTABLE PRODUCTS

A. The following is a list of acceptable products:

Products:	Specified Manufacturers:	Acceptable Manufacturers:
HINGES	MCKINNEY	HAGER, LAWERENCE
PIVOTS	RIXON	LCN
FLUSH BOLTS	ROCKWOOD	HAGER, TRIMCO
EXIT DEVICES	CORBIN-RUSSWIN	YALE, SARGENT
CYLINDERS	BEST	NO SUBSTITUTE
ELECTRONIC CYL	INTELLIKEY	NO SUBSTITUTION
LOCKS	CORBIN-RUSSWIN	YALE, SARGENT
ELECTRIC STRIKES	FOLGER ADAM	NO SUBSTITUTE
POWER SUPPLIES	FOLGER ADAM	NO SUBSTITUTE
MAGNETIC LOCKS	FOLGER ADAM	NO SUBSTITUTE
PUSH-PULLS	ROCKWOOD	HAGER, TRIMCO
DOOR CLOSERS	CORBIN-RUSSWIN	YALE, SARGENT
KICK PLATES	ROCKWOOD	HAGER, TRIMCO
DOOR STOPS	ROCKWOOD	HAGER, TRIMCO
THRESHOLDS	PEMKO	NATIONAL GUARD, REESE
W / S SETS	PEMKO	NATIONAL GUARD, REESE
DOOR BOTTOMS	PEMKO	NATIONAL GUARD, REESE

B. To the greatest extent possible, obtain materials from one manufacturer. Manufacturers listed above are intended to insure quality and design of the project. Other manufacturers submitted will be acceptable, provided they are equal or exceed standard of quality proposed for this project.

2.2 MATERIALS

A. SCREWS & FASTENERS: All screws and fasteners required for the hardware items are listed in the individual hardware sets. Any omission of these items should be reflected in the schedule submitted for approval.

B. HINGES: Where hinges are specified unless otherwise noted they shall be of types and sizes as required by ANSI A156.1. SIZE HINGES ACCORDING TO MANUFACTURERS RECOMMENDATIONS. Provide stainless steel continuous hinges as listed in the hardware sets.

1. Provide electric hinges with ElectroLynx standardized plug in connectors to accommodate up to twelve wires.
2. Plug connectors shall plug directly into ElectroLynx through door wiring harness for connection to electric locking devices and power supplies.
3. Provide sufficient number of concealed wires to accommodate electric function of specified electro mechanical hardware.

C. PIVOTS: All pivots and/or pivot sets shall be the product of one (1) manufacturer. Sets as noted in the hardware groups shall be matching in design for aluminum storefront doors. The doors as noted in the hardware sets are to have intermediate pivots as well as top pivots. All pivot sets are required to meet ANSI Grade One standards as standard listed in ANSI A156.4, 1980.

D. FLUSH BOLTS: Provide annual and automatic flush bolts as noted in the hardware sets. All flush bolts are required to meet ANSI A156.3.

E. COORDINATOR & CARRY BARS: Provide coordinator and carry bars as noted in the hardware sets. Coordinators and carry bars are required to meet ANSI A156.2 TYPE 21.

F. LOCKSETS & CYLINDERS: Provide lock sets and cylinders as noted in hardware sets. Lock sets shall meet ANSI A156.13, Grade One operational, Grade Two security, UL listed. Lock cases shall be field reversible without disassembly of lock case. Cylinders shall be 7 pin Best 1E7424 to match existing system.

1. Provide locksets with ElectroLynx standardized plug in connectors.

G. LOCK TRIM: The design criteria selected for the lock set is as noted in the hardware sets. This is the acceptable design selected by the owner and intended for this project.

H. EXIT DEVICES: Provide the series and type of exit devices as noted in the hardware sets. These exit devices are required to meet ANSI A156.3 Grade One. All exit devices and electrically controlled exit devices shall be of one manufacturer.

1. Provide exit devices with ElectroLynx standardized plug in connectors.

I. DOOR CLOSERS: Provide the series and type of door closers as noted in the hardware sets. These door closers are required to meet ANSI A156.4 Grade One. All closers and power actuated closers shall be of one manufacturer. Plated finish door closers shall have plated arms and brackets. Painted finish door closers shall be powder coated.

J. PUSH, PULL & KICK PLATE: Provide the type and size of these plates as noted in the hardware sets. These items are intended for the use and accessibility as protection of the openings indicated in the hardware schedule.

K. DOOR STOPS & HOLDERS: Provide the types as noted in the hardware sets. Any variation in the job site conditions could change the type as specified. This should be reflected in the schedule submitted for approval. Install all floor stops so as not to interfere with pedestrian or cart traffic. Floor stops shall be installed within 12 inches of the pivot point of the door and frame assembly.

L. THRESHOLD & WEATHER-STRIPPING: Provide the types as noted in the hardware sets. All exterior openings and interior fire rated openings shall have the necessary items to meet the local building code standards. Provide stainless steel screws at all locations.

M. SILENCERS: Provide the type required to accommodate the hollow metal frames and wood frames fabricated for the project.

N. ELECTRICAL PRODUCTS: Too assure proper integration, ALL ELECTRICAL PRODUCTS **TO BE PRODUCED BY THE SAME MANUFACTURER.**

2.3 FINISHES

A. Provide the finishes as specified in the hardware schedule. Otherwise, provide matching finishes for the hardware items at each door opening to the greatest extent possible. Refer to the ANSI A156.18 for the identification of these finishes.

2.4 KEYING

A. Key all cylinders to match existing BEST 7 PIN removable core Grand Master Key System at the direction of the Architect and owner.

B. Review with the Architect and/or owner all keying requirements.

C. Each key shall be marked and identified as directed by the Architect using the mechanical impact method of transferring the numerical impression to the key bow. Characters shall be consistent and uniform in their placement, alignment and depth of impression. Mark each key “DO NOT DUPLICATE”.

D. Provide 3 factory cut change keys per lock, 2 master keys per group, 25 pre-combinated cores and 200 key blanks. All factory cut and blank keys shall be restricted for use in the geographic area and be of nickel silver. Ship all permanent factory cut keys, key blanks and cylinders direct via registered US Mail to the designated representative of LYH.

E. Provide all cylinders with temporary master keyed construction core system. Furnish General Contractor 10 keys for construction core system.

2.5 KEY CONTROL

A. KEY CABINET: Provide a key control system including envelopes, labels tags, with self locking key clips, receipt forms, three-way visible card index, temporary markers and standard metal cabinet. Provide all of this material from one manufacturer and per that manufacturer’s system standard. Provide a system with the capacity for 150% of the number of cylinders and lock sets required for the project.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Refer to the DHI manual publication for Recommended Locations for Builders Hardware, ACCESSIBILITY CODE AND ADA REQUIREMENTS for instruction. Also, coordinate with the door suppliers for these locations. Install all hardware in compliance with manufacturer’s instruction and recommendations. Drill and countersink all items which are not factory prepared for fasteners. Cut and fit all thresholds and weather-stripping to profile of door frames. Set threshold in accordance with the application condition.

3.2 OPERATIONS, MAINTENANCE AND TRAINING

A. At completion of the project, provide the owner with a manual containing the following information:

1. Final (as built) copy of hardware schedule.
2. Final copy of keying schedule.
3. Final copy of all system schematics and wiring diagrams.
4. Copy of product data sheets as submitted including all Warranty data.
5. Parts list for Locksets, Door Closers and Exit Devices.
6. Copy of installation instructions for each type of hardware used.
7. Name, address and phone number of each manufacturer and local representative.
8. Complete set of any specialized tools.
9. Complete set of manufacturer warranty information for each hardware type.

B. At the completion of the project the supplier shall engage a factory authorized service representative to train the Owner's maintenance personnel to adjust, operate and maintain door hardware and electronic cylinder, lock systems, and electro-mechanical hardware provided in this section.

3.2 PROTECTION

A. The general contractor is responsible for the proper protection of all items of hardware until final acceptance of the project by the owner and the architect.

3.3 HARDWARE SCHEDULE

A. Hardware sets are as follows:

HARDWARE SET 1			**SINGLE RESTROOM**		
QTY	ITEM	MODEL	SIZE/TRIM	OPTION	FINISH
3 ea	HINGES	T4A3386	4.5 X 4.5		630
1 ea	LOCKSET	ML2020	LC LSA		626
1 ea	CLOSER	DC 6210		A4	689
1 ea	KICK PLATE	K1050 B4E	8 X 2	LDW	630

HARDWARE SET 2			**ELEVATOR MACHINE ROOM**		
QTY	ITEM	MODEL	SIZE/TRIM	OPTION	FINISH
3 ea	HINGES	T4A3386	4.5 X 4.5	NRP	630
1 ea	LOCK	ML 2057	LC LSA		626
1 ea	CYLINDER		LAR		626
1 ea	CLOSER	DC 6210		A4	689
1 ea	KICK PLATE	K1050 B4E	12 X 2	LDW	630
1 ea	THRESHOLD	171A	LAR		AL
1 ea	DOOR BOTTOM	315 CN	LAR		AL
1 ea	SOUND SEAL	332CR	LAR		AL

HARDWARE SET 3			**INTERIOR CLOSET / STORAGE**		
QTY	ITEM	MODEL	SIZE/TRIM	OPTION	FINISH
3 ea	HINGES	T4A3316	4.5 X 4.5		630
1 ea	LOCK	ML 2057	LC LSA		626
1 ea	CYLINDER		LAR		626
1 ea	CLOSER	DC 6200			689
1 ea	DOOR STOP	441CU			626

HARDWARE SET 4			INTERIOR FIRE PUMP ROOM		
QTY	ITEM	MODEL	SIZE/TRIM	OPTION	FINISH
3 ea	HINGES	T4A3386	4.5 X 4.5	NRP	630
1 ea	LOCK	ML 2057	LC LSA		626
1 ea	CYLINDER		LAR		626
1 ea	CLOSER	DC 6210		A4	689
1 ea	KICK PLATE	K1050 B4E	12 X 2	LDW	630
1 ea	THRESHOLD	171A	LAR		AL
1 ea	W/S SET	303 AS	LAR		AL

HARDWARE SET 5			EXTERIOR ENTRY OUTSWING		
QTY	ITEM	MODEL	SIZE/TRIM	OPTION	FINISH
3 ea	HINGES	T4A3386	4.5 X 4.5	NRP	630
1 ea	LOCK	ML 2055	LC LSA		626
1 ea	CYLINDER		LAR		626
1 ea	CLOSER	DC 6210		A4	689
1 ea	KICK PLATE	K1050 B4E	8 X 2	LDW	630
1 ea	THRESHOLD	2001AV	LAR		AL
1 ea	DOOR BOTTOM	315 CN	LAR		AL
1 ea	W/S SET	303 AS	LAR		AL
1 ea	DOOR STOP	471			626

HARDWARE SET 6			INTERIOR STAIR		
QTY	ITEM	MODEL	SIZE/TRIM	OPTION	FINISH
3 ea	HINGES	T4A3316	4.5 X 4.5		630
1 ea	EXIT DEVICE	ED 5200	L955		626
1 ea	CYLINDER		LAR		626
1 ea	CLOSER	DC 6210		A3	689
1 ea	DOOR STOP	441CU			626

HARDWARE SET 7			ACCESS CONTROL / DELAYED EGRESS		
QTY	ITEM	MODEL	SIZE/TRIM	OPTION	FINISH
2 ea	HINGES	T4A3386	5 X 4.5	NRP	630
1 ea	EL HINGE	T4A3386	5 X 4.5	QC	630
1 ea	EXIT DEVICE	ED 5200SA	L9905	D QC M91	630
2 ea	CYLINDER		LAR		626
1 ea	CLOSER	DC 6210		A3	689
1 ea	BATTERY	B24-5			-
1 ea	POWER SUPPLY	BPS-24-2	CKL		600

1 ea	KICK PLATE	K1050 B4E	8 X 2	LDW	630
1 ea	MOP PLATE	K1050 B4E	8 X 2	LDW	630
1 ea	THRESHOLD	2001AV	LAR		AL
1 ea	W/S SET	303 AS	LAR		AL
1 ea	DOOR BOTTOM	315 CN	LAR		AL
1 ea	DOOR STOP	471			626

END SECTION 087100

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SECTION 088000 - GLAZING

PART 1 - GENERAL

1.1 SUMMARY

A. Provide glazing work specified and shown on the drawings.

B. Glazing includes the following:

1. Glazing exterior fixed glazing frames.

2. Glazing interior doors and view windows.

3. Miscellaneous interior glazing.

4. Unframed mirror glazing.

C. All glazing work for the project is governed by this section.

1.2 SYSTEM PERFORMANCE

A. Insulating glass shall be fabricated and installed to withstand normal temperature changes, wind loading, impact loading, without failure including loss or breakage of glass, failure of sealants or gaskets to remain watertight and airtight, deterioration of insulating glass materials, and other defects in the work. Deterioration of insulating glass is defined as failure of hermetic seal due to other causes than breakage which results in intrusion of dirt, or moisture, internal condensation or fogging at temperatures above -20 degrees F (28 degrees C), deterioration of protected internal glass coating, resulting from seal failure, and other visual evidence of seal failure or performance.

1.3 REFERENCE STANDARDS

A. Glazing work and materials shall conform to the applicable requirements of the following: FGMA Glazing Manual, FGMA Sealant Manual, AAMA TIR-A7 "Sloped Glazing Guidelines, SIGMA TM-3000 and TM-3001 "Vertical Glazing and Guidelines."

B. Glazing Standards: Comply with FGMA (Flat Glass Marketing Association) Glazing Manual and FGMA Sealant Manual except where more stringent requirements are indicated.

C. Safety Glazing Standard: Where safety glass is indicated or required by authorities having jurisdiction, provided type of products indicated which comply with ANSI Z97.1 and testing requirements of 16 CFR Part 1201 for category II materials. Provide safety glass permanently marked with certification label of Safety Glass Certification Council (SGCC) or other certification agency acceptable to authorities having jurisdiction.

1. Conform to local building code.

2. Conform to safety glazing statutes and regulations of the State of Virginia.

D. Insulating Glass Certification Program: Subject to compliance with requirements, provide insulating glass units permanently marked either on spacers or on at least one component pane of units with appropriate certification label of Insulating Glass Certification Council (IGCC).

1.4 SUBMITTALS

A. Submit manufacturer's product data and installation instructions for each type of glass and each glazing material required. Include test data and certificates, substantiating that with specified requirements.

B. Samples:

1. Submit two 12-inch x 12-inch samples of each type of glass required, except clear glass. Submit as insulating panels where applicable.

2. Submit two, 8-inch long samples of each color (except black) and for each type of glazing sealant and gasket exposed to view. Install sealant or gasket between two strips of materials representative of adjoining framing system in color.

C. Submit sealant-substrate adhesion and sealant compatibility test reports including glazing sealant manufacturer's findings and recommendations.

D. Submit shop drawing or typed schedule to indicate location of each type and thickness of glass.

E. Certificates: Submit certificates from respective manufacturer attesting that insulating glass and glazing materials furnished for project comply with requirements.

F. Submit calculations for all glass installations certifying compliance with wind load requirements as given in the drawings. The wind load shall be derived from ASCE 7 (components and cladding) or from actual wind load tests. The thickness of the glass shall be determined using ASTM E 2461 and ASTM E 1300. The design shall be prepared, sealed and signed by a registered in the State of Virginia structural professional engineer with experience in design of glass. Submit proof of experience.

G. Cab Glazing- Submit drawings and calculations signed and sealed by a licensed engineer in the State of Virginia showing complete details of the proposed setting methods, mullion details, edge blocking, size of openings, frame details and materials, and types and thickness of glass.

1.5 DELIVERY, STORAGE AND HANDLING

A. Comply with manufacturer's instructions for shipping, storing and handling insulating glass units, including protection of edges. Where substantial altitude changes will be made, comply with venting-and-sealing recommendations to avoid hermetic seal ruptures.

1.6 JOB CONDITIONS

A. Examine the framing and glazing channel surfaces, backing, removable stop design, and conditions under which the glazing is to be performed. Do not proceed with the glazing until unsatisfactory conditions have been corrected.

B. Install sealants glazing materials only when weather conditions and temperatures are within manufacturer's recommended limitations for installation.

1.7 SPECIFIC PRODUCT WARRANTY

A. Laminated Glass: Provide written 5-year warranty signed by manufacturer of laminated glass agreeing to replace defective glass f.o.b. project site within specified warranty period.

B. Coated Glass Products: Provide written 5-year warranty signed by manufacturer of coated glass agreeing to replace defective glass f.o.b. project site within specified warranty period.

C. Provide written 10-year warranty signed by manufacturer of laminated glass agreeing to furnish f.o.b. project site, within specified warranty period, insulating glass units which develop manufacturing defects. Manufacturing defects are defined as failure of hermetic seal of air space (beyond that due to glass breakage) as evidenced by intrusion of dirt or moisture, internal condensation or fogging at temperature above -20 degrees F (-29 degrees C), deterioration of protected internal glass coatings, if any, and other visual indications of seal failure or performance, provided the manufacturer's instructions for handling, installing, protection and maintaining units have been complied with during the warranty period.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Viracon, Inc.

B. Guardian Industries Corp.

C. Libbey-Owens-Ford Co.

D. PPG Industries, Inc.

E. Saint Gobain/Euroglass Corp.

F. Perilstein Corp.

2.2 GLASS SIZE AND THICKNESS

A. Sizes: Fabricate to sizes required by details shown on drawings. Provide edge clearances and tolerances complying with FGMA Manual and recommendations of glass manufacturer. Provide thickness indicated or as recommended by FGMA Manual and glass manufacturer for application intended.

2.3 PRIMARY GLASS

A. Clear Glass: Float glass Fed. Spec. DD-G-451, Type I, Class I, Quality q3, 1/4-inch thick, except as otherwise indicated.

B. Clear Sheet Glass: Fed. Spec. DD-G-451, Type I, Sheet, Class I, Quality q3, Glazing "B", double strength, except as otherwise indicated.

1. Provide 1/8-inch double strength, thick glass, except as otherwise indicated.

2.4 HEAT-STRENGTHENED

A. Manufacturing Process: Horizontal (roller hearth) process with roll wave distortion parallel with bottom edge of glass as installed, unless otherwise indicated.

B. Clear Tempered Glass: Fed. Spec. DD-G-1403 Float Glass, Grade B, Style 1, Type I, Quality q3, Class 1, heat-strengthened standard to achieve a flexural strength of four times normal glass strength.

C. Tinted Tempered Glass: Fed. Spec. DD-G-1403, Float Glass, Grade A, Style 1, Type I, Quality q3, Class 1, heat-strengthened to achieve a flexural strength of two times normal glass strength; 1/4-inch thickness, except as otherwise indicated on the drawings.

D. Clear Heat-Strengthened Glass: Fed. Spec. DD-G-1403, Float Glass, Grade A, Style 1, Type I, Quality q3, Class 1, heat-strengthened to achieve a flexural strength of two times normal glass strength; 1/4-inch thickness, except as otherwise indicated on the drawings.

E. Tinted Heat-Strengthened Glass: Fed. Spec. DD-G-1403, Float Glass, Grade A (heat strengthened), Style I (uncoated surfaces), Type I (float), Quality q3, Class 1. Provide tint and characteristics of LOF tinted primary glass above. Provide 1/4-inch unless otherwise indicated.

2.5 MIRRORS

A. Mirrors: Clear float glass, FS DD-G-451, Type I, Class 1, quality q1, 1/4-inch with silver coating, copper protective coating and two mil thick paint coating conforming to Fed. Spec. DD-G-411.

2.6 LAMINATED GLASS PRODUCTS

A. General: Refer to primary and heat-strengthened glass requirements relating to properties of uncoated glass making up laminated glass products.

B. Laminated Glass at Control Room Cab: Laminated Annealed Glass Units

Provide 1-1/2” laminated glass units: ASTM C1172; Fabricated from two plies of 3/4-inch thick monolithic annealed glass bonded by 0.090-inch clear polyvinyl butyral interlayer. Provide #3 surface with pyrolytic Low-E coating.

C. Plastic Interlayer: Provide (polyvinyl butyryl) interlayer for laminating panes of glass, with a proven record of showing no tendency to bubble, discolor or lose physical or mechanical properties after laminating and installation, in clear or colors and of thickness indicated. Provide Salfex by Monsanto Co., or approved equal.

D. Laminating Process: Fabricate laminated glass using heat-plus-pressure process to produce glass free from foreign substances, air and glass pockets.

E. Laminated Safety Glass: Two panes of heat strengthened glass of equal thickness, laminated together with 0.090 thick plastic interlayer and complying with requirements indicated below:

1. Glass Characteristics: Float glass, complying with requirements for Class, Tint, Grade and Thickness of each pane indicated below.

2. Clear for both panes; thickness, 1/4-inch; color of plastic interlayer, clear.

F. Laminated glass for interior doors: HGP Laminated Burglar Resistant Glass meeting the standards of UL 972 and the requirements of ASTM C1036, ANSI z97.1 and CPSC 16CFR1201 Category I and II. Thickness shall be 5/16" Clear Laminated 1/8" + 1/8".

G. Performance for Glazing Assemblies: U=4.0, SC=0.48, SHGC=0.41.

2.7 SEALED INSULATING GLASS

A. General: Provide preassembled units consisting of organically sealed panes of glass enclosing a hermetically sealed dehydrated air space; comply with requirements indicated for

glass characteristics, air space, sealing system, sealant, spacer material, corner design, and desiccant.

1. Provide heat-treated clear panes of grade and at locations indicated or, if not indicated, provide heat-strengthened panes where recommended by manufacturer for application indicated and tempered where indicated or where safety glass is designated or required.

2. Thickness of Each Pane: 1/4 inch.

3. Air Space Thickness: 1/2 inch.

4. Sealing System: Manufacturer's standard. Double sealing system with glass elastomer inner seal and silicone secondary seal.

5. Spacer Material: Manufacturer's standard bronze aluminum.

6. Desiccant: Manufacturer's standard material.

7. Corner Design: Manufacturer's standard.

B. Insulating Glass Units: Provide manufacturer's standard units complying with the following requirements:

1. Basis of Design: 1” Insulating VE1-2M by Viracon, Inc.

2. Exterior Pane: Tinted float glass.

   a. Color: Clear.

   b. Laminated Safety Glass — See Section 2.6.E

3. Interior Pane of Glass: Clear float glass, #3 surface with pyrolytic Low-E coating.

   a. Grade: Heat-strengthened, unless otherwise indicated or required for the location.

4. Performance of Sealed Insulating Glass Assemblies: U (winter) = 1.5, SC = 0.44.

2.8 GLAZING SEALANTS AND COMPOUNDS

A. Provide back color from manufacturer's standard colors for exposed glazing materials. Comply with recommendations of sealant and glass manufacturers for the required application and condition of installation in each case. Provide compounds recommended by sealant, glass and frame manufacturer's and which are proven to be fully compatible with surfaces contacted.

B. Sealants shall conform to FGMA Sealant Manual.

2.9 GLAZING GASKETS

A. Glazing gaskets shall be type and material recommended by glass and frame system manufacturers.

2.10 MISCELLANEOUS GLAZING MATERIALS

A. Setting Blocks: Neoprene, EPDM 80-90, Shore A durometer hardness, with proven compatibility with sealants used.

B. Spacers and Edge Blocks: Neoprene or EPDM, of hardness as recommended by glass manufacturer with proven compatibility with sealants used.

C. Compressible Filler Rod: Closed-cell or waterproof-jacketed rod stock of synthetic rubber or plastic foam, proven to be compatible with sealants used, flexible and resilient, with 5-10 psi compression strength for 25% deflection.

D. Cleaners, Primers and Sealers: Type recommended by sealant or gasket manufacturer.

E. Mirror Adhesive: Palmer Mirro-Mastic by Palmer Products Corp. or approved equal.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Sealants: Comply with FGMA Glazing Manual. Comply with combined recommendations of glass manufacturer and manufacturer of sealants and other materials used in glazing, except where more stringent requirements are shown or specified.

B. Comply with FGMA Glazing Manual by Flat Glass Marketing Association except as shown and specified otherwise, and except as specifically recommended otherwise by the manufacturers of the glass and glazing materials.

C. Inspect each piece of glass immediately before installation, and eliminate all glass with edge damage or face imperfections.

D. Unify appearance of each series of lights by setting each piece to match others as nearly as possible. Inspect each piece and set with pattern, draw and bow oriented in the same direction as other pieces.

3.2 PREPARATION FOR GLAZING

A. Clean glazing channel and other framing members to receive glass, immediately before glazing. Remove coatings which are not firmly bonded to the substrate. Remove lacquer from metal surfaces wherever elastomeric sealants are used.

B. Apply primer or sealer to joint surfaces wherever recommended by sealant manufacturer.

3.3 GLAZING

A. Install setting blocks of proper size at quarter point of sill rabbet. Set blocks in thin course of the heel-bead compound, if any.

B. Provide spacers inside and out, and of proper size and spacing, in accordance with FGMA Glazing Manual, except where gaskets are used for glazing.

C. Tool exposed surfaces of glazing liquids and compounds to provide a substantial "wash" away from the glass. Install pressurized tapes and gaskets to protrude slightly out of the channel, so as to eliminate dirt and moisture pockets.

D. Clean and trim excess glazing materials from the glass stops and frames promptly after installation, and eliminate stains and discolorations.

E. Gasket Glazing: Miter cut and bond ends together at corners where gaskets are used for channel glazing.

3.4 MIRRORS

A. Adhesive Installation of Mirrors: Apply one additional coat of moisture-resistant paint, of type recommended by adhesive manufacturer to back of mirror, and allow to dry. Apply mirror mastic and set mirror in accordance with adhesive manufacturer's directions.

3.5 WIND-UP AND CLEAN-UP

A. Cure glazing sealants and compounds in compliance with manufacturer's instructions and recommendations.

B. Protect exterior glass from breakage immediately upon installation, by attachment of crossed streamers to framing held away from glass. Do not apply markers of any type to surfaces of glass.

C. Remove and replace glass with new glass which is broken, chipped, cracked, abraded or damaged.

D. Maintain glass in a reasonably clean condition during construction, so that it will not be damaged by corrosive action and will not contribute by wash-off to the deterioration of glazing materials and other work.

E. Wash and polish glass on both faces not more than four days prior to Owner's acceptance of the work in each area. Comply with glass manufacturer's recommendations.

END OF SECTION 088000

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SECTION 089100 - LOUVERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this section.

1.2 SUMMARY

A. General: Provide all labor, material, equipment, related services and supervision required, including manufacturing, erection and installation for louvers in accordance with the requirements of the Contract Documents.

B. The extent of louvers is shown on the drawings.

C. This section includes fixed, extruded-aluminum weatherproof louvers as shown on the drawings.

D. Related sections include the following:

1. Division 7, Section 079200 - JOINT SEALANTS for sealants installed in perimeter joints between louver frames and adjoining construction.

2. Division 23 Sections for mechanical sheet metal ductwork connections to architectural louvers.

1.3 DEFINITIONS

A. Louver Terminology: Definitions of terms for metal louvers contained in AMCA 501 apply to this section, unless otherwise defined in this section or in referenced standards.

B. Standard Free Area: Free area of a louver 48 inches wide by 48 inches high, identical to that provided.

C. Maximum Standard Airflow: Airflow at point of beginning water penetration through a louver 48 inches wide by 48 inches high, identical to that provided.

1.4 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide exterior metal louvers capable of withstanding the effects of loads and stresses from wind and normal thermal movement without evidencing permanent deformation of louver components including blades, frames, and supports; noise or metal fatigue caused by louver blade rattle or flutter; or permanent damage to fasteners and anchors.

1. Wind Load: Uniform pressures (velocity pressures) indicated on Drawings, acting inward and outward.

2. Thermal Movements: Provide louvers that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, and other detrimental effects:

a. Temperature Change (Range): 120 degrees F, ambient; 180 degrees F, material surfaces.

B. Air-Performance, Water-Penetration, and Air-Leakage Ratings: Provide louvers complying with performance requirements indicated, as demonstrated by testing manufacturer's stock units 48 inches wide by 48 inches high. Test units according to AMCA 500.

1. Perform testing on unpainted, cleaned, degreased units.

2. Perform water-penetration testing on louvers without screens.

1.5 SUBMITTALS

A. Product Data: For each type of product specified.

B. Shop Drawings: For louver units and accessories. Include plans; elevations; sections; and details showing profiles, angles, and spacing of louver blades. Show unit dimensions related to wall openings and construction; free area for each size indicated; profiles of frames at jambs, heads, and sills; and anchorage details and locations.

C. Samples for Initial Selection: Manufacturer's standard color charts showing the full range of colors available for units with factory-applied color finishes.

D. Product Certificates: Signed by manufacturers of louvers certifying that the products furnished comply with requirements and are licensed to bear the AMCA seal based on tests made according to AMCA 500 and complying with AMCA's Certified Ratings Program.

1.6 QUALITY ASSURANCE

A. Source Limitations: Obtain louvers through one source from a single manufacturer where alike in one or more respects regarding type, design, or factory-applied custom color finish.

B. Welding Standards: As follows:

1. Comply with AWS D1.2, "Structural Welding Code--Aluminum."

2. Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.

C. SMACNA Standard: Comply with SMACNA's "Architectural Sheet Metal Manual" recommendations for fabrication, construction details, and installation procedures.

1.7 PROJECT CONDITIONS

A. Field Measurements: Verify louver openings by field measurements before fabrication and indicate measurements on Shop Drawings.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers Basis of Design: Ruskin Company; wind driven rain louver – horizontal blade. The named manufacturer and associated product is the basis of design for the project. Other

manufacturers whose products may be incorporated into the work, subject to compliance with requirements, are also listed. The Contractor is responsible for any modifications to the work resulting from the use of materials other than the basis of design, at no additional cost to the Owner.

1. Construction Specialties: ELF6375DXD 6-inch double drain, fixed exterior flashed mullion louver with bird screens.

B. Additional Acceptable Manufacturers (providing equal products):

1. Greenheck Fan Corporation

2.2 MATERIALS

A. Aluminum Extrusions: ASTM B221, alloy 6063-T5 or T-52.

B. Aluminum Sheet: ASTM B209, alloy 3003 or 5005 with temper as required for forming, or as otherwise recommended by metal producer for required finish.

C. Aluminum Castings: ASTM B26, alloy 319.

D. Fasteners: Of same basic metal and alloy as fastened metal or 300 series stainless steel, unless otherwise indicated. Do not use metals that are incompatible with joined materials.

1. Use types and sizes to suit unit installation conditions.

2. Use Phillips flat-head screws for exposed fasteners, unless otherwise indicated.

E. Anchors and Inserts: Of type, size, and material required for loading and installation indicated. Use nonferrous metal or hot-dip galvanized anchors and inserts for exterior installations and elsewhere as needed for corrosion resistance. Use toothed steel or expansion bolt devices for drilled-in-place anchors.

F. Bituminous Paint: Cold-applied asphalt mastic complying with SSPC-Paint 12 but containing no asbestos fibers, or cold-applied asphalt emulsion complying with ASTM D1187.

2.3 FABRICATION

A. Assemble louvers in factory to minimize field splicing and assembly. Disassemble units as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.

1. Continuous Vertical Assemblies: Where height of louver units exceeds fabrication and handling limitations, fabricate units to permit field-bolted assembly with close-fitting joints in jambs and mullions, reinforced with splice plates and without interrupting blade-spacing pattern.

B. Maintain equal louver blade spacing to produce uniform appearance.

C. Fabricate frames, including integral sills, to fit in openings of sizes indicated, with allowances made for fabrication and installation tolerances, adjoining materials' tolerances, and perimeter sealant joints.

1. Frame Type: Channel type, unless otherwise indicated.

D. Include supports, anchorages, and accessories required for complete assembly.

E. Provide vertical mullions of type and at spacings indicated, but not more than recommended by manufacturer, or 72 inches o.c., whichever is less.

F. Provide sill extensions and loose sills made of same material as louvers where indicated or required for drainage to exterior and to prevent water penetrating to interior.

G. Join frame members to one another and to fixed louver blades with fillet welds concealed from view, unless otherwise indicated or size of louver assembly makes bolted connections between frame members necessary.

H. Corners: Miter all corners.

2.4 FIXED, EXTRUDED-ALUMINUM LOUVERS

A. Louver Construction: Provide fixed-blade louvers with extruded-aluminum frames and blades.

B. Continuous, Horizontal, Drainable-Blade Louvers: Fabricated with close-fitting, field-made splice joints in blades designed to permit expansion and contraction without deforming blades or framework. Supporting framework is concealed from view by placing braces, mullions, and brackets on inside face of louver.

1. Drainable Heads: Designed to divert water that washes down wall from above louver away from face of louver by means of gutter in head and channels in jambs and mullions.

2. Louver Depth: 6 inches, unless otherwise indicated.

3. Blade Profile: One piece extrusions with gutters designed to catch and direct water to jamb and mullion drains.

4. Mullions: Sliding interlock with integral internal drains.

5. Exterior Corners: Prefabricated corner units with mitered and welded blades aligned with straight sections, with concealed bracing.

6. Performance: 44 percent (min.) Free area. Beginning point of water penetration at 0.01 oz./sq. ft. is 1,023 FPM (min.). Maximum static pressure drop at 500 FPM is 0.06 inch of water.

3. Provide closed cell PVC compression gaskets between bottom of mullion and jambs and top of sill to provide watertight connections.

2.5 LOUVER SCREENS

A. General: Provide each exterior louver with louver screens complying with the following requirements:

1. Screen Location for Fixed Louvers: Exterior face.

2. Screening Type: Bird screening. (Refer to Mechanical drawings for removable insect screen and frame mounted in sheet metal duct at room side of louvers.)

B. Secure screens to louver frames with stainless-steel machine screws, spaced a maximum of 6 inches from each corner and at 12 inches o.c.

C. Louver Screen Frames: Fabricate screen frames with mitered corners to louver sizes indicated and to comply with the following requirements:

1. Metal: Same kind and form of metal as indicated for louver to which screens are attached. Reinforce extruded-aluminum screen frames at corners with clips.

2. Finish: Same finish as louver frames to which louver screens are attached.

3. Type: Non-rewirable, U-shaped frames for permanently securing screen mesh.

D. Louver Screening for Aluminum Louvers:

1. Bird Screening: Aluminum, 1/2-inch- square mesh, 0.063-inch wire.

2.6 FINISHES

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Finish louvers after assembly.

C. Finish designations prefixed by AA comply with system established by the Aluminum Association for designating aluminum finishes.

D. High-Performance Organic Coating Finish: AA-C12C42R1x (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: acid-chromate-fluoride-phosphate conversion coating; Organic Coating: as specified below). Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

1. Fluoropolymer Two-Coat Coating System: Custom color, two-coat, thermocured system consisting of specially formulated inhibitive primer and fluoropolymer color topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight; complying with AAMA 2605-11.

a. Color and Gloss: To match adjacent walls unless otherwise specified.

b. Provide manufacturers 20-year warranty for the finish.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine the areas and conditions under which louvers and associated items are to be installed. Do not proceed with the work until unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Coordinate Setting Drawings, diagrams, templates, instructions, and directions for installation of anchorages.

3.3 INSTALLATION

A. Locate and place louver units level, plumb, and at indicated alignment with adjacent work.

B. Use concealed anchorages where possible. Provide brass or lead washers fitted to screws where required to protect metal surfaces and to make a weather tight connection.

C. Form closely fitted joints with exposed connections accurately located and secured.

D. Provide perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.

E. Repair finishes damaged by cutting, welding, soldering, and grinding. Restore finishes so no evidence remains of corrective work. Return items that cannot be refinished in the field to the factory, make required alterations, and refinish entire unit or provide new units.

F. Protect galvanized and nonferrous-metal surfaces from corrosion or galvanic action by applying a heavy coating of bituminous paint on surfaces that will be in contact with dissimilar metals.

G. Install concealed gaskets, flashings, joint fillers, and insulation, as louver installation progresses, where weather tight louver joints are required. Comply with Division 7, Section 079200 - JOINT SEALANTS for sealants applied during louver installation.

3.4 ADJUSTING, CLEANING, AND PROTECTING

A. Periodically clean exposed surfaces of louvers that are not protected by temporary covering to remove fingerprints and soil during construction period. Do not let soil accumulate until final cleaning.

B. Before final inspection, clean exposed surfaces with water and a mild soap or detergent not harmful to finishes. Thoroughly rinse surfaces and dry.

C. Protect louvers from damage during construction. Use temporary protective coverings where needed and approved by louver manufacturer. Remove protective covering at the time of Substantial Completion.

D. Restore louvers damaged during installation and construction so no evidence remains of corrective work. If results of restoration are unsuccessful, as determined by Architect, remove damaged units and replace with new units.

END OF SECTION 089100

SECTION 092116 - GYPSUM BOARD ASSEMBLIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Interior gypsum wallboard.

2. Exterior gypsum board panels for ceilings and soffits.

3. Non-load-bearing steel framing.

B. Related Sections include the following:

1. Division 5 Section 054000 - COLD-FORMED METAL FRAMING for load-bearing steel framing.

2. Division 7 Section 072100 - THERMAL INSULATION for insulation and vapor retarders installed in gypsum board assemblies.

1.3 DEFINITIONS

A. Gypsum Board Terminology: Refer to ASTM C 11 for definitions of terms for gypsum board assemblies not defined in this Section or in other referenced standards.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Show locations, fabrication, and installation of control and expansion joints including plans, elevations, sections, details of components, and attachments to other units of Work.

1.5 QUALITY ASSURANCE

A. Fire-Test-Response Characteristics: For gypsum board assemblies with fire-resistance ratings, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing and inspecting agency acceptable to authorities having jurisdiction.

1. Fire-Resistance-Rated Assemblies: Indicated by design designations from UL's "Fire Resistance Directory."

B. Sound Transmission Characteristics: For gypsum board assemblies with STC ratings, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by a qualified independent testing agency.

1. STC-Rated Assemblies: Indicated by design designations from GA-600, "Fire Resistance Design Manual."

C. Single-Source Responsibility for Steel Framing: Obtain steel framing members for gypsum board assemblies from a single manufacturer, unless otherwise indicated.

D. Single-Source Responsibility for Panel Products: Obtain each type of gypsum board and other panel products from a single manufacturer.

E. Single-Source Responsibility for Finishing Materials: Obtain finishing materials from either the same manufacturer that supplies gypsum board and other panel products or from a manufacturer acceptable to gypsum board manufacturer.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in original packages, containers, or bundles bearing brand name and identification of manufacturer or supplier.

B. Store materials inside under cover and keep them dry and protected against damage from weather, direct sunlight, surface contamination, corrosion, construction traffic, and other causes. Stack gypsum panels flat to prevent sagging.

C. Handle gypsum board to prevent damage to edges, ends and surfaces. Do not bend or otherwise damage metal corner beads and trim.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Comply with ASTM C 840 requirements or gypsum board manufacturer's written recommendations, whichever are more stringent.

B. Room Temperatures: For installation of gypsum board to framing, maintain not less than 40 degrees F. For gypsum board finishing, maintain not less than 50 degrees F for 48 hours before application and continuously after until dry. Do not exceed 95 degrees F when using temporary heat sources.

C. Ventilation: Ventilate building spaces as required to dry joint treatment materials. Avoid drafts during hot, dry weather to prevent finishing materials from drying too rapidly.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Steel Framing and Furring:

a. Dale Industries, Inc. - Dale/Incor.
b. Dietrich Industries, Inc.
c. MarinoWare; Division of Ware Ind.
d. National Gypsum Company; Gold Bond Building Products Division.
e. Unimast, Inc.
f. United States Gypsum Co.

2. Gypsum Board and Related Products:

a. American Gypsum Co.
b. G-P Gypsum Corp.
c. National Gypsum Company; Gold Bond Building Products Division.
d. United States Gypsum Co.

2.2 STEEL SUSPENDED CEILING AND SOFFIT FRAMING

A. Components, General: Comply with ASTM C 754 for conditions indicated.

B. Tie Wire: ASTM A 641, Class 1 zinc coating, soft temper, 0.0625-inch-diameter wire, or double strand of 0.0475-inch-diameter wire.

C. Hangers: As follows:

1. Wire Hangers: ASTM A 641, Class 1 zinc coating, soft temper, 0.162-inch diameter.

2. Rod Hangers: ASTM A 510, mild carbon steel with protective coating complying with ASTM A 153, hot-dip galvanized.

3. Flat Hangers: Commercial-steel sheet, ASTM A 653, G40, hot-dip galvanized.

4. Angle Hangers: ASTM A 653, G60, hot-dip galvanized commercial-steel sheet.

a. Minimum Base Metal Thickness: 0.0179 inch.

D. Carrying Channels: Cold-rolled, commercial-steel sheet with a base metal thickness of 0.0538 inch, a minimum 1/2-inch-wide flange, with ASTM A 653, G40, hot-dip galvanized zinc coating.

1. Depth: 1-1/2 inches minimum.

E. Furring Channels (Furring Members): Commercial-steel sheet with ASTM A 653, G40, hot-dip galvanized zinc coating.

1. Cold Rolled Channels: 0.0538-inch bare steel thickness, with minimum 1/2-inch-wide flange, 3/4 inch deep.

2. Steel Studs: ASTM C 645.

a. Minimum Base Metal Thickness: 0.0179 inch.
b. Depth: As indicated.

3. Hat-Shaped, Rigid Furring Channels: ASTM C 645, 7/8 inch deep.

a. Minimum Base Metal Thickness: 0.0179 inch.

4. Resilient Furring Channels: 1/2-inch-deep members designed to reduce sound transmission.

a. Configuration: Asymmetrical or hat shaped, with face attached to single flange by a slotted leg (web) or attached to two flanges by slotted or expanded metal legs.

F. Grid Suspension System for Interior Ceilings: ASTM C 645, direct-hung system composed of main beams and cross-furring members that interlock to form a modular supporting network.

2.3 STEEL PARTITION AND SOFFIT FRAMING

A. Components, General: As follows:

1. Comply with ASTM C 754 for conditions indicated.

2. Steel Sheet Components: Complying with ASTM C 645 requirements for metal and with ASTM A 653, G40, hot-dip galvanized zinc coating.

B. Steel Studs and Runners: ASTM C 645.

1. Minimum Base Metal Thickness: 0.0179 inch.

2. Depth: As indicated.

3. Gauge of metal shall be increased in accordance with ASTM C 754 Table 3 or manufacturer's limiting height tables so that deflection shall not exceed L/240 at 5 pounds per square foot.

C. Deep-Leg Deflection Track: ASTM C 645 top runner with 2-inch-deep flanges.

D. Proprietary Deflection Track: Steel sheet top runner manufactured to prevent cracking of gypsum board applied to interior partitions resulting from deflection of structure above; in thickness indicated for studs and in width to accommodate depth of studs.

1. Product: Subject to compliance with requirements, provide one of the following:

a. Delta Star, Inc., Superior Metal Trim; Superior Flex Track System (SFT).
b. Metal-Lite, Inc.; Slotted Track.

E. Proprietary Firestop Track: Top runner manufactured to allow partition heads to expand and contract with movement of the structure while maintaining continuity of fire-resistance-rated assembly indicated; in thickness not less than indicated for studs and in width to accommodate depth of studs.

1. Product: Subject to compliance with requirements, provide one of the following:

a. Fire Trak Corp.; Fire Trak attached to studs with Fire Trak Slip Clip.
b. Metal-Lite, Inc.; The System.

F. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated.

1. Minimum Base Metal Thickness: 0.0179 inch.

G. Cold-Rolled Channel Bridging: 0.0538-inch bare steel thickness, with minimum 1/2-inch-wide flange.

1. Depth: 1-1/2 inches.

2. Clip Angle: 1-1/2 by 1-1/2 inch, 0.068-inch-thick, galvanized steel.

H. Hat-Shaped, Rigid Furring Channels: ASTM C 645.

1. Minimum Base Metal Thickness: 0.0179 inch.

2. Depth: 7/8 inch.

I. Resilient Furring Channels: 1/2-inch-deep, steel sheet members designed to reduce sound transmission.

1. Configuration: Asymmetrical or hat shaped, with face attached to single flange by a slotted leg (web) or attached to two flanges by slotted or expanded metal legs.

J. Cold-Rolled Furring Channels: 0.0538-inch bare steel thickness, with minimum 1/2-inch-wide flange.

1. Depth: 3/4 inch.

2. Furring Brackets: Adjustable, corrugated-edge type of steel sheet with minimum bare steel thickness of 0.0312 inch.

3. Tie Wire: ASTM A 641, Class 1 zinc coating, soft temper, 0.0625-inch-diameter wire, or double strand of 0.0475-inch-diameter wire.

K. Z-Shaped Furring: With slotted or nonslotted web, face flange of 1-1/4 inches, wall attachment flange of 7/8 inch, minimum bare metal thickness of 0.0179 inch, and depth required to fit insulation thickness indicated.

L. Fasteners for Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates; complying with the recommendations of gypsum board manufacturers for applications intended.

2.4 INTERIOR GYPSUM WALLBOARD

A. Panel Size: Provide in maximum lengths available that will minimize joints in each area and correspond with support system indicated.

1. Widths: Provide gypsum board in 48 inch widths, unless otherwise indicated.

2. Thickness: 5/8-inch, unless otherwise indicated.

B. Gypsum Wallboard: ASTM C 36.

1. Type: Regular, except where Type X is required for fire resistance rated assemblies.

2. Long Edges: Tapered.

3. Locations: As indicated.

C. Sag-Resistant Gypsum Wallboard: ASTM C 36, manufactured to have more sag resistance than regular-type gypsum board.

1. Thickness: 1/2 inch, unless otherwise indicated.

2. Long Edges: Tapered.

3. Location: Ceiling surfaces.

D. Water-Resistant Gypsum Backing Board: ASTM C 630.

1. Type: Regular, except for Type X where required for fire-resistance-rated assemblies.

2. Location: Tile backing panels and where otherwise indicated.

E. Abuse Resistant Gypsum Panels: Equivalent to Fiberock Brand VHI Gypsum Fiber Panels as manufactured by USG.

1. Locations: Where indicated on drawings.

2.5 EXTERIOR GYPSUM PANELS FOR CEILINGS AND SOFFITS

A. Panel Size: Provide in maximum lengths and widths available that will minimize joints in each area and correspond with support system indicated.

B. Exterior Gypsum Soffit Board: ASTM C 931, with manufacturer's standard edges.

1. Core: As indicated.

2.6 TRIM ACCESSORIES

A. Interior Trim: ASTM C 1047.

1. Material: Galvanized or aluminum-coated steel sheet or rolled zinc.

2. Shapes:

a. Cornerbead: Use at outside corners.
b. Bullnose Bead: Use where indicated.
c. LC-Bead (J-Bead): Use at exposed panel edges.
d. L-Bead: Use where indicated.
e. U-Bead: Use where indicated.
f. Expansion (Control) Joint: Use where indicated.

B. Exterior Trim: ASTM C 1047.

1. Material: Hot-dip galvanized steel sheet or rolled zinc.

2. Shapes:

a. Cornerbead: Use at outside corners.
b. LC-Bead (J-Bead): Use at exposed panel edges.
c. Expansion (Control) Joint: One-piece, rolled zinc with V-shaped slot and removable strip covering slot opening.

2.7 JOINT TREATMENT MATERIALS

A. General: Comply with ASTM C 475.

B. Joint Tape: Paper reinforcing tape, unless otherwise indicated.

C. Joint Compound for Interior Gypsum Wallboard: For each coat use formulation that is compatible with other compounds applied on previous or for successive coats.

1. Prefilling: At open joints, rounded or beveled panel edges, and damaged surface areas, use setting-type taping compound.

2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use setting-type taping compound or drying-type, all-purpose compound.

   a. Use setting-type compound for installing paper-faced metal trim accessories.

3. Fill Coat: For second coat, use setting-type, sandable topping compound or drying-type, all-purpose compound.

4. Finish Coat: For third coat, use setting-type, sandable topping compound or drying-type, all-purpose compound.

D. Joint Compound for Exterior Applications:

1. Exterior Gypsum Soffit Board: Use setting-type taping and setting-type, sandable topping compounds.

E. Joint Compound for Tile Backing Panels:

1. Water-Resistant Gypsum Backing Board: Use setting-type taping and setting-type, sandable topping compounds.

2.8 ACOUSTICAL SEALANT

A. Products: Subject to compliance with requirements, provide one of the following:

1. Acoustical Sealant for Exposed and Concealed Joints:

   a. Pecora Corp.; AC-20 FTR Acoustical and Insulation Sealant.
   b. United States Gypsum Co.; SHEETROCK Acoustical Sealant.

2. Acoustical Sealant for Concealed Joints:

   a. Ohio Sealants, Inc.; Pro-Series SC-170 Rubber Base Sound Sealant.
   b. Pecora Corp.; BA-98.
   c. Tremco, Inc.; Tremco Acoustical Sealant.

B. Acoustical Sealant for Exposed and Concealed Joints: Nonsag, paintable, nonstaining, latex sealant complying with ASTM C 834 that effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.

C. Acoustical Sealant for Concealed Joints: Nondrying, nonhardening, nonskinning, nonstaining, gunnable, synthetic-rubber sealant recommended for sealing interior concealed joints to reduce airborne sound transmission.

2.9 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written recommendations.

B. Steel Drill Screws: ASTM C 1002, unless otherwise indicated.

1. Use screws complying with ASTM C 954 for fastening panels to steel members from 0.033 to 0.112 inch thick.

C. Isolation Strip at Exterior Walls:

1. Asphalt-Saturated Organic Felt: ASTM D 226, Type I (No. 15 asphalt felt), nonperforated.

2. Foam Gasket: Adhesive-backed, closed-cell vinyl foam strips that allow fastener penetration without foam displacement, 1/8 inch thick, in width to suit steel stud size.

D. Sound Attenuation Blankets: ASTM C 665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.

1. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of assembly.

E. Thermal Insulation: As specified in Division 7, Section 072100 - THERMAL INSULATION.

F. Polyethylene Vapor Retarder: As specified in Division 7, Section 072100 - THERMAL INSULATION.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames, cast-in anchors, and structural framing, for compliance with requirements and other conditions affecting performance. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Suspended Ceilings: Coordinate installation of ceiling suspension systems with installation of overhead structure to ensure that inserts and other provisions for anchorages to building structure have been installed to receive ceiling hangers at spacing required to support ceilings and that hangers will develop their full strength.

1. Furnish devises indicated to other trades for installation in advance of time needed for coordination and construction.

B. Coordination with Sprayed Fire-Resistive Materials:

1. Before sprayed fire-resistive materials are applied, attach offset anchor plates or ceiling runners (tracks) to surfaces indicated to receive sprayed-on fire-resistive materials. Where offset anchor plates are required, provide continuous plates fastened to building structure not more than 24 inches o.c.

2. After sprayed fire-resistive materials are applied, remove them only to extent necessary for installation of gypsum board assemblies and without reducing the fire-resistive material thickness below that which is required to obtain fire-resistance rating indicated. Protect remaining fire-resistive materials from damage.

3.3 INSTALLING STEEL FRAMING, GENERAL

A. Installation Standards: ASTM C 754, and ASTM C 840 requirements that apply to framing installation.

B. Install supplementary framing, blocking, and bracing at terminations in gypsum board assemblies to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction. Comply with details indicated and with gypsum board manufacturer's written recommendations or, if none available, with United States Gypsum's "Gypsum Construction Handbook."

C. Isolate steel framing from building structure at locations indicated to prevent transfer of loading imposed by structural movement.

1. Isolate ceiling assemblies where they abut or are penetrated by building structure.

2. Isolate partition framing and wall furring where it abuts structure, except at floor. Install slip-type joints at head of assemblies that avoid axial loading of assembly and laterally support assembly.

a. Use deep-leg deflection track where indicated.

b. Use proprietary deflection track where indicated.

c. Use proprietary firestop track where indicated.

D. Do not bridge building control and expansion joints with steel framing or furring members. Frame both sides of joints independently.

3.4 INSTALLING STEEL SUSPENDED CEILING AND SOFFIT FRAMING

A. Suspend ceiling hangers from building structure as follows:

1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or ceiling suspension system. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.

2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with the location of hangers required to support standard suspension system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards.

3. Secure wire hangers by looping and wire-tying, either directly to structures or to inserts, eyescrews, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause them to deteriorate or otherwise fail.

4. Secure rod, flat and angle hangers to structure, including intermediate framing members, by attaching to inserts, eyescrews, or other devices and fasteners that are secure and appropriate for structure and hanger, and in a manner that will not cause hangers to deteriorate or otherwise fail.

5. Do not attach hangers to steel deck tabs.

6. Do not attach hangers to steel roof deck. Attach hangers to structural members.

7. Do not connect or suspend steel framing from ducts, pipes, or conduit.

B. Installation Tolerances: Install steel framing components for suspended ceilings so members for panel attachment are level to within 1/8 inch in 12 feet measured lengthwise on each member and transversely between parallel members.

C. Sway-brace suspended steel framing with hangers used for support.

D. For exterior soffits, install cross bracing and framing to resist wind uplift.

E. Wire-tie or clip furring channels to supports, as required to comply with requirements for assemblies indicated.

F. Install suspended steel framing components in sizes and spacings indicated, but not less than that required by the referenced steel framing and installation standards.

G. Grid Suspension System: Attach perimeter wall track or angle where grid suspension system meets vertical surfaces. Mechanically join main beam and cross-furring members to each other and butt-cut to fit into wall track.

3.5 INSTALLING STEEL PARTITION AND SOFFIT FRAMING

A. Install tracks (runners) at floors, ceilings, and structural walls and columns where gypsum board assemblies abut other construction.

1. Where studs are installed directly against exterior walls, install asphalt-felt or foam-gasket isolation strip between studs and wall.

B. Installation Tolerance: Install each steel framing and furring member so fastening surfaces vary not more than 1/8 inch from the plane formed by the faces of adjacent framing.

C. Extend partition framing full height to structural supports or substrates above suspended ceilings, except where partitions are indicated to terminate at suspended ceilings. Continue framing over frames for doors and openings and frame around ducts penetrating partitions above ceiling to provide support for gypsum board.

1. Cut studs 1/2 inch short of full height to provide perimeter relief.

2. For fire-resistance-rated and STC-rated partitions that extend to the underside of floor/roof slabs and decks or other continuous solid-structure surfaces to obtain ratings, install framing around structural and other members extending below floor/roof slabs and decks, as needed to support gypsum board closures and to make partitions continuous from floor to underside of solid structure.

D. Install steel studs and furring at the following spacings:

1. Single-Layer Construction: 16 inches o.c., unless otherwise indicated.

2. Multilayer Construction: 16 inches o.c., unless otherwise indicated.

E. Install steel studs so flanges point in the same direction and leading edge or end of each panel can be attached to open (unsupported) edges of stud flanges first.

F. Frame door openings to comply with GA-600 and with gypsum board manufacturer's applicable written recommendations, unless otherwise indicated. Screw vertical studs at jambs to jamb anchor clips on door frames; install runner track section (for cripple studs) at head and secure to jamb studs.

1. Install two studs at each jamb, unless otherwise indicated.

2. Install cripple studs at head adjacent to each jamb stud, with a minimum 1/2-inch clearance from jamb stud to allow for installation of control joint.

3. Extend jamb studs through suspended ceilings and attach to underside of floor or roof structure above.

G. Frame openings other than door openings the same as required for door openings, unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.

H. Z-Furring Members:

1. Erect insulation vertically and hold in place with Z-furring members spaced 24 inches o.c.

2. Except at exterior corners, securely attach narrow flanges of furring members to wall with concrete stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches o.c.

3. At exterior corners, attach wide flange of furring members to wall with short flange extending beyond corner; on adjacent wall surface, screw-attach short flange of furring channel to web of attached channel. At interior corners, space second member no more than 12 inches from corner and cut insulation to fit.

4. Until gypsum board is installed, hold insulation in place with 10-inch staples fabricated from 0.0625-inch-diameter, tie wire and inserted through slot in web of member.

I. Polyethylene Vapor Retardant: Install to comply with requirements specified in Division 7 Section "Thermal Insulation."

3.6 APPLYING AND FINISHING PANELS, GENERAL

A. Gypsum Board Application and Finishing Standards: ASTM C 840 and GA-216.

B. Install sound attenuation blankets before installing gypsum panels, unless blankets are readily installed after panels have been installed on one side.

C. Install ceiling board panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in the central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.

D. Install gypsum panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch of open space between panels. Do not force into place.

E. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.

F. Attach gypsum panels to steel studs so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.

G. Attach gypsum panels to framing provided at openings and cutouts.

H. Form control and expansion joints with space between edges of adjoining gypsum panels.

I. Cover both faces of steel stud partition framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.

1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. in area.

2. Fit gypsum panels around ducts, pipes, and conduits.

3. Where partitions intersect open concrete coffers, concrete joists, and other structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by coffers, joists, and other structural members; allow 1/4- to 3/8-inch-wide joints to install sealant.

J. Isolate perimeter of non-load-bearing gypsum board partitions at structural abutments, except floors. Provide 1/4- to 1/2-inch-wide spaces at these locations, and trim edges with U-bead edge trim where edges of gypsum panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.

K. STC-Rated Assemblies: Seal construction at perimeters, behind control and expansion joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C 919 and manufacturer's written recommendations for locating edge trim and closing off sound-flanking paths around or through gypsum board assemblies, including sealing partitions above acoustical ceilings.

L. Space fasteners in gypsum panels according to referenced gypsum board application and finishing standard and manufacturer's written recommendations.

1. Space screws a maximum of 12 inches o.c. for vertical applications.

M. Space fasteners in panels that are tile substrates a maximum of 8 inches o.c.

3.7 PANEL APPLICATION METHODS

A. Single-Layer Application:

1. On ceilings, apply gypsum panels before wall/partition board application to the greatest extent possible and at right angles to framing, unless otherwise indicated.

2. On partitions/walls, apply gypsum panels horizontally (perpendicular to framing), unless otherwise indicated or required by fire-resistance-rated assembly, and minimize end joints.

a. Stagger abutting end joints not less than one framing member in alternate courses of board.

b. At stairwells and other high walls, install panels horizontally, unless otherwise indicated or required by fire-resistance-rated assembly.

3. On Z-furring members, apply gypsum panels vertically (parallel to framing) with no end joints. Locate edge joints over furring members.

B. Multilayer Application on Ceilings: Apply gypsum board indicated for base layers before applying base layers on walls/partitions; apply face layers in same sequence. Apply base layers at right angles to framing members and offset face-layer joints 1 framing member, 16 inches minimum, from parallel base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly.

C. Multilayer Application on Partitions/Walls: Apply gypsum board indicated for base layers and face layers vertically (parallel to framing) with joints of base layers located over stud or furring member and face-layer joints offset at least one stud or furring member with base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly. Stagger joints on opposite sides of partitions.

1. Z-Furring Members: Apply base layer vertically (parallel to framing) and face layer either vertically (parallel to framing) or horizontally (perpendicular to framing) with vertical joints offset at least one furring member. Locate edge joints of base layer over furring members.

D. Single-Layer Fastening Methods: Apply gypsum panels to supports with steel drill screws.

E. Multilayer Fastening Methods: Fasten base layers and face layers separately to supports with screws.

F. Exterior Soffits and Ceilings: Apply exterior gypsum soffit board panels perpendicular to supports, with end joints staggered and located over supports.

1. Install with 1/4-inch open space where panels abut other construction or structural penetrations.

2. Fasten with corrosion-resistant screws.

G. Tile Backing Panels:

1. Water Resistant Gypsum Backing Board: Install at showers, tubs, and where indicated. Install with 1/4-inch gap where panels abut other construction or penetrations.

2. Where tile backing panels abut other types of panels in the same plane, shim surfaces to produce a uniform plane across panel surfaces.

3.8 INSTALLING TRIM ACCESSORIES

A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.

B. Control Joints: Install control joints at locations indicated on Drawings and in accordance with ASTM C 840. In no location shall the locations of control joints exceed 30 feet apart unless specifically indicated on drawings. Verify locations of all control joints with Architect prior to installation.

3.9 FINISHING GYPSUM BOARD ASSEMBLIES

A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.

B. Prefill open joints, rounded or beveled edges, and damaged surface areas.

C. Apply joint tape over gypsum board joints, except those with trim having flanges not intended for tape.

D. Gypsum Board Finish Levels: Finish panels to levels indicated below, according to ASTM C 840, for locations indicated:

1. Level 1: Embed tape at joints in ceiling plenum areas, concealed areas, and where indicated, unless a higher level of finish is required for fire-resistance-rated assemblies and sound-rated assemblies.

2. Level 2: Embed tape and apply separate first coat of joint compound to tape, fasteners, and trim flanges where panels are substrate for tile and where indicated.

3. Level 4: Embed tape and apply separate first, fill, and finish coats of joint compound to tape, fasteners, and trim flanges at panel surfaces that will be exposed to view, unless otherwise indicated.

3.10 FIELD QUALITY CONTROL

A. Above-Ceiling Observation: Architect will conduct an above-ceiling observation before installing gypsum board ceilings and report deficiencies in the Work observed. Do not proceed with installation of gypsum board to ceiling support framing until deficiencies have been corrected.

1. Notify Architect seven days in advance of date and time when Project, or part of Project, will be ready for above-ceiling observation.

2. Before notifying Architect, complete the following in areas to receive gypsum board ceilings:

a. Installation of 80 percent of lighting fixtures, powered for operation.

b. Installation, insulation, and leak and pressure testing of water piping systems.

c. Installation of air-duct systems.

d. Installation of air devices.

e. Installation of mechanical system control-air tubing.

f. Installation of ceiling support framing.

END OF SECTION 092116

SECTION 095113 – ACOUSTICAL PANEL CEILINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this section.

1.2 SUMMARY

A. This section includes ceilings consisting of acoustical panels and exposed suspension systems.

B. Related sections include the following:

1. Division 7, Section 079200 – JOINT SEALANTS for acoustical sealants.

1.3 SUBMITTALS

A. General: Submit each item in this article according to the Conditions of the Contract and Division 1 specification sections.

B. Product Data: For each type of product specified. Include manufacturerσ recommendations for cleaning and refinishing.

C. Samples for Verification: Full-size units of each type of ceiling assembly indicated; in sets for each color, texture, and pattern specified, showing the full range of variations expected in these characteristics.

1. 6-inch-square samples of each acoustical panel type, pattern, and color.
2. Set of 12-inch-long samples of exposed suspension system members, including moldings, for each color and system type required.
3. 24” X 24” nominal panel size.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experienced installer who has completed acoustical panel ceilings similar in material, design, and extent to that indicated for this project and with a record of successful in-service performance.

B. Source Limitations for Ceiling Units: Obtain each acoustical ceiling panel from one source with resources to provide products of consistent quality in appearance and physical properties without delaying the work. Ceiling units must be compatible with suspension system.

C. Source Limitations for Suspension System: Obtain each suspension system from one source with resources to provide products of consistent quality in appearance and physical properties without delaying the work. Suspension system must be compatible with ceiling units.

D. Fire-Test-Response Characteristics: Provide acoustical panel ceilings that comply with the following requirements:

1. Fire-response tests were performed by UL, ITS/Warnock Hersey, or another independent testing and inspecting agency that is acceptable to authorities having jurisdiction and that performs testing and follow-up services.
2. Surface-burning characteristics of acoustical panels comply with ASTM E1264 for Class A materials as determined by testing identical products per ASTM E84. All panel components shall have a flame spread rating of less than 25

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver acoustical panels and suspension system components to project site in original, unopened packages and store them in a fully enclosed space where they will be protected against damage from moisture, direct sunlight, surface contamination, and other causes.

B. Before installing acoustical panels, permit them to reach room temperature and stabilized moisture content.

C. Handle acoustical panels carefully to avoid chipping edges or damaging units in any way.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Do not install acoustical panel ceilings until spaces are enclosed and weatherproof, wet-work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for project when occupied for its intended use.

B. Contractor shall notify Architect after grid installation for above ceiling review before installation of any acoustical panels. All light fixtures and mechanical diffusers are to be in place before review.

1.7 COORDINATION

A. Coordinate layout and installation of acoustical panels and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

1.8 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed, are packaged with protective covering for storage, and are identified with labels describing contents. Deliver to Owner at site in unopened boxes.

1. Acoustical Ceiling Units: Full-size units equal to 2.0 percent of amount of each type installed, rounded up to the nearest full box, minimum of 2 boxes.
2. Suspension System Components: Quantity of each exposed component equal to 2.0 percent of amount of each type installed, rounded up to the nearest full box, minimum of 2 boxes.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Products: Subject to compliance with requirements, provide one of the products indicated for each designation in the Key and Finish Schedules in the Drawings. Basis of design shall be:

a. <u>ATCT Cab</u>: Armstrong Fine Fissured square lay-in 1728BL (2’x2’x5/8”) with 15/16” Prelude Excel grid system (non-reflective Black).

b. Other Scheduled Rooms: Armstrong Fine Fissured square lay-in 1728 (2'x2'x5/8") with 15/16" Prelude Excel grid system.

2.2 ACOUSTICAL PANELS, GENERAL

A. Acoustical Panel Standard: Provide manufacturer's standard panels of configuration indicated that comply with ASTM E1264 classifications as designated by types, patterns, acoustical ratings, and light reflectances, unless otherwise indicated.

1. Mounting Method for Measuring Noise Reduction Coefficient: Type E-400; plenum mounting in which face of test specimen is 15-3/4 inches away from test surface per ASTM E795.
2. Test Method for Ceiling Attenuation Class (CAC): Where acoustical panel ceilings are specified to have a CAC, provide units identical to those tested per ASTM E1414 by a qualified testing agency.

B. Acoustical Panel Patterns: See Key and Finish Schedule in the Drawings.

C. Provide manufacturers written standard warranty for 10 years from date of installation against sagging, warping or shrinking of acoustical ceiling panels under conditions up to 90 degrees F temperature and 90 percent relative humidity for products so designated in the Key and Finish Schedule in the Drawings.

D. Panel Characteristics: Comply with requirements indicated in ASTM E1264 classifications, Acoustical Data (ASTM C423: Panels Tested Used Type E400 Mounting as /ASTM E995).

2.3 METAL SUSPENSION SYSTEMS, GENERAL

A. Metal Suspension System Standard: Provide manufacturer's standard direct-hung metal suspension systems of types, structural classifications, and finishes indicated that comply with applicable ASTM C635 requirements.

B. Metal Suspension System Characteristics: Comply with requirements indicated in the Key and Finish Schedule in the Drawings.

C. Finishes and Colors, General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes. Provide manufacturer's standard factory-applied finish for type of system indicated.

D. Attachment Devices: Size for five times design load indicated in ASTM C635, Table 1, Direct Hung, unless otherwise indicated.

E. Wire Hangers, Braces, and Ties: Provide wires complying with the following requirements:

1. Zinc-Coated Carbon-Steel Wire: ASTM A641, Class 1 zinc coating, soft temper.
2. Size: Select wire diameter so its stress at three times hanger design load (ASTM C635, Table 1, Direct Hung) will be less than yield stress of wire, but provide not less than 0.106-inch-diameter wire.

F. Hanger Rods: Mild steel, zinc coated or protected with rust-inhibiting paint.

G. Flat Hangers: Mild steel, zinc coated or protected with rust-inhibiting paint.

H. Angle Hangers: Angles with legs not less than 7/8 inch wide; formed with 0.04-inch-thick, galvanized steel sheet complying with ASTM A653, G90 coating designation; with bolted connections and 5/16-inch-diameter bolts.

I. Sheet-Metal Edge Moldings and Trim: Type and profile indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations that fit acoustical panel edge details and suspension systems indicated; formed from sheet metal of same material and finish as that used for exposed flanges of suspension system runners.

1. For lay-in panels with reveal edge details, provide stepped edge molding that forms reveal of same depth and width as that formed between edge of panel and flange at exposed suspension member.
2. For circular penetrations of ceiling, provide edge moldings fabricated to diameter required to fit penetration exactly.
3. For narrow-face suspension systems, provide suspension system and manufacturer's standard edge moldings that match width and configuration of exposed runners.

J. Hold-Down Clips and torsion spring for Non-Fire-Resistance-Rated Ceilings: For interior ceilings in Vestibules 3 and 4 as indicated on the drawings, provide hold-down clips spaced 24 inches o.c. on all cross tees.

2.4 MISCELLANEOUS MATERIALS

A. Acoustical Sealant: Non-drying, non-hardening, non-skinning, non-staining, non-bleeding gunnable sealant complying with requirements specified in Division 7, Section 079200 – JOINT SEALANTS.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and structural framing to which acoustical panel ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other sections that affect ceiling installation and anchorage, and other conditions affecting performance of acoustical panel ceilings. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Coordination: Furnish layouts for inserts, clips, and other ceiling anchors whose installation is specified in other sections.

B. Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders, and comply with layout shown on reflected ceiling plans. If layout shown on plans will result in less-than-half-width panels, based upon actual field dimensions, notify Architect and request direction.

3.3 INSTALLATION

A. General: Install acoustical panel ceilings to comply with publications referenced below per manufacturer's written instructions and CISCA's "Ceiling Systems Handbook."

1. Standard for Ceiling Suspension System Installations: Comply with ASTM C636.

B. Suspend ceiling hangers from building's structural members and as follows:

1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.

2. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.

3. Where width of ducts and other construction within ceiling plenum produces hanger spacing's that interfere with location of hangers at spacing's required to support standard suspension system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications.

4. Secure wire hangers to ceiling suspension members and to supports above with a minimum of three tight turns. Connect hangers directly either to structures or to inserts, eye screws, or other devices that are secure; that are appropriate for substrate; and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.

5. Secure flat, angle, channel, and rod hangers to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices that are secure and appropriate for both structure to which hangers are attached and type of hanger involved. Install hangers in a manner that will not cause them to deteriorate or fail due to age, corrosion, or elevated temperatures.

6. Do not support ceilings directly from permanent metal forms or floor deck.

7. Do not attach hangers to steel deck tabs.

8. Do not attach hangers to steel roof deck. Attach hangers to structural members.

9. Space hangers not more than 48 inches o.c. along each member supported directly from hangers, unless otherwise indicated; and provide hangers not more than 8 inches from ends of each member.

C. Install edge moldings, shadow moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels.

1. Apply acoustical sealant in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.

2. Screw attach moldings to substrate at intervals not more than 16 inches o.c. and not more than 3 inches from ends, leveling with ceiling suspension system to a tolerance of 1/8 inch in 12 feet. Miter corners accurately and connect securely.

3. Do not use exposed fasteners, including pop rivets, on moldings and trim.

D. Install suspension system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.

E. Install acoustical panels with undamaged edges and fitted accurately into suspension system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide a neat, precise fit. Fit shall not be so tight as to prevent ready removal for necessary access.

1. Arrange directionally patterned acoustical panels as indicated on reflected ceiling plans.

2. For reveal-edged panels on suspension system runners, install panels with bottom of reveal in firm contact with top surface of runner flanges.

3. Paint cut panel edges remaining exposed after installation; match color of exposed panel surfaces using coating recommended in writing for this purpose by acoustical panel manufacturer.

4. Install hold-down clips in areas indicated in Part 2 of this section; space as recommended by panel manufacturer's written instructions, unless otherwise indicated or required.

3.4 CLEANING AND PROTECTION

A. Clean exposed surfaces of acoustical panel ceilings, including trim, edge moldings, and suspension system members. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

B. Protect the acoustical ceilings, including temperature and humidity limitations and dust control, so that the work will be without damage and deterioration at the time of acceptance by the Owner.

3.5 ACOUSTICAL PANEL CEILING SCHEDULE

A. Fabric Covered Ceilencio Modular Acoustical Panels: Provide acoustical panels complying with the following:

1. Basis of Design: The named manufacturer and associated product is the basis of design for the work, and is intended to establish a level of quality, function and appearance. Comparable products from Hunter Douglas Techstyle system or equal. that meet the performance characteristics of the basis for design or the following listed characteristics are also acceptable.

a. ACT-4 Techstyle Classic Series

Refer to Key Schedule in the Drawings.

2. Color: See Finish Schedule in the Drawings.

3. Light Reflectance Coefficient: Not less than LR -1 (0.75) ASTM E 1477

4. Noise Reduction Coefficient: NRC 0.85.; SAA 0.85.

5. Ceiling Attenuation Class: Not less than CAC 17 W/no backer

6. Surface Burning: Class A(1), (ASTM E 84 less than 25

7. Thickness: 1.125 inch.

8. Size: ACT-4 See Finish Schedule in the Drawings, and varies.

9. Moisture Resistance: Resistant to 0.95 humidity in 104 degrees F Temp.

B. Suspension System for Techstyle Modular Acoustical Panel Ceilings: Provide acoustical panel ceiling suspension system complying with the following:

1. Basis of Design: The named manufacturer and associated product is the basis of design for the work, and is intended to establish a level of quality, function and appearance. Comparable products from USG Interiors, Inc. or Chicago Metallic that meet the performance characteristics of the basis for design or the following listed characteristics are also acceptable.

   a. ACT-4: Techstyle Ceiling 15/16 x 1-1/2" high t-bar grid.

2. Wide-Face, Capped, Double-Web, Metal Suspension System (FCP): Main and cross runners roll formed from cold-rolled steel sheet, prepainted, electrolytically zinc coated, or hot-dip galvanized according to ASTM A653, G01 coating designation, with prefinished 15/16 inch-wide metal caps on flanges; other characteristics as follows:

   a. Structural Classification: Intermediate duty system.

   b. End Condition of Cross Runners: Override (stepped) or butt-edge type, as standard with manufacturer.

   c. Face Design: Substrate of Acoustical mat W/ Polyester Non-woven

   d. Cap Material: Aluminum.

C. Water-Felted, Mineral-Base Acoustical Panels: Provide acoustical panels complying with the following:

1. Basis of Design: The named manufacturer and associated product is the basis of design for the work, and is intended to establish a level of quality, function and appearance. Comparable products from USG Interiors, Inc. or Armstrong that meet the performance characteristics of the basis for design or the following listed characteristics are also acceptable.

   a. ACT-1: Armstrong Cirrus or USG Artisan-SL.

2. Color: Suprafine White.

3. Light Reflectance Coefficient: Not less than LR 0.80.

4. Noise Reduction Coefficient: NRC 0.50.

5. Ceiling Attenuation Class: Not less than CAC 35.

6. Edge Detail: Tegular.

7. Thickness: 9/16 inch.

8. Size: ACT-1: 24 inches by 24 inches.

9. Non-Sag Warranty.

D. Suspension System for ACT-1 Acoustical Panel Ceilings: Provide acoustical panel ceiling suspension system complying with the following:

1. Basis of Design: The named manufacturer and associated product is the basis of design for the work, and is intended to establish a level of quality, function and appearance. Comparable products from USG Interiors, Inc. or Chicago Metallic that meet the performance characteristics of the basis for design or the following listed characteristics are also acceptable.

    a. ACT-1: Armstrong Suprafine 9/16-inch Exposed Tee.

2. Wide-Face, Capped, Double-Web, Steel Suspension System (ACT-1): Main and cross runners roll formed from cold-rolled steel sheet, prepainted, electrolytically zinc coated, or hot-dip galvanized according to ASTM A653, G01 coating designation, with prefinished 15/16-inch-wide metal caps on flanges; other characteristics as follows:

    a. Structural Classification: Intermediate-duty system.

    b. End Condition of Cross Runners: Override (stepped) or butt-edge type, as standard with manufacturer.

    c. Face Design: Flush face.

    d. Cap Material: Steel sheet.

    e. Cap Finish: Painted white.

END OF SECTION 095113

SECTION 096500 - RESILIENT FLOORING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this section.

1.2 SUMMARY

A. Extent of resilient flooring and accessories is shown on the drawings and in schedules.

B. This section includes the following:

1. Vinyl composition floor tile.
2. Vinyl wall base.
3. Vinyl accessory molding.

1.3 SUBMITTALS

A. Product Data: Submit manufacturer’s technical data and installation instructions for each type of resilient flooring and accessory.

1. Certification by tile manufacturer that products supplied for tile installation comply with local regulations controlling use of volatile organic compounds (VOCs).

B. Samples for Initial Selection: Manufacturer's color charts consisting of units or sections of units showing the full range of colors and patterns available for each type of product indicated.

C. Samples for Verification: Full-size tiles of each different color and pattern of resilient floor tile specified, showing the full range of variations expected in these characteristics.

1. For resilient accessories, manufacturer's standard-size samples, but not less than 12 inches long, of each resilient accessory color and pattern specified.

D. Maintenance Data: For resilient floor tile to include in the maintenance manuals specified in Division 1.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experienced installer to perform work of this section who has specialized in installing resilient products similar to those required for this project and with a record of successful in-service performance.

B. Source Limitations: Obtain each type, color, and pattern of tile and accessories specified from one source with resources to provide products of consistent quality in appearance and physical properties without delaying the work. Provide primers, adhesives, sealants, leveling compounds and similar materials that are compatible to and in conformance with the manufacturer’s recommendations regarding tile, accessories and substrates.

C. Fire-Test-Response Characteristics: Provide products with the following fire-test-response characteristics as determined by testing identical products per the ASTM test method indicated below by Underwriters Laboratories, Inc. (UL) or another testing and inspecting agency acceptable to authorities having jurisdiction.

1. Critical Radiant Flux: 0.45 W/sq. cm or greater when tested per ASTM E648.
2. Smoke Density: Maximum specific optical density of 450 or less when tested per ASTM E662.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to project site in manufacturer's original, unopened cartons and containers, each bearing names of product and manufacturer, project identification, and shipping and handling instructions.

B. Store products in dry spaces protected from the weather, with ambient temperatures maintained between 50 and 90 degrees F.

C. Store tiles on flat surfaces. Move products into spaces where they will be installed at least 48 hours before installation, unless longer conditioning period is recommended by manufacturer.

1.6 PROJECT CONDITIONS

A. Maintain a temperature of not less than 70 degrees F or more than 95 degrees F in spaces to receive products for at least 48 hours before installation, during installation, and for at least 48 hours after installation, unless manufacturer's recommendations specify longer time periods. After post installation period, maintain a temperature of not less than 55 degrees F or more than 95 degrees F.

B. Do not install products until they are at the same temperature as the space where they are to be installed.

C. Close spaces to traffic during flooring installation and for time period after installation recommended by manufacturer.

D. Install tiles and accessories after other finishing operations, including painting, have been completed.

E. Do not install flooring over concrete slabs until slabs have cured and are sufficiently dry to bond with adhesive, as determined by flooring manufacturer's recommended bond and moisture test.

F. Sequence installing products specified in this section with other construction to minimize possibility of damage and soiling during remainder of construction period.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturer: Subject to compliance with requirements, provide products by one of the following:

1. Vinyl Composition Tile

a. Armstrong World Industries, Inc.
b. Azrock Industries, Inc.
c. Flexco; Robbins, Inc.
d. Kentile, Inc.
e. Mannington Commercial Flooring.
f. Tarkett, Inc.

2. Vinyl Base

a. Armstrong World Industries, Inc.
b. Flexco; Robbins, Inc.
c. Johnsonite; Duramax, Inc.
d. Maclanburg-Duncan, Inc.
e. Mercer Products Co., Inc.
f. Roppe Corporation.

3. Vinyl Accessories

a. Afco Rubber Corp.
b. Flexco; Robbins, Inc.
c. Johnsonite; Duramax, Inc.
d. Maclanburg-Duncan, Inc.
e. Mercer Products Co., Inc.
f. Roppe Corporation

B. Finish Schedule: Refer to the Finish Schedule in the Contract Documents for actual product selections.

2.2 RESILIENT TILE

A. Vinyl Composition Floor Tile: Products complying with ASTM F1066 and with requirements specified as follows:

1. Class: Class 2, through-pattern tile.
2. Thickness: 1/8 inch.
3. Size: 12 by 12 inches.
4. Wearing Surface: Smooth.
5. Color and Pattern: Refer to Finish Key on drawings. VT-1.

2.3 RESILIENT ACCESSORIES

A. Vinyl Wall Base: Products complying with FS SS-W-40, Type II and with requirements specified as follows:

1. Style: Cove with top-set toe.
2. Minimum Thickness: 1/8 inch.
3. Height: VB-1; 6 inches high, VB-2; 4 inches high.
4. Lengths: Coils in lengths standard with manufacturer but not less than 96 feet.
5. Outside Corners and End Stops: Premolded. Kerfing straight base for use as an outside corner is unacceptable.
6. Surface: Smooth.
7. Color and Pattern: Refer to Finish Key on drawings. VB-1, VB-2.

B. Vinyl Accessory Molding: Provide the following vinyl accessories, selected from manufacturer's standard types, profile, sizes, thickness, style, color and pattern.

1. Cap for cove carpet.
2. Carpet bar for tackless installations.
3. Carpet edge for glue-down application.
4. Carpet nosing.
5. Nosing for resilient floor covering.
6. Reducer strip for resilient flooring.

2.4 INSTALLATION ACCESSORIES

A. Concrete Slab Primer: Nonstaining type as recommended by flooring manufacturer.

B. Trowelable Leveling and Patching Compounds: Latex-modified, Portland-cement-based formulation provided or approved by flooring manufacturer for applications indicated.

C. Adhesives: Water-resistant type recommended by manufacturer to suit resilient products and substrate conditions indicated. Approved by manufacturer for use on below-grade slabs, if any. Asphalt emulsions and other nonwaterproof types are not acceptable.

D. Metal Edge Strips: Extruded aluminum with mill finish of width shown, of height required to protect exposed edge of tiles, and in maximum available lengths to minimize running joints.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions where installation of resilient products will occur, with Installer present, for compliance with manufacturer's requirements. Verify that substrates and conditions are satisfactory for resilient product installation and comply with requirements specified.

B. Concrete Subfloors: Verify that concrete slabs comply with ASTM F710 and the following:

1. Slab substrates are dry and free of curing compounds, sealers, hardeners, and other materials that may interfere with adhesive bond. Determine adhesion and dryness characteristics by performing bond and moisture tests recommended by flooring manufacturer.

2. Subfloor finishes comply with requirements specified in Division 3, Section 033000 – CAST-IN-PLACE CONCRETE for slabs receiving resilient flooring.

3. Subfloors are free of cracks, ridges, depressions, scale, and foreign deposits.

C. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. General: Comply with resilient product manufacturer's written installation instructions for preparing substrates indicated to receive resilient products.

B. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, and depressions in substrates.

C. Remove coatings, including curing compounds, and other substances that are incompatible with flooring adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.

D. Broom and vacuum clean substrates to be covered immediately before product installation. After cleaning, examine substrates for moisture, alkaline salts, carbonation, or dust. Do not proceed with installation until unsatisfactory conditions have been corrected.

E. Apply concrete slab primer, if recommended by flooring manufacturer, prior to applying adhesive. Apply according to manufacturer’s directions.

3.3 TILE INSTALLATION

A. General: Comply with tile manufacturer's written installation instructions.

B. Lay out tiles from center marks established with principal walls, discounting minor offsets, so tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half of a tile at perimeter. Lay tiles square with room axis, unless otherwise indicated.

C. Match tiles for color and pattern by selecting tiles from cartons in the same sequence as manufactured and packaged, if so numbered. Cut tiles neatly around all fixtures. Discard broken, cracked, chipped, or deformed tiles.

1. Lay tiles with grain running in one direction.

D. Scribe, cut, and fit tiles to butt neatly and tightly to vertical surfaces and permanent fixtures, including built-in furniture, cabinets, pipes, outlets, edgings, door frames, thresholds, and nosings.

E. Extend tiles into toe spaces, door reveals, closets, and similar openings.

F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on finish flooring as marked on subfloor. Use chalk or other nonpermanent, nonstaining marking device.

G. Adhere tiles to flooring substrates using a full spread of adhesive applied to substrate to comply with tile manufacturer's written instructions, including those for trowel notching, adhesive mixing, and adhesive open and working times.

1. Provide completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.

H. Hand roll tiles according to tile manufacturer's written instructions.

3.4 RESILIENT ACCESSORY INSTALLATION

A. General: Install resilient accessories according to manufacturer's written installation instructions.

B. Apply resilient wall base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required. Install wall base in lengths as long as practicable without gaps at seams and with tops of adjacent pieces aligned. Tightly adhere wall base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates. Do not stretch base during installation.

1. On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient wall base with manufacturer's recommended adhesive filler material.

2. Install premolded outside corners before installing straight pieces.

C. Place resilient accessories so they are butted to adjacent materials and bond to substrates with adhesive. Install reducer strips at edges of flooring that would otherwise be exposed.

3.5 CLEANING AND PROTECTING

A. Perform the following operations immediately after installing resilient products:

1. Remove adhesive and other surface blemishes using cleaner recommended by resilient product manufacturers.

2. Sweep or vacuum floor thoroughly.

3. Do not wash floor until after time period recommended by flooring manufacturer.

4. Damp-mop floor to remove marks and soil.

B. Protect flooring against mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods indicated or recommended in writing by flooring manufacturer.

1. Cover products installed on floor surfaces with undyed, untreated building paper until inspection for Substantial Completion.

2. Do not move heavy and sharp objects directly over floor surfaces. Place plywood or hardboard panels over flooring and under objects while they are being moved. Slide or roll objects over panels without moving panels.

C. Clean floor surfaces not more than 4 days before dates scheduled for inspections intended to establish date of Substantial Completion in each area of project. Clean products according to manufacturer's written recommendations.

END OF SECTION 096500

SECTION 096800 - CARPET

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to this section.

1.2 SUMMARY

A. This section includes carpet, installation and accessories.

1.3 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification sections.

B. Product data for each type of carpet material and installation accessory required. Submit written data on physical characteristics, durability, resistance to fading, and flame resistance characteristics.

C. Shop drawings showing layout and seaming diagrams. Indicate pile or pattern direction and locations and types of edge strips. Indicate columns, doorways, enclosing walls or partitions, built-in cabinets, and locations where cutouts are required in carpet. Show installation details at special conditions.

D. Samples for verification purposes in manufacturer's standard size, showing full range of color, texture, and pattern variations expected. Prepare samples from same material to be used for the work. Submit the following:

1. 12-inch square samples of each type of carpet material required.

2. 12-inch long samples of each type exposed edge stripping and accessory item.

3. 6-inch square samples of each type of carpet cushion.

1.4 QUALITY ASSURANCE

A. Carpet Surface Burning Characteristics: Provide carpet identical to that tested for the following fire performance characteristics, per test method indicated below, by UL or other testing and inspecting organizations acceptable to authorities having jurisdiction. Identify carpet with appropriate markings of applicable testing and inspecting organization.

1. Test Method: DOC FF 1-70.

2. Rating: Pass.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to project site in original factory wrappings and containers, labeled with identification of manufacturer, brand name, and lot number.

B. Store materials in original undamaged packages and containers, inside well-ventilated area protected from weather, moisture, soilage, extreme temperatures, and humidity. Lay flat,

blocked off ground. Maintain minimum temperature of 68 degrees F at least three days prior to and during installation in area where materials are stored.

1.6 PROJECT CONDITIONS

A. Substrate Conditions: No condensation within 48 hours on underside of 4 foot by 4-foot polyethylene sheet, fully taped at perimeter to substrate.

B. Substrate Conditions: pH of 9 or less when substrate wetted with potable water and pHydrion paper applied.

1.7 EXTRA MATERIALS

A. Deliver extra materials to Owner. Furnish extra materials matching products installed as described below, packaged with protective covering for storage and identified with labels describing contents.

1. Carpet: Before installation begins, furnish quantity of full width for each type of material equal to 5 percent of amount installed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers:

a. <u>ATCT Cab:</u>
Interface Flor Commercial - Furrows II ESD Computer Grade Tile
PRODUCT NUMBER: 146380250C
PRODUCT CONSTRUCTION: Tufted Textured Loop
STANDARD COLORLINE: 2 YARN SYSTEM: Blue Chip™ solution dyed type 6¸6 nylon DYE METHOD: 100% Solution Dye SOIL/STAIN PROTECTION: Protekt²® ANTIMICROBIAL: (AATCC 138 Washed) (AATCC 174 Parts 2&3) Intersept®
PRODUCT SPECIFICATIONS:

SIZE: 19.69 in x 19.69 in
Standard Backing: Computer Grade Tile
Backing Options: Computer Grade Tile
INSTALLATION: Tile: Quarter-Turn
Miscellaneous: Electrical Resistance:
2.5 x 10E5 to 1.0 x 10E8 Surface to Ground @ 500v and 20% RH
2.5 x 10E5 to 1.0 x 10E8 Surface to Surface @ 500v and 20% RH
COLOR: 1449 Volcanic Ash

b. <u>Other Scheduled Rooms</u>: Interface Flor Commercial - Furrows II Standard Grade with SOIL/STAIN PROTECTION: Protekt²® ANTIMICROBIAL: (AATCC 138 Washed) (AATCC 174 Parts 2&3) Intersept®
COLOR: 1449 Volcanic Ash

2.2 ACCESSORIES

A. Carpet Edge Guard: Extruded or molded heavy-duty vinyl or rubber of size and profile indicated; minimum 2-inch wide anchorage flange; manufacturer's standard colors.

B. Seaming Cement: Hot-melt adhesive tape or similar product recommended by carpet manufacturer for taping seams and butting cut edges at backing to form secure seams and to prevent pile loss at seams.

C. Carpet Adhesive: Water resistant and nonstaining as recommended by carpet manufacturer to comply with flammability requirements for installed carpet. Computer Grade carpet tiles must be installed with a full spread application of Re:Source Technologies 2400 Conductive Adhesive using the long-napped paint roller. Because the adhesive is an integral part of the conductivity of the installation extra care must be taken to ensure an even coat of adhesive with no voids or thin areas. Do not spread around chalk lines or add water to the adhesive.

D. RTG connector kit: where computer grade carpet is installed.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clear away debris and scrape up cementitious deposits from concrete surfaces to receive carpet; apply sealer to prevent dusting.

3.2 INSTALLATION

A. Comply with manufacturer's recommendations for seam locations and direction of carpet; maintain uniformity of carpet direction and lay of pile. At doorways, center seams under door in closed position; do not place seams perpendicular to door frame, in direction of traffic through doorway. Do not bridge building expansion joints with continuous carpet.

B. Extend carpet under removable flanges and furnishings and into alcoves and closets of each space.

C. Provide cutouts where required, and bind cut edges where not concealed by protective edge guards or overlapping flanges.

D. Install carpet edge guard where edge of carpet is exposed; anchor guards to substrate.

E. Install with pattern parallel to walls and borders.

F. Fit sections of carpet prior to application of adhesive. Trim edges and butt cuts with seaming cement.

G. Apply adhesive uniformly to substrate in accordance with manufacturer's instructions. Butt edges tight to form seams without gaps. Roll entire area lightly to eliminate air pockets and ensure uniform bond.

H. Raised Floor Installation: A swath of adhesive on each panel and offset joints are essential for a successful installation on raised floors. Raised floor panels are prone to subtle flexing. To insure long-term uniform appearance, avoid matching raised floor seams with tile joints. A brief pass on each panel with the adhesive roller will assure the installation remains tight in spite of subtle flexing from the raised panels.

I. Install Furrows II ESD Computer Grade carpet squares following manufacturing written guidelines and per FAA STD-019d, e, minimum of four (4) RTG connector kits per 1,000 sq. ft. (and/ or per room) of installed ESD control carpeting from the carpeting under-surface and conductive adhesive to the raised floor panel understructure. For stringer and bolted corner lock system, the contractor shall wire the access floor system to a bolt and three (3) successive pedestal heads and run the wire every 1,000 sq. feet. In locations where the

access floor system is being grounded, install the RTG connector. Grounding system for the access floor shall follow the recommendations of the manufacturer and applicable building and electrical codes.

3.3 CLEANING

A. Remove adhesive from carpet surface with manufacturer's recommended cleaning agent.

B. Remove and dispose of debris and unusable scraps. Vacuum with commercial machine with face-beater element. Remove soil. Replace carpet where soil cannot be removed. Remove protruding face yarn.

C. Vacuum carpet.

3.4 PROTECTION

A. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and installer, to ensure carpet is not damaged or deteriorated at time of substantial completion.

END OF SECTION 096800

SECTION 096900 - ACCESS FLOORING

PART 1 - GENERAL

1.1 Section Includes

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

B. Work of this section includes, but is not limited to: access floor panels, floor coverings, understructure and various electrical, data and communication accessories.

1.2 Related Sections

A. Concrete sealer shall be compatible with pedestal adhesive, see Division 3.

B. Electrical contractor shall provide necessary material and labor to electrically connect and ground the access floor to the building, see Division 26.

1.3 Environmental Conditions for Storage and Installation

A. Area to receive and store access floor materials shall be enclosed and maintained at ambient temperatures between 35° to 95° F and relative humidity levels between 20 to 80%. All floor panels shall be stored at ambient temperatures between 50° to 90° F for at least 24 hours before installation begins. All areas of installation shall be enclosed and maintained at ambient temperature between 50° to 90° F and at relative humidity levels between 20% to 80% and shall remain within these environmental limits throughout occupancy.

1.4 References

A. CISCA (Ceilings & Interior Systems Construction Association) - “Recommended Test Procedures for Access Floors” shall be used as a guideline when presenting load performance product information.

1.5 Performance Certification

A. Product tests shall be witnessed and certified by independent engineering and testing laboratory based in the U.S. with a minimum of five years experience testing access floor components in accordance CISCA “Recommended Test Procedures for Access Floors”.

1.6 Country-of-Origin and Product Marking

A. Access floor materials shall comply with the provisions outlined in FAR Subpart 25.2 – Buy American Act – Construction Materials.

B. Floor panels shall be permanently marked with manufacturer’s name, product identification, manufacturing date and country-of-origin. Removable Product ID stickers are not acceptable.

1.7 Performance Requirements

A. Design Load: Panel supported on actual understructure (the system) shall be capable of supporting a safe working load or design load of 1250 lbs. This rating signifies that the system will withstand not only a concentrated load placed on a one square inch area at any location on the panel without yielding but also demonstrate the ability to withstand an overload

capacity of two times its rating (i.e. a safety factor of 2). (For a detailed description of this important criteria, refer to the Design Load bulletin at www.tateaccessfloors.com and click on Technical Resources/Technical Bulletins)

B. Safety Factor: Panel supported on actual understructure (the system) shall be capable of withstanding a minimum of (2) two times the design load anywhere on the panel without failure. Failure is defined as the point at which the system will no longer accept the load.

C. Uniform Load: Panel supported on actual understructure (the system) shall be capable of supporting a uniform load of 400 lbs./ft2 placed on the entire area of the panel without yielding and generating a permanent set of no more than 0.100" once the load is removed. Note: The uniform load rating of an access floor panel as specified herein should not be confused with the "uniform live load" as specified in seismic zone applications.

D. Rolling Load: Panel supported on actual understructure (the system) shall be able to withstand the following rolling loads at any location on the panel without developing a local and overall surface deformation greater than 0.040 inches. Note: wheel 1 and wheel 2 tests shall be performed on two separate panels.

Wheel 1:	Size: 3" dia x 1 13/16" wide	Load: 1000 lbs.	Passes: 10
Wheel 2:	Size: 6" dia x 2" wide	Load: 800 lbs.	Passes: 10,000

E. Impact Load: Panel supported on actual understructure (the system) shall be capable of supporting an impact load of 150 lbs. dropped from a height of 36 inches onto a one square inch area (using a round or square indentor) at any location on the panel.

F. Concentrated Load (For Reference Only): Panel (supported on steel blocks) shall be capable of supporting a concentrated load of 1250 lbs. placed on a one square inch area (using a round or square indentor) at any location on the panel with a maximum top surface deflection of 0.100 inches. Panel shall not exceed a permanent set of 0.100 inches, after the load is removed. (Important note: Although a concentrated load rating is often used to define an access floor performance, it does not represent the system's true performance as it is a panel test on steel blocks vs. actual understructure supports. Tate recommends using Design Load as a true indicator of system performance.)

G. Panel Drop Test: Panel shall be capable of being dropped face up onto to a concrete slab from a height of 36", after which it shall continue to meet all load performance requirements as previously defined.

H. Panel Cutout: Panel with an 8" diameter interior cutout supported on actual understructure shall be capable of maintaining its design load strength anywhere on the panel without the use of additional supports.

I. Flammability: System shall meet *Class A* Flame spread requirements for flame spread and smoke development. Tests shall be performed in accordance with ASTM-E84-1998, Standard Test Method for Surface Burning Characteristics for Building Materials.

J. Combustibility: All components of the access floor system shall qualify as noncombustible by demonstrating compliance with requirements of ASTM E 136, Standard Test Method for Behavior of Materials in a Vertical Tube Furnace at 750 deg C.

K. Recycled Content: Panel and understructure system shall be required to have a minimum recycled content of 30%

L. Axial Load: Pedestal support assembly shall provide a minimum 5000 lb. axial load without permanent deformation.

M. Overturning Moment: Pedestal support assembly shall provide an average overturning moment of 1000 in-lbs. when glued to a clean, sound, uncoated concrete surface. ICBO number for the specific system or structural calculations shall be required attesting to the lateral stability of the system under seismic conditions.

1.8 Design Requirements:

A. Access floor system, where indicated on the design documents, shall consist of modular and removable fully encased cementitious filled welded steel panels fastened onto, and supported by, adjustable height pedestal assemblies. Pedestal head and panel corner design must provide a positive location and lateral engagement of the panel to the understructure support system without the use of fasteners.

B. Panel shall be easily removed by one person with a suction cup lifting device and shall be interchangeable except where cut for special conditions.

C. Quantities, finished floor heights (FFH) and location of accessories shall be as specified on the contract drawings.

1.9A Submittals for Review

A. Detail sheets, for each proposed product type, which provide the necessary information to describe the product and its performance.

B. Test reports, certified by an independent testing laboratory with a minimum of five years experience testing access floor components in accordance CISCA Recommended Test Procedures, certifying that component parts perform as specified.

1.9B Submittals for Information

A. Manufacturer's installation instructions and guidelines.

B. Manufacturer's Owner Manual outlining recommended care and maintenance procedures.

PART 2 - PRODUCTS

2.1 Manufacturers

A. Access floor system shall be as manufactured by Tate Access Floors, Inc. and shall consist of the ConCore® CC 1250 panel-24" access floor panel supported by PosiLock understructure system.

B. Alternative products shall meet or exceed all requirements as indicated herein and must receive prior written approval by the architect or designer.

C. Access floor manufacture shall be ISO9001:2000 certified demonstrating it has a robust and well documented quality management system with continual improvement goals and strategies.

2.2 Support Components

Pedestals:

A. Pedestal assemblies shall be corrosive resistant, all steel welded construction, and shall provide an adjustment range of +/- 1” for finished floor heights 6” or greater.

B. Pedestal assemblies shall provide a means of leveling and locking the assembly at a selected height, which requires deliberate action to change height setting and prevents vibration displacement.

C. Pedestal head shall be designed with locating tabs and integral shape to interface with the panel for positive lateral retention and positioning without fasteners. Note: This allows the floor to be installed during the construction process without screws so that access by other related trades can be accomplished quickly and easily. It also enables the user to have a mixed installation of fastened and unfastened panels within the same installation.

D. Hot dip galvanized steel pedestal head shall be welded to a threaded rod which includes a specially designed adjusting nut. The nut shall provide location lugs to engage the pedestal base assembly, such that deliberate action is required to change the height setting.

E. Threaded rod shall provide a specially designed anti-rotation device, such that when the head assembly is engaged in the base assembly, the head cannot freely rotate (for FFH of 6” or greater). Note: This prevents the assembly from inadvertently losing its leveling adjustment when panels are removed from the installation during use.

F. Hot dip galvanized pedestal base assembly shall consist of a formed steel plate with no less than 16 inches of bearing area, welded to a 7/8” square steel tube and shall be designed to engage the head assembly.

2.3 Panel Components

Floor Panels:

A. Panels shall consist of a top steel sheet welded to a formed steel bottom pan filled internally with a lightweight cementitious material. Mechanical or adhesive methods for attachment of the steel top and bottom sheets are unacceptable.

B. Cementitious fill material shall be totally encased within the steel welded shell except where cut for special conditions. Note: This greatly reduces the potential for dust in the environment from exposed cement materials.

C. Panel shall have an electrically conductive epoxy paint finish.

D. Corner of panel shall have a locating tab and integral shape design to interface with the pedestal head for positive lateral retention and positioning with or without fasteners.

E. Fastening of panels to pedestal heads shall be accomplished by the use of a machine screw which is specially designed to be self capturing within the body of the panel. Note: This prevents the inadvertent loss of panel fastening screws when accessing the underfloor space and potential damage to objects by screws which extend beyond the depth of the panel.

F. Top surface of the panel shall have an option for four positioning location holes to engage positioning buttons on the PosiTile® carpet tile for precise matching of the carpet tile to the panel.

G. Fit between the pedestal head, panel, and screw shall enable an installation with an average panel to panel gap of 0.015”.

2.4 Accessories

A. UL listed Power, Voice & Data Servicenters shall be provided in locations as detailed on the contract drawings. High capacity 11 ¼ inch square PVD Servicenters shall be capable of accommodating four duplex receptacles and three knockouts for standard voice/data faceplates or Tate voice/data interface plates (or grommeted interface plates). Standard capacity 7-5/16 by 6-15/16 inch PVD Servicenters shall be capable of accommodating two duplex receptacles and two Tate voice/data interface plates (or grommeted interface plates). The service outlet box shall be a drop-in design having a hinged Lexan lid with carpet insert and Lexan frame with tapered edge. Service outlet box lid shall be capable of withstanding without failure a load of 800 lb.

B. Provide manufacturer's standard steps, ramps, fascia plate, perimeter support, and grommets where indicated on the contract drawings.

C. Provide 5 spare floor panels and 8 square feet of understructure systems for each type used in the project rounded up to the nearest full box, minimum of 2 boxes for maintenance stock. Deliver to project in manufacturer's standard packaging clearly marked with the contents.

D. Provide two (2) panel lifting devices.

E. When applicable provide manufacturer's standard underfloor air systems components (including grilles and diffusers) where indicated on the contract drawings.

2.5 Finishes

A. Finish the surface of floor panels with floor covering material as indicated on the contract drawings. Where floor coverings are by the access floor manufacturer, the type, color and pattern shall be selected from manufacturer's standard. All areas to be furnished with laminated floor panels must be maintained at ambient temperature between 50° to 90° F and at humidity level between 20% to 80% relative and shall remain within these ranges through installation and occupancy.

B. Carpet tile: Access floor system shall be designed to accommodate ESD carpet tile.

C. Edge treatments for factory applied finishes shall be as follows:
All Other Finishes: Monolithic or vinyl edge trim pieces applied to the panel's top surface and shall not wrap around the panel's edge.

2.6 Fabrication Tolerances

A. Floor panel flatness measured on a diagonal: +/- 0.035"
B. Floor panel flatness measured along edges: +/- 0.025"
C. Floor panel width or length of required size: +/- 0.010"
D. Floor panel squareness tolerance: +/- 0.015"

PART 3 - EXECUTION

3.1 Preparation

A. Examine structural subfloor for unevenness, irregularities and dampness that would affect the quality and execution of the work. Do not proceed with installation until structural floor surfaces are level, clean, and dry as completed by others.

B. Concrete sealers, if used, shall be identified and proven to be compatible with pedestal adhesive. Verify that adhesive achieves bond to slab before commencing work.

C. Verify dimensions on contract drawings, including level of interfaces including abutting floor, ledges and doorsills.

D. The General Contractor shall provide clear access, dry subfloor area free of construction debris and other trades throughout installation of access floor system.

E. Area to receive and store access floor materials shall be enclosed and maintained at ambient temperatures between 35° to 95° F and relative humidity levels between 20 to 80%. At least 24 hrs. before installation begins, all floor panels shall be stored at ambient temperatures between 50° to 90° F and relative humidity levels between 20% to 80% and shall remain within these environmental limits throughout occupancy.

3.2 Installation

A. Pedestal locations shall be established from approved shop drawings so that mechanical and electrical work can be installed without interfering with pedestal installation.

B. Installation of access floor shall be coordinated with other trades to maintain the integrity of the installed system. All traffic on access floor shall be controlled by access floor installer. No traffic but that of access floor installers shall be permitted on any floor area for 24 hours to allow the pedestal adhesive to set. Access floor panels shall not be removed by other trades for 72 hours after their installation.

C. Floor system and accessories shall be installed under the supervision of the manufacturer's authorized representative and according to manufacturer's recommendations.

D. No dust or debris producing operations by other trades shall be allowed in areas where access floor is being installed to ensure proper bonding of pedestals to subfloor.

E. Access floor installer shall keep the subfloor broom clean as installation progresses.

F. Partially complete floors shall be braced against shifting to maintain the integrity of the installed system where required.

G. Additional pedestals as needed shall support panels where floor is disrupted by columns, walls, and perimeter cutouts.

H. Understructure shall be aligned such that all uncut panels are interchangeable and fit snugly but do not bind when placed in alternate positions.

I. Finished floor shall be level, not varying more than 0.062" in 10 feet or 0.125" overall.

J. Installed panels shall be straight and square and spaced so that the distance from one end to the other of any line of 12 panels is not less than 24 feet and does not exceed 24' 1/8".

K. Acceptance: General contractor shall accept floor in whole or in part prior to allowing use by other trades.

L. All cable and wire openings shall be sealed with manufacturer's removable cable cutout seal or grommets.

END SECTION 096900

SECTION 099000 – PAINTING

PART 1 - GENERAL

1.1 DESCRIPTION

A. Provide painting work specified herein and when shown on the drawings. The word paint means to apply paint materials and refers to the paint materials specified including primers, undercoats, sealers, fillers, stains and the finish coats of paint material.

B. Shop priming and primer touch-up of miscellaneous steel items is specified in other sections.

C. The work includes painting of interior and exterior unfinished and primed items, drain and fire sprinkler piping and other surfaces throughout the project, unless otherwise specified or shown on drawings. Where items and surfaces are not specifically identified but are not specifically excluded from the painting work, paint the same as specified for adjacent similar surfaces and items.

D. Colors will be selected by Architect.

E. Coordinate painting with all other sections for surfaces and items specified to be shop primed and for items to be factory and shop finished.

1.2 SURFACES NOT TO BE PAINTED

A. Surface preparation and priming of items and surfaces specified in other sections to be factory or shop primed.

B. Surfaces and items specified in other sections to be factory or shop finished.

C. Concealed wall and ceiling surfaces and inaccessible surfaces such as in pipe and duct chases and shafts, elevator shafts and similar areas.

D. Galvanized steel surfaces that will be concealed in completed work.

E. Fire rating labels, equipment labels and name plates.

1.3 SUBMITTALS

A. Manufacturer's Product Data: Submit for each product. Include block fillers and primers.

1. General: Include manufacturer's identification numbers, major pigment and vehicle constituents by volume, surface preparation, mixing, thinning, application and curing instructions.
2. Material List: Submit an inclusive of required coating materials. list of manufacturer's brand name and number of each material proposed for use. Identify surface(s) to receive material.
3. Certification by the manufacturer that products supplied comply with local regulations controlling use of volatile organic compounds (VOCs).

B. Samples: Submit for each material and color to be applied, with texture to simulate actual conditions, on representative samples of the actual substrate.

C. Qualifications: Applicators shall submit data to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names of architects and owners, and other information that may substantiate experience.

1.4 QUALITY ASSURANCE

A. Applicator Qualifications: Applicator shall have completed painting system applications similar in material and extent to that indicated for this project with a record of successful in-service performance.

B. Source Limitations: Obtain block fillers, primers, and undercoat materials for each coating system from the same manufacturer as the finish coats.

1.5 DELIVERY, STORAGE AND HANDLING

A. Deliver all materials to the project site in manufacturer's original, unopened packages and containers bearing manufacturer's name and label and the following information:

1. Product or material name.
2. Product description (generic classification or binder type).
3. Contents by volume, for pigment and vehicle constituents.
4. Thinning and application instructions.
5. Volatile organic compound (VOC) content.

1.6 JOB CONDITIONS

A. Paint Application:

1. Apply water-based paints only when temperature of surfaces to be painted is between 50 and 90°F.

2. Apply solvent thinned paints only when the temperature of surfaces to be painted is between 45 and 95°F.

B. Do not apply paint in rain, fog, or mist; or when the relative humidity exceeds 85 percent; or at temperatures less than 5°F above the dew point; or to damp or wet surfaces.

C. Paint Coordination: Review other sections in which primer paints are specified to ensure chemical compatibility with finish coating system. Furnish finish products which are compatible with primer products, or apply barrier coats over incompatible primers or remove and reprime.

D. Protection: Remove or otherwise protect hardware, light fixtures, sprinkler heads, electric outlet plates, A/C grilles and registers and similar items in place prior to painting and re-position upon completion of operations. Protect floors and other adjacent work by use of clean drop cloths or similar coverings. Protect the work of other trades from damage. Post signs on freshly painted surfaces immediately following their completion.

PART 2 - PRODUCTS

2.1 GENERAL

A. Paint systems, primers, sealer, fillers and finish paint shall be by one manufacturer for each

type surface. Products shall be factory ready mixed for immediate application without thinning or other modification.

2.2 ACCEPTABLE MANUFACTURERS

A. First grade products of the following manufacturers are acceptable, subject to submittal and approval of a schedule of products listing the surfaces for which they are intended.

1. Benjamin Moore & Company.
2. ICI Paints. (Formerly Devoe & Raynolds Company and Glidden Paint)
3. PPG Industries, Inc.
4. Pratt & Lambert Company.
5. Sherwin-Williams Company.

2.3 PRODUCT SCHEDULE

A. Block Filler: B42W46 Heavy-duty, high-performance acrylic resin latex emulsion block filler for interior and exterior use in filling bare CMU and concrete before application of finish coats.

B. Primers for Metals:

1. Universal Metal Primer: B50Z Series Kem Kromik alkyd base metal primer for all interior ferrous metal.
2. Rust-Inhibitive Primer: B50Z Series Kem Bond HS alkyd base metal primer for all exterior ferrous metal and may be used for all interior ferrous metal in lieu of Universal Metal Primer above.
3. Galvanized and Non-ferrous Metal Primer: B50WZ30 Galvite HS, solvent based acrylic primer for all galvanized and non-ferrous metal.

C. Primers for Wood:

1. Alkyd-oil base Y24 A-100 primer for exterior wood to receive paint finish.
2. Alkyd-oil base B49 Series PrepRite alkyd enamel undercoat for interior wood to receive paint finish.

D. Primer-Sealer: B28W200 PrepRite premium quality latex primer-sealer for drywall.

E. Gloss Enamel: A85 Series SuperPaint acrylic latex base enamel for gloss exterior finish coat.

F. Flat Masonry Paint: A-100 (A6), acrylic latex base masonry paint for exterior concrete and stucco.

G. Interior Flat: B30 ProMar 200/400, vinyl-acrylic latex type low sheen finish coat.

H. Interior Satin: B20 ProMar 200/400, vinyl acrylic latex type eggshell sheen enamel finish coat.

I. Interior Semi-Gloss: B34 ProMar 200/400 alkyd type semi-gloss enamel finish coat.

PART 3 - EXECUTION

3.1 PREPARATION OF SURFACES

A. Cleaning: Remove accumulated dirt and loose dust by brushing or wiping.

B. Concrete Masonry: Clean all excess mortar, loose and foreign material using metal scraper and wire brush. Remove all grease and oil spots by suitable cleaning compound and rinse (to remove alkali). If necessary, neutralize by washing with zinc sulphate solution.

C. Gypsum Board: Inspect joint and nail-head treatment; correct all imperfections before proceeding. Remove all dust and dirt by use of a soft cloth or brush.

D. Metal: Surfaces shall be free of rust and loose scale. Clean with mineral spirits before painting. Surfaces which will be inaccessible after installation shall be completely painted before installation. Prime field welds, bolts and rivets.

1. Aluminum: Clean and remove all lacquer or other protective coating.

2. Steel: Wipe shop primed metal clean of foreign matter, retouch where scratched, marred or rusted using similar primer. As soon as practical after erection (to minimize rusting) wire brush structural and miscellaneous steel and touch-up welds, scratches and abrasions of shop applied primer.

E. Wood: Sandpaper smooth. Before installation apply wood-sealer. Back-prime trim and prime cut ends to match finished surface. Ease sharp knife-edge corners by rubbing with fine sandpaper. Remove soil by wiping using clean cloth moistened with alcohol.

3.2 APPLICATION

A. Workmanship: Read and conform to instructions in label on containers. Materials uniformly spread and smoothly finished. Do not thin in excess of the printed directions. Mix and apply in accordance with manufacturer's directions. Field applied priming coats shall be applied as soon as possible after the work is received or in place. Apply coats by brush or roller. Coverage of products shall not be less than that recommended by manufacturer. When finishing operating parts, the parts shall be painted in the "open" position and shall remain so until dry. Metal surfaces required to be bare for proper operations shall be kept free of paint. Cut sharp lines at different colors, glass and other unpainted materials. In painted work each coat shall differ in color from the preceding and succeeding coats.

3.3 COLORS

A. Colors shall match colors scheduled by Architect.

B. Colors for surfaces not scheduled:

1. Access Panels: Match adjacent wall or ceiling.

2. Exterior Louvers: Match adjacent wall.

2. Electric and Telephone Panels: Match adjacent walls.

3. Closets: Match spaces into which they open.

4. Steel Door Frames: Match wall.

5. Hardware (prime coated hinges and closers): Match door and frames to which attached.

6. Interior of Ducts Visible Through Grilles: Matte black.

3.4 EXTERIOR PAINT SCHEDULE

A. Non-ferrous Metals and Piping: Galvanized and non-ferrous metal primer and two coats gloss enamel.

B. Ferrous Metals and Piping: Rust Inhibitive primer and two coats gloss enamel.

C. Wood Doors and Trim: Alkyd-oil base primer and two coats gloss enamel

D. Concrete: Two coats semi-gloss masonry paint

E. CMU: Block Filler and two semi-gloss masonry paint.

3.5 INTERIOR PAINT SCHEDULE

A. Ferrous Metal and Piping: Universal metal primer and two coats interior semi-gloss enamel.

B. Non-Ferrous and Galvanized Metal and Piping: Galvanized and non-ferrous metal primer and two coats interior semi-gloss enamel.

C. Gypsum Drywall:

1. Walls to Receive Fabric Wallcovering: One coat primer-sealer.

2. Walls: Primer-Sealer and two coats interior satin latex finish coat.

3. Ceilings: Primer-Sealer and two coats interior flat latex finish coat.

D. Wood Trim: Undercoater and two coats interior semi-gloss enamel.

3.6 TOUCH-UP

A. Retouch finished surfaces, including factory finished items, necessary so work is neat, clean and unblemished at time of substantial completion.

3.7 CLEANING

A. Keep freshly coated surfaces, brushed and cans clean and dust free. Remove paint splatters and daubs from hardware, glass, floors and any other surfaces not indicated to be painted.

SEE FOLLOWING CHART FOR

COMPARISON OF APPROVED PRODUCTS

APPROVED PRODUCTS COMPARISON

Product Description	S-W	Ben Moore	ICI	PPG	Pratt &Lambert
Block Filler	Heavy Duty Block Filler B42W46	Latex Block Filler 946-11	Ultra Hide Block Filler #3010	Pitt Glaze Hi Perf. Block Filler 16-90	Vina Prime Block Filler 26-1646
Universal Metal Primer	Kem Kromik Universal Metal Primer B50Z	Ironclad #168	Glid Guard Univ. Metal Primer #5210	Red Primer #97-608	Tech Guard Primer E-155
Rust-Inhibitive Primer	Kem Bond HS B50Z Series	Universal Metal Primer M07	Glid Guard Rustmaster #595	Multiprime #97682	Heavy Duty Primer
Galv. & Non Ferrous Primer	Galvite HS B50 WZ30	N/A	Mirrolac Galv. Primer #13201	Galvinized Metal Primer 6-209	N/A
Alkyd Wood Primer	A-100 Alk. Wood Primer Y24	Moorwhite Primer #100	All Weather Exterior Primer #1102	Sunproof Alkyd Primer 1-70	Suprime 8 Alkyd Primer S/D1008
Alkyd Enamel Undercoat	PrepRite Wall & Wood B49	Moorcraft Alkyd Primer #268	Alkyd Wood Undercoater #310	Speedhide Alkyd Undercoat 6-6	Suprime Alkyd Primer S/D 1011
Primer/Sealer for D/W	PrepRite 200 Latex Primer B28	Regal First Coat All Purpose	Sped Ultra Latex Primer #5111	Speedhide Latex Wall Primer 6-2	Suprime 4 Latex Wall Primer Z/F 1004
Primer/Sealer for W/C	PrepRite Wall & Wood B49	Moorcraft Alkyd Primer #268	Ultra Hide W/C Primer/Sealer #64897	Speedhide Alkyd Undercoat 6-6	Suprime 11 Alkyd Primer SD 1011
Ext. Latex High Gloss	SuperPaint High Gloss	Impervex #309	Decrasheild Ext. Gloss #2406	Pitt-Tech 90-374	Accolade Z/F 4300
Flat Masonry Paint	A-100 Ext. Acrylic A-6	Moorcraft 100% Acrylic #180	Spred House Dura Flat #3600	Sun Proof 72-45	Vapex Ext Flat Z/F 1900
Interior Flat	ProMar 200 Latex Flat B30	Regal Wall Satin #215	Ultra Flat Y4000	Wall Hide 80-45	Vapex Int Flat Z/F 2300
Interior Satin	ProMar 200 Latex Eg-Shel B20	Regal Aquavelvet Eg-Shell #319	Ultra Latex Eggshell Y4100	Manor Hall 89-6	Aqua Satin Latex Z/F2300
Interior Alk. S/G	ProMar 200 Alkyd S/G B34	Moorcraft Alkyd S/G #271	Ultra Hide Alkyd Enamel 5950	Wall Hide Alkyd S/G 27-914	Cellutone Alkyd Satin SD 5700

END OF SECTION 099000

SECTION 099600 – HIGH-PERFORMANCE COATING (EXTERIOR STUCCO SYSTEM)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes surface preparation and the application of paint systems on the following exterior substrates:

1. Tilt-up concrete panels

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Samples for Initial Selection: For each type of topcoat product indicated.

C. Samples for Verification: For each type of paint system and each color and gloss of topcoat indicated.

1. Submit Samples on rigid backing, 8 inches square.

2. Step coats on Samples to show each coat required for system.

3. Label each coat of each Sample.

4. Label each Sample for location and application area.

D. Product List: For each product indicated, include the following:

1. Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules.

2. Printout of current "MPI Approved Products List" for each product category specified in Part 2, with the proposed product highlighted.

1.4 QUALITY ASSURANCE

A. Master Painters Institute (MPI) Standards:

1. Products: Complying with MPI standards indicated and listed in "MPI Approved Products List."

2. Preparation and Workmanship: Comply with requirements in "MPI Architectural Painting Specification Manual" for products and paint systems indicated.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F.

1. Maintain containers in clean condition, free of foreign materials and residue.

2. Remove rags and waste from storage areas daily.

1.6 PROJECT CONDITIONS

A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F or as recommended by manufacture.

B. Do not apply paints in rain, fog, or mist; when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Tilt-up concrete: Furnish product by the following or an approved equivalent:

1. Thorocoat Course by BASF Construction Chemicals – Building Systems

2. Approved Equivalent.

2.2 PAINT, GENERAL

A. Material Compatibility:

1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.

2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.

B. Colors: As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of work.

1. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows: Concrete Percent

B. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.

C. Begin coating application only after unsatisfactory conditions have been corrected and surfaces are dry.

1. Beginning coating application constitutes Contractor's acceptance of substrates and conditions.

3.2 PREPARATION

A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates and paint systems indicated.

B. Remove plates, machined surfaces, and similar items already in place that are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.

1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.

2. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.

C. Clean substrates of substances that could impair bond of paints, including dirt, oil, grease, and incompatible paints and encapsulants.

1. Remove incompatible primers and reprime substrate with compatible primers as required to produce paint systems indicated.

D. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.

3.3 APPLICATION

A. Apply paints according to manufacturer's written instructions.

1. Use applicators and techniques suited for paint and substrate indicated.

2. Paint surfaces behind movable items same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed items with prime coat only.

B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Tint undercoats to match color of topcoat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.

C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.

D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

3.4 CLEANING AND PROTECTION

A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.

D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.5 EXTERIOR COATING SCHEDULE

A. Concrete Substrates, Nontraffic Surfaces: Provide for tilt-up

1. Thorocoat Coarse Texture by Degussa. (Only silica aggregate permitted)

a. Prime Coat: Thoro CM Primer.

b. Topcoat: Thorocoat Coarse Spray applied and back rolled for a total dry-film thickness (DFT) of 12-16 mils.

END OF SECTION 099600

SECTION 102813 – TOILET ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes toilet and bath accessory items as scheduled.

B. Mirrored glass for frameless applications is specified in Division 8, Section 088000 - GLAZING.

1.3 SUBMITTALS

A. General: Submit the following according to Conditions of Contract and Division 1 Specifications Sections.

B. Product data for each toilet accessory item specified, including construction details relative to materials, dimensions, gages, profiles, mounting method, specified options, and finishes.

C. Schedule indicating types, quantities, sizes, and installation locations (by room) for each toilet accessory item to be provided for project.

D. Setting drawings where cutouts are required in other work, including templates, substrate preparation instructions, and directions for preparing cutouts and installing anchorage devices.

E. Maintenance instructions including replaceable parts and service recommendations.

1.4 QUALITY ASSURANCE

A. Inserts and Anchorages: Furnish accessory manufacturers' standard inserts and anchoring devices that must be set in concrete or built into masonry. Coordinate delivery with other work to avoid delay.

B. Single-Source Responsibility: Provide products of same manufacturer for each type of accessory unit and for units exposed to view in same areas, unless otherwise acceptable to Architect.

1.5 PROJECT CONDITIONS

A. Coordination: Coordinate accessory locations, installation, and sequencing with other work to avoid interference with and ensure proper installation, operation, adjustment, cleaning, and servicing of toilet accessory items.

1.6 WARRANTY

A. Warranty: Submit a written warranty executed by mirror manufacturer, agreeing to replace any mirrors that develop visible silver spoilage defects within warranty period.

B. Warranty Period: 15 years from date of Substantial Completion.

C. The warranty shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and will be in addition to and run concurrent with other warranties made by the Contractor under requirements of the Contract Documents.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide toilet accessories by one of the following:

1. A & J Washroom Accessories.

2. American Specialties, Inc.

3. Bobrick Washroom Equipment, Inc.

4. Bradley Corporation.

5. McKinney/Parker.

B. The toilet accessories schedule is shown in the drawings. The schedule references specific catalog items from the indicated manufacturer, unless otherwise noted, in order to establish the level of function and quality for the project. Equivalent products of manufacturers listed above are acceptable for submittal.

2.2 MATERIALS, GENERAL

A. Stainless Steel: AISI Type 302/304, with polished No. 4 finish, 0.034-inch (22-gage) minimum thickness.

B. Sheet Steel: Cold-rolled, commercial quality ASTM A 366, 0.04-inch (20-gage) minimum. Surface preparation and metal pretreatment as required for applied finish.

C. Galvanized Steel Sheet: ASTM A 527, G60.

D. Chromium Plating: Nickel and chromium electro-deposited on base metal, ASTM B 456, Type SC 2.

E. Mirror Glass: Nominal 6.0 mm (0.23 inches) thick, conforming to ASTM C 1036, Type I, Class I, Quality q2, and with silvering, electroplated copper coating and protective organic coating.

F. Galvanized Steel Mounting Devices: ASTM A 153, hot-dip galvanized after fabrication.

G. Fasteners: Screws, bolts, and other devices of same material as accessory unit, or of galvanized steel where concealed.

2.3 TOILET ACCESSORIES

A. See schedule on Architectural drawings.

2.4 FABRICATION

A. General: No names or labels are permitted on exposed faces of toilet and bath accessory units. On either interior surface not exposed to view or on back surface, provide identification

of each accessory item either by a printed, waterproof label or a stamped nameplate indicating manufacturer's name and product model number.

B. Surface-Mounted Toilet Accessories, General: Except where otherwise indicated, fabricate units with tight seams and joints, exposed edges rolled. Hang doors or access panels with continuous stainless steel piano hinge. Provide concealed anchorage wherever possible.

C. Recessed Accessories: Where indicated, fabricate units of all-welded construction without mitered corners. Hang doors and access panels with full-length, stainless steel hinge. Provide anchorage that is fully concealed where unit is closed.

D. Framed Mirror Units, General: Fabricate frames for glass mirror units to accommodate wood, felt, plastic, or other glass edge protection material. Provide mirror backing and support system that will permit rigid, tamperproof glass installation and prevent moisture accumulation, as follows:

1. Provide galvanized-steel backing sheet, not less than 0.034 inch (22 gage) and full mirror size, with nonabsorptive filler material. Corrugated cardboard is not an acceptable filler material.

E. Mirror Unit Hangers: Provide system for mounting mirror units that will permit rigid, tamperproof, and theftproof installation, as follows:

1. One-piece, galvanized-steel, wall-hanger device with spring-action locking mechanism to hold mirror unit in position with no exposed screws or bolts.

F. Keys: Provide universal keys for access to toilet accessory units requiring internal access for servicing, resupply, etc. Provide minimum of six keys to Owner's representative.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install toilet accessory units according to manufacturers' instructions, using fasteners appropriate to substrate as recommended by unit manufacturer. Install units plumb and level, firmly anchored in locations and at heights indicated.

B. Secure mirrors to walls in concealed, tamperproof manner with special hangers, toggle bolts, or screws. Set units plumb, level, and square at locations indicated, according to manufacturer's instructions for type of substrate involved.

C. Install grab bars to withstand a downward load of at least 250 lbf, complying with ASTM F 446.

3.2 ADJUSTING AND CLEANING

A. Adjust toilet accessories for proper operation and verify that mechanisms function smoothly. Replace damaged or defective items.

B. Clean and polish all exposed surfaces strictly according to manufacturer's recommendations after removing temporary labels and protective coatings.

END OF SECTION 102813

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SECTION 104400 - FIRE-PROTECTION SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this section.

1.2 SUMMARY

A. This section includes the following:

1. Portable fire extinguishers.

2. Fire-extinguisher cabinets.

3. Fire-protection accessories.

1.3 SUBMITTALS

A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for fire-protection specialties.

3. Fire Extinguishers: Include rating and classification.

4. Cabinets: Include roughing-in dimensions, details showing mounting methods, relationships of box and trim to surrounding construction, door hardware, cabinet type, trim style, and panel style.

B. Samples for Initial Selection: Manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available for each type of cabinet finish indicated.

C. Samples for Verification: For each type of exposed cabinet finish required, prepared on Samples of size indicated below and of same thickness and material indicated for the work. If finishes involve normal color and texture variations, include sample sets showing the full range of variations expected.

1. Size: 6-by-6-inch- square Samples.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain fire extinguishers and cabinets through one source from a single manufacturer.

B. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Standard for Portable Fire Extinguishers."

C. UL-Listed Products: Fire extinguishers UL-listed and bear UL AListing Mark≅ for type, rating and classification of extinguisher.

D. FM-Listed Products: Fire extinguishers approved by Factory Mutual Research Corporation for type, rating and classification of extinguisher and carry appropriate FM marking.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis of Design: The basis of design for the Project is Larsens Manufacturing Company's "Architectural Series Model 2409-R2." The basis of design is intended to establish a level of quality, function and appearance for the work and is not intended to limit competition. Other manufacturers whose products may be incorporated into the work, subject to compliance with requirements, are also listed. The Contractor is responsible for any modifications to the work resulting from the use of materials other than the basis of design, at no additional cost to the Owner.

1. J.L. Industries, Inc.

2. Kidde: Walter Kidde, The Fire Extinguisher Co.

3. Modern Metal Products; Div. of Technico.

4. Potter-Roemer; Div. of Smith Industries, Inc.

5. Watrous; Div. of American Specialties, Inc.

2.2 MATERIALS

A. Cold-Rolled Steel Sheet: Carbon steel, complying with ASTM A366, commercial quality, stretcher leveled, temper rolled.

B. Stainless Steel: 304 stainless steel with #4 finish.

2.3 PORTABLE FIRE EXTINGUISHERS

A. General: Provide fire extinguishers of type, size, and capacity for each cabinet and other locations indicated.

B. Multipurpose Dry-Chemical Type: UL-rated 4-A:60-B:C, 10-lb (4.5-kg) nominal capacity, in enameled-steel container.

C. Include 3 units to be located by Architect.

2.4 FIRE EXTINGUISHER CABINETS

A. Cabinet: Occult Series, O-2409, Solid Door, Black Type 'A' Lettering, Fully Recessed.

B. Door Material: Manufacturer's standard, as follows:

1. Stainless Steel sheet.

C. Door Style: Manufacturer's standard design, as follows:

1. Solid.

D. Door Hardware: Provide manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated. Provide either lever handle with cam-action latch, or exposed or concealed door pull and friction latch. Provide concealed or continuous-type hinge permitting door to open 180 degrees.

I. Include 5 units to be located by Architect.

2.5 ACCESSORIES

A. Mounting Brackets: Manufacturer's standard steel, designed to secure extinguisher, of sizes required for types and capacities of extinguishers indicated, with plated or baked-enamel finish.

1. Provide brackets for extinguishers not located in cabinets.

B. Identification: Provide lettering to comply with authorities having jurisdiction for letter style, color, size, spacing, and location. Locate as indicated by Architect.

1. Identify bracket-mounted extinguishers with the words "FIRE EXTINGUISHER" in red letter decals applied to wall surface.

2.6 FINISHES, GENERAL

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

D. Cabinet Finishes: Provide manufacturer's standard baked-enamel paint for cabinet interiors.

2.7 ALUMINUM FINISHES

A. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.

B. Class I, Color Anodic Finish: AA-M12C22A42/A44 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, integrally colored or electrolytically deposited color coating 0.018 mm or thicker) complying with AAMA 606.1 or AAMA 608.1.

1. Color: As selected by Architect from the full range of industry colors and color densities.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify location of cabinets with Architect and Owner prior to installation.

B. Examine walls and partitions for suitable framing depth and blocking where recessed cabinets are to be installed.

C. Examine fire extinguishers for proper charging and tagging. Remove and replace damaged, defective, or undercharged units.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with manufacturer's written instructions for installing fire-protection specialties.

B. Install in locations and at mounting heights indicated or, if not indicated, at heights acceptable to authorities having jurisdiction.

1. Prepare recesses for cabinets as required by type and size of cabinet and trim style.

2. Fasten mounting brackets to structure and cabinets, square and plumb.

3. Fasten cabinets to structure, square and plumb.

3.3 ADJUSTING, CLEANING, AND PROTECTION

A. Adjust cabinet doors that do not swing or operate freely.

B. Refinish or replace cabinets and doors damaged during installation.

C. Provide final protection and maintain conditions that ensure that cabinets and doors are without damage or deterioration at the time of Substantial Completion.

END OF SECTION 104400

SECTION 10 73 16 – PRE-ENGINEERED ALUMINUM CANOPY SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Hanger rod supported, pre-engineered metal canopies including fascia channels, decking, tension rods, and attachment hardware..

1.2 REFERENCES

A. American Architectural Manufacturers Association (AAMA):
   1. AAMA 603 - Voluntary Performance Requirements and Test Procedures for Pigmented Organic Coatings on Extruded Aluminum.
   2. AAMA 605 - Voluntary Specification for High Performance Organic Coatings on Architectural Extrusions and Panels.
   3. AAMA 607.1 - Voluntary Guide Specification and Inspection Methods for Clear Anodic Finishes for Architectural Aluminum.
   4. AAMA 608.1 - Voluntary Guide Specification and Inspection Methods for Electrolytically Deposited Color Anodic Finishes for Architectural Aluminum.

B. The Aluminum Association (AA):
   1. The Aluminum Design Manual 2000, Specifications & Guidelines for Aluminum Structures.

C. American Society of Civil Engineers (ASCE):
   1. ASCE 7, Minimum Design Loads for Buildings and Other Structures.

D. American Welding Society (AWS):
   1. ANSI/AWS D1.2, Structural Welding Code – Aluminum.

1.3 DESIGN REQUIREMENTS

A. Columns, Beams, Deck, and Trim: Aluminum extrusions.

B. Structural Framing: Interlocking deck sections secured by screws.
   1. Heli-arc welded, one-piece rigid bents.
   2. Mechanically fastened bents using internally concealed bolted connections.

C. Canopy: Flat, self-draining from deck through bents to discharge point at ground level thru column cutout and internal diverter or as otherwise shown.

D. Structural Performance Requirements:
   1. Structural Performance: Provide metal building systems capable of withstanding the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
      a. The following codes and publications, of the latest edition, govern this work unless indicated or specified otherwise.
         1) Aluminum Design Manual.
         2) International Building Code.
   2. Design Loads: As indicated in this Section.
   3. Live Loads: The structure shall be designed to withstand a roof live load of 20 PSF in accordance with applicable code requirements.

4. Wind Loads: As indicated on the structural drawings.
5. Snow Loads: As indicated on the structural drawings.
6. Seismic Loads: As indicated on the structural drawings.
7. Load Combinations: Per applicable codes.
8. Deflection Limits: Engineer assemblies to withstand design loads with deflections no greater than the following:
   a. Primary Roof Members: Vertical deflection of 1/120 of the span under a dead load plus live load combination, with a 1/180 limit under live and wind loads applied separately.
   b. Secondary Roof Members: Vertical live load deflection of 1/150 of the span.
   c. Metal Roof Panels: Vertical total load deflection of 1/60 of the span.
   d. Primary Frame Drift: Horizontal deflection of 1/120 of the height.
9. Thermal Movements: Provide metal panel systems that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
   a. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

1.4 SUBMITTALS

A. Submit under provisions of Section 013000.

B. Product Data: Manufacturer's catalog data, detail sheets, and specifications.

C. Shop Drawings: Layout and erection drawings showing roof framing, deck panels, cross sections, and trim details, clearly indicating proper assembly.

D. Samples: Color selection samples consisting of actual coating material or anodizing process on aluminum extrusions.

E. Quality Assurance/Control Submittals:
   1. Qualifications: Letter certifying manufacturer's required qualifications.
   2. Structural Design Calculations.
   3. Manufacturer's Installation Instructions.

1.5 QUALITY ASSURANCE

A. Overall Standard: Structural engineering design documents signed and sealed by a structural engineer registered to practice in State of Virginia.

B. Manufacturer Qualifications: Minimum five years experience in producing covers/canopies with welded bents and of the type specified.

C. Installer Qualifications: Minimum two years experience in erecting covers/canopies of the type specified.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver prefabricated components, sheets, panels, and other manufactured items so they will not be damaged or deformed. Package roof panels for protection against transportation damage.

B. Handling: Exercise care in unloading, storing, and erecting wall and roof covering panels to prevent bending, warping, twisting, and surface damage.

C. Stack materials on platforms or pallets, covered with tarpaulins or other suitable weathertight ventilated covering. Store metal wall and roof panels so that water accumulations will drain freely. Do not store panels in contact with other materials that might cause staining, denting or other surface damage.

D. Follow manufacturer's instructions.

1.7 WARRANTY

A. Roofing Panel Finish Warranty: : Furnish the roofing panel manufacturer's written warranty, covering failure of the factory-applied exterior finish on metal wall and roof panels within the warranty period.
   1. Warranty period for factory-applied exterior finishes on wall and roof panels is 10 years after the date of Substantial Completion.

B. Weather Tightness Warranty: Furnish a 5-year “weather tight” manufacturer’s labor and material warranty.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Manufacturer: Subject to compliance with specified requirements, acceptable canopy system manufacturers are, but not limited to, the following:
   1. Perfection Architectural Systems, Inc.; Orlando, Florida.
   2. Peachtree Protective Covers, Inc.; Hiram, Georgia.
   3. AustinMohawk and Company, Inc.; Utica, New York.
   4. Spencer Fabrications, Inc.; Tavares, Florida.

B. Provide all protective covers from a single manufacturer.

2.2 MATERIALS

A. Aluminum Extrusions: ASTM B221, 6063 alloy, T-6 temper.

B. Fasteners: Aluminum, 18-8 stainless steel, or 300 series stainless steel.

C. Protective Coating for Aluminum Columns Embedded in Concrete: Clear acrylic.

D. Foam Block-Outs: Rigid foam blocks sized as required for column embedment depth and shape.

E. Gaskets: Dry seal santoprene pressure type.

F. Aluminum Flashing: ASTM B209, Type 3003 H14, 0.040 inch, minimum.

2.3 COMPONENTS

A. Columns:

1. Radius-cornered aluminum tubular extrusion of size shown on drawings. Provide with cutout and internal diverter for drainage where indicated.
2. Grout Key: Provide two 1-1/2 inch (38 mm) diameter holes in column base, one each in opposite sides (if column embed option is used).
3. Provide clear acrylic protection coat on surfaces in contact with grout.

B. Beams: Open top aluminum tubular extrusions.
1. Size: As required by structural engineering design, 6” x 6” minimum.

C. Deck: Extruded aluminum, self-flashing, interlocking sections that form a composite unit.
1. Size and Profile: As required by structural engineering design.
2. Provide welded endplate water dams where sections terminate at other than drainage channels.

D. Fascia: Manufacturer's standard extruded aluminum fascia sections as shown on drawings and as required to complete the installation resulting in a neat finished appearance.
1. Include manufacturer's standard extruded aluminum gutters.

E. Flashing: Aluminum sheet, thickness as recommended by manufacturer for specific condition.

2.4 ACCESSORIES

A. Fasteners:
1. Deck Screws: No. 14 by 1 inch (25 mm), self-tapping, Type 18-8 stainless steel with neoprene washers.
2. Trim Screws: No. 10 by 1/2 inch (13 mm), self-tapping, Type 18-8 stainless steel.
3. Trim Rivets: Aluminum, size recommended by manufacturer for specific condition.
4. Other Fasteners: Type 18-8 stainless steel, type recommended by manufacturer for specific condition.

2.5 FABRICATION

A. Shop Assembly: Assemble components in shop to greatest extent possible to minimize field assembly. Fabricate cross beams and columns for field assembled bolted connections.

B. Welding: In accordance with ANSI/AWS D1.2.

C. Bent Construction: Factory weld beams to columns with neatly mitered corners to form one-piece rigid bents. Make welds smooth and uniform using an inert gas shielded arc. Perform suitable edge preparation to assure 100% penetration. Grind welds where interfering with adjoining structure to allow for flush connection. Field welding is not permitted. Rigid mechanical joints may be used only if fully welded bents cannot be shipped on local, state, or federal highways without a special permit.

D. Deck Construction: Fabricate from extruded modules that interlock in a self-flashing manner. Positively fasten interlocking joints at 8 inches on center creating a monolithic structural unit capable of developing the full strength of sections. The fastenings shall have minimum shear strength of 350 pounds each. Assemble deck with sufficient camber to offset dead load deflection.

2.6 FINISHES

A. Bents:

1. Fluoropolymer Coating: 70 percent PVDF resin based fluoropolymer, AA-C-12C-42R-1. Color and Gloss: Match existing. (PPG Duranar XL Bright Silver Metallic No. UC55028.), comply with AAMA 605.
   a. Two coat application.

B. Deck:
1. Fluoropolymer Coating: 70 percent PVDF resin based fluoropolymer, AA-C-12C-42R-1, color as selected by architect from manufacturer's standard color range, comply with AAMA 605.
   a. Two coat application.

C. Fascia/Gutter:
1. Fluoropolymer Coating: 70 percent PVDF resin based fluoropolymer, AA-C-12C-42R-1, Color and Gloss: Match existing. (PPG Duranar XL Bright Silver Metallic No. UC55028.), comply with AAMA 605.
   a. Two coat application.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine footings in which bents will be set. Verify footing locations and elevations comply with shop drawings.

B. Coordinate with responsible trade to perform corrective work on unsatisfactory footings or surfaces.

C. Commencement of work by installer is acceptance of existing conditions.

3.2 ERECTION

A. Erect protective covers in accordance with manufacturer's installation instructions.

B. Set bents plumb, straight, and true to line, adequately braced to maintain position until grout has cured.

C. Fill downspout columns with grout to the discharge level to prevent standing water. Install weep holes at top of concrete in non-draining columns to remove condensation.

3.3 CLEANING

A. Clean surfaces soiled by work as recommended by manufacturer.

B. Remove surplus materials and debris from the site.

3.4 PROTECTION

A. Protect finished aluminum surfaces from damage due to subsequent construction operations. Touch-up all damaged surfaces with like paint to specified system.

END OF SECTION 10 73 16

SECTION 122412 - ATCT TRANSPARENT PLASTIC WINDOW SHADES

1.1 PART 1 SUMMARY

This Section includes requirements for material, fabrication and installation of transparent plastic window shades for use in Airport Traffic Control Tower (ATCI) cabs. These shades are required to reduce the sun's direct and reflective glare and to contribute to temperature control of tower cabs. Shades shall be installed on all exposures of the cab. The use of single or dual shades is specified in the Solicitation.

1.2 REFERENCS

The current issues of the publications listed below a part of this specification to the extent referenced. The publications are referred in the text by the basic designation only.

FEDERAL SPECIFICATION (FS)

FS L-P-377 Plastic Sheet and Strip
Polyester

ASSOCIATION OF INDUSTRIAL METALIZERS, COATERS AND LAMINATORS (AIMCAL)

AIMCAL Standard
Methods

FEDERAL STANDARD (FED-STD)

FED-STD-102 Preservation, Packaging, and Packing
Level

1.3 SUBMITTALS

A. Where the contractor elects to use the manufacturer and model number specified herein, no technical information or shop drawing need to submitted.

B. Where the desires to utilize the products of another manufacturer or where no make or model number are specified, a complete set of shop drawings and descriptive literature shall be submitted. The contractor shall submit copies of descriptive literature, shop drawings and/or samples of to the Contracting Officer for approval for any item he wishes to submit as equal to the brand name(s) as specified.

C. The use of a brand name with or without an or equal statement following the purchase description in this specification or on the project drawings is intended to promote competition by encouraging the offering of products that are equal in all materials respects to the brand name products cited in such descriptions.

D. Identification by brand names does not indicate a preference for the products mentioned but indicates the quality and characteristics that will meet the government needs. All characteristics of a specified brand name product, which are essential to the government, are described in the specification or on the project drawings. The contractor shall obtain product

literature from the manufacturer of the specified brand name product to determine its general quality and functional characteristics and shall use that information in making any desired substitutions.

1.4 PERFORMANCE REQUIREMENTS

A. Shade material shall be manufactured from a polyester type polymer in accordance with Federal Specification L-F-377b for type weather able DuPont Mylar clear sheet film or other manufacturer approved by the CarR.. Fire resistant rated "self-extinguishing to very slow burning" U.S. Testing Company, fire test 302; melting point 500 deg. F, combustion 977 deg. F. no toxic hazard.

B. Transparent Plastic Shade Film Construction: Shade product shall consist of a 5 mil, 3-ply laminated polyester film. Two sheets of polyester vat dyed gray, hard coat SIR applied to one side. The final film construction shall be 5 gauge thick, optically clear and totally transparent. Surface tinting or color adhesives will not be acceptable.

C. Visible Light Transmission: Shade shall transmit no more than 4 percent of the visible solar energy (from 380 to 780 nanometers) when measured by Association of Industrial Metalizers, Coaters, and Laminators (AIMCAL) Standard Methods.

D. Ultra-Violet Transmission: Shade shall transmit no more than 2 percent of the ultra-violet solar energy (from 800 to 780 nanometers) when measured by AIMCAL Standard Methods.

E. T<tal Solar Energy Rejected: Shade will reject 60.5 percent of the total solar energy transmitted (from 360 to 2100 nanometers) when measured by AIMCAL Standard Methods.

1. Solar Absorptions: 61 percent.
2. Shading Coefficient: 0.45.
3. Solar Heat Gain Coefficient: 0.40.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Manufacturer who can comply with applicable standard methods of the Association of Industrial Metalizers, Coaters, and Laminators (AIMCAL) for manufacture and fabrication of transparent plastic window shades. Manufacturer shall be recognized producer of transparent plastic window shades for the previous 10years.

B. Fire-Test-Response Characteristics: Provide products passing flame-resistance testing according to NFPA 701 by a testing agency acceptable to authorities having jurisdiction.

1.6 WARRANTY

A. Furnish to FAA three copies of the product warranty that certifies that all the specification requirements have been met. Warranty shall be for a minimum of one full year from date of acceptance against faulty materials and workmanship.

PART 2- PRODUCTS

2.1 TRANSPARENT PLASTIC WINDOW SHADES

Manufacturers listed are for color and material reference and are not intended to limit select ion of other manufacturers' products with similar colors and materials.

A. Primary Shades

Primary Shades shall be dark, heavy duty, F72 SR shades by Plastic-View, Simi Valley, CA (800) 468-6301 or approved equal. Surface tinting and/or color adhesives will not be accepted as equal without independent reports qualifying the color stability in comparison with the vat dyed process.

B. Secondary Shades

When double (secondary) shades are called for in the Statement of Work or are necessary at a future point, the secondary shade shall be of DS 8 SR material by Plastic-View, Simi Valley, CA (800) 468-6301, or FAA approved equal.

2.2 ROLLER SHADE SYSTEM FABRICATION

A. Bottom Bar: Shades shall have a flat l-inch by 112 inch, dull black, full width metal hemline bar, minimum of 26 gage, at bottom onto which the pull cord and shade are attached. Black plastic caps shall be provided on each end of the line bar to cover any sharp exposed edges.

B. Shade Cords: Shade cords shall be black and of sufficient length to route around equipment to cord lock positions whenever required. The cords shall be 9/64 inch diameter rope made of 4.5 Duro Nylon and shall be attached underneath the center of the bottom of the hemline bar.

C. Shade Rollers: Shades shall be mounted on a 1-3/4 inch diameter corrosion resistant metal wrapped roller. The rollers shall be spring loaded, single piece barrel, with a reusable safety cotter key type retainer installed through both end pins and washers to prevent roller from falling out of mounting brackets. Constant tensions in shades are required.

D. Mounting Brackets: Provide mounting brackets with a 2-1/4 inch resting ledge. Standard ceiling brackets are not acceptable. A label stating "This End Down" with an arrow pointing in the proper installation direction of the roller into the mounting brackets shall be placed on the spring motor end of each shade roller. The shade film laminate material shall be mounted on rollers to minimize ridging. Roll-off direction of material from roller shall be as directed by the shade manufacturer for use in the tower cab.

E. Each shade shall have a label or whatever suitable means required to specify and identity the proper roll-off direction.

F. Each shade shall have a manufacturer's label attached to the metal bar hemline giving cleaning instructions and the telephone number fur emergency service.

G. Lock Pulley. Lock pulleys shall consist of a roller and a spring return side action earn cord grip.

H. Cord Direction Change Pulley: Provide cord direction change pulley which shall be used to route shade cord around obstructions where they exist. Pulleys shall be positioned in direct line with cord outlet on metal hemline.

I. Shade Size: Shade roller width shall be within 1/2-inch of maximum possible width as determined by physical limitations. Shade material with shade fully drawn shall be to within 1 inch of columns on bias cut sides and to within 1-3/4 inch of columns on vertical cut sides. Horizontal seam shall be 1ocated a minimum of 70 inches from the bottom of the shade. Shades in ATCT cabs shall be bias cut when required. To ensure a safe roll-up, a minimum of

15 inches of shade material shall remain on the roller when the shade is fully extended.

J. Measuring for Shades: Measuring for shades and positioning shall be strictly in accordance with the shade manufacturer's instructions. Marks showing the precise position of all brackets, pulleys, and metal hemline positions as related to the factory measuring instructions shall be provided. All measurements shall be taken per instructions from shade manufacturer.

PART 3- EXECUTION

3.1 ROLLER SHADE INSTALLATION

A. Install roller shades level, plumb, and aligned with adjacent units according to manufacturer's written instructions. Allow clearances for window operation hardware.

B. Shades shall be installed in shade recess pockets or on wood or metal plates. Shades shall follow the slope of cab glass as closely as practical within physical limitations of air ducts and other equipment. No drilling shall be done in vertical uprights of cab because some uprights may contain electrical cables.

C. Spring tension in roller shall be manually adjusted so that shades roll comfortably and do not bind.

D. In order to safely control and limit the shade travel, the installer shall make two knots in the shade cord. One knot shall be placed before the lock pulley to prevent the metal hemline bar from hitting the windowsill. The second know shall be placed after the lock pulley to prevent the metal hemline bar from hitting and overcoming the shade roller. Adherence to THIS END UP label when installing shade will prevent improper roller installation which can result in a locked shade situation when the metal bar hemline is near the lock pulley and cannot be pulled down to release the spring motor cam lock.

E. Shade shall be able to operate at a moment's notice; to gain unimpeded rapid access for the use of emergency light guns. The inability for one controller to "snap-up" the shade in an emergency endangers lives, any system that does not meet the unimpeded rapid access will not be approved.

F. Adjust and balance roller shades to operate smoothly, easily, safely, and free from binding or malfunction throughout entire operational range.

G. Clean roller shade surfaces after installation, according to manufacturer's written instructions.

END OF SECTION 122412

SECTION 137022 – 49 CFR PART 1542 COMPUTER CONTROLLED ACCESS SYSTEM AND CCTV SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this section.

B. All Division 26 Electrical sections apply to the work specified in this section.

C. The following Contract items defined in other sections and provided under this contract must be compatible with and connect to the existing Computer Controlled Access System (CCAS) provided as part of the Terminal building.
1. Network Electronics. (Provided under this contract)
2. Uninterruptible Power Supplies. (Provided under this contract)

1.2 SUMMARY

A. This section of the specification indicates the scope of the work for the Aircraft Rescue and Fire Fighting Building Contract. The CCAS components and wiring provided under this contract must communicate with, connect to, and operate identically to the existing Terminal Building components.

B. The work includes furnishing all labor, materials, tools, and equipment, and the performance of all operations necessary for coordinating, detailing, fabricating, inspecting, documenting, delivering, installing and testing the hardware, software and firmware for a complete and integrated CCAS in accordance with this section, including but not limited to the following:
1. Data Transmission Subsystem (DTS)
   a. Network Based Intelligent Field Panels (IFPs).
2. Controlled Access Subsystem (CAS)
   a. Card Readers with PINpads.
   b. Electronics Interface Boxes (EIB)
   c. Exit Pushbuttons.
   d. Interface with door locking sub-system.
   e. Interface with delayed egress Panic Hardware.
   f. Gate Control Panel for vehicle gates.
   g. Signage.
3. Intrusion Detection Subsystem (IDS)
   a. Tamper Switches.
   b. Door and Gate Position Switch (Balanced Magnetic Switch).
   c. Duress Alarm Devices.
   d. Vehicle Presence Sensor (ground loops).
4. Surveillance and Assessment Subsystem (SAS)
   a. Complete Integrated Video Management System.
   b. Day/night IP Fixed Cameras.
   c. Day/night IP Autodome PTZ Cameras.
   d. Camera Mounting.
   e. Camera Power Supply and Cabling.

1.3 REFERENCES, CODES, AND REGULATIONS

A. Design, material, fabrication, testing, inspection, certification, documentation and operation shall conform to the following referenced codes, regulations, standards and specifications.

1. Regulations Transportation Security Administration 49 CFR:
   a. Part 1520 - Protection of Sensitive Security Information.
   b. Part 1540 - Civil Aviation Security.
   c. Part 1542 - Airport Security.
   d. Part 1544 - Aircraft Operator Security.
2. Guidelines
   a. Recommended Security Guidelines for Airport Planning, Design and Construction - DOT/FAA/AR-00-52 June 2001.
   b. RTCA/DO-230 Standards for Airport Security Access Control Systems.
3. American National Standards Institute (ANSI):
   a. C2 - National Electrical Safety Code.
   b. C37.90A - Guide for Surge Withstand Capability Tests.
   c. C62.41 - Guide for Surge Voltage in Low Voltage AC Power Circuits.
   d. C63.12 - Recommended Practice on Procedures for Control of System Electromagnetic Compatibility.
   e. X3.4 - American Standard Code for Information Interchange (ASCII).
4. American Society of Testing and Materials (ASTM):
   a. ASTM B 8 - Concentric-Lay Stranded Copper Conductors.
   b. ASTM D 635 - Rate of Burning and / or Extent and Time of Burning of Self-Supporting Plastics in a Horizontal Position.
5. Federal Communications Commission (FCC):
   a. FCC Rules and Regulations, Part 15 and 68.
6. General Services Administration (GSA):
   a. FS W-A-450B - Federal Specification (Interim): Components for Interior Security Alarm Systems.
7. Institute of Electrical and Electronics Engineers (IEEE):
   a. IEEE Transaction Volume COM-21 - Lightning Surges in Open Wire, Coaxial and Paired Cables.
   b. IEEE C62-1990 - Guides and Standards for Surge Protection.
   c. IEEE 802 - Standard for Local Area Networks.
   d. IEEE 802.2 - Standards for Local Area Networks: Media Access Control (MAC) Bridges.
   e. IEEE 802.3 - Ethernet local area network.
   f. IEEE 802.11a - Wireless local area network.
8. International Standards Organization (ISO):
   a. ISO/IEC 8802-3 - Information Processing System - Local Area Networks - Part 3.
   b. ISO/IEC 8802-4 - Information Processing System - Local Area Networks - Part 4.
9. National Electrical Manufacturers Association (NEMA):
   a. NEMA 250 (1985) - Enclosures for Electrical Equipment.
10. National Fire Protection Association (NFPA):
    a. NFPA 70 (1996) - National Electrical Code (NEC).
11. Underwriters' Laboratories (UL):
    a. UL 6 - Rigid Metal Electrical Conduit.
    b. UL 198 (1988) - Fuses.
    c. UL 294 (1987) - Standard for Access Control Systems.
    d. UL 437 - Key Locks.
    e. UL 512 (1987) - Fuse Holders.
    f. UL 634 (1985) - Connectors and Switches for Use with Burglar Alarm Systems.
    g. UL 639 (1986) - Intrusion Detection Units.

h. UL 796 (1984) - Printed Circuit Boards.
i. UL 1076 (1988) - Proprietary Burglar-Alarm Units and Systems.
j. UL 1449 (1985) - Standard for Safety Transient Voltage Surge Suppressors.

12. Applicable Federal, state and local laws, regulations, ordinances and codes.

B. In the event of conflicting requirements between the authorities cited above or between authorities cited and those specified, such disagreements shall be resolved by the A/E or Owner.

1.4 SUBMITTALS

A. The Contractor shall submit all items in accordance with the requirements of, Section 013300 – SUBMITTAL PROCEDURES.

B. Unless noted otherwise in General Conditions, within 30 days of award of Contract, the Contractor shall submit manufacturer's specification or data sheets for all subsystem equipment to be utilized in the CCAS.

C. The Contractor shall submit the following:

1. Shop Drawings: Provide complete shop drawings which include the following:
   a. Indicate all system device locations on 1/8” scale architectural floor plans. No other system(s) shall be included on these plans.
   b. Include full schematic wiring information on these drawings for all devices. Wiring information shall include cable type, conductor routings, quantities, and connection details at device
   c. Include a complete CCAS one-line, block diagram.
   d. Include a statement of the system sequence of operation of each access control portal and overall system performance.
   e. Include a statement indicating seamless integration of various systems.
2. Product Data: Provide complete product data that includes the following:
   a. Manufacturer’s technical data for all material and equipment at the system and sub system level to be provided as part of the CCAS.
   b. A system description including analysis and calculations used in sizing equipment required by the CCAS. The description shall show how the equipment will operate as a system to meet the performance requirements of the CCAS. The following information shall be supplied as a minimum:
      1) Server(s) processor(s), disk space and memory size
      2) Description of site equipment and its configuration
      3) Network bandwidth, latency and reliability requirements
      4) Backup/archive system size and configuration
      5) Start up operations
      6) System expansion capability and method of implementation
      7) System power requirements and UPS sizing
      8) Device / component environmental requirements (cooling and or heating parameters)
      9) A description of the operating system and application software.
3. Contract Close-Out Submittals: Provide three sets of hard copy manuals and three sets electronic format manuals including operating instructions, maintenance recommendations and parts list including wiring and connection diagrams modified to reflect as-built conditions.
4. Manuals: Final copies of the manuals shall be delivered within 30 days after completing the installation test. Each manual=s contents shall be identified on the cover. The manual shall include names, addresses, and telephone numbers of

the contractor responsible for the installation and maintenance of the system and the factory representatives for each item of equipment for each system. The manuals shall have a table of contents and labeled sections. The final copies delivered after completion of the installation test shall include all modifications made during installation, checkout, and acceptance testing. The manuals shall consist of the following:

a. Functional Design Manual: The functional design manual shall identify the operational requirements for the system and explain the theory of operation, design philosophy, and specific functions. A description of hardware and software functions, interfaces, and requirements shall be included.

b. Hardware Manual: The manual shall describe all equipment furnished including:
   - a) General description and specifications
   - b) Installation and check out procedures
   - c) Equipment layout and electrical schematics to the component level
   - d) System layout drawings and schematics
   - e) Alignment and calibration procedures
   - f) Manufacturers repair parts list indicating sources of supply

c. Software Manual: The software manual shall describe the functions of all software and shall include all other information necessary to enable proper loading, testing, and operation. The manual shall include:
   - a) Definition of terms and functions
   - b) System use and application software
   - c) Initialization, start up, and shut down
   - d) Reports generation
   - e) Details on forms customization and field parameters

d. Operators Manual: The operators manual shall fully explain all procedures and instructions for the operation of the system including:
   - a) Computers and peripherals
   - b) System start up and shut down procedures
   - c) Use of system, command, and applications software
   - d) Recovery and restart procedures
   - e) Graphic alarm presentation
   - f) Use of report generator and generation of reports
   - g) Data entry
   - h) Operator commands
   - i) Alarm messages and reprinting formats
   - j) System permissions functions and requirements

e. Maintenance Manual: The maintenance manual shall include descriptions of maintenance for all equipment including inspection, periodic preventive maintenance, fault diagnosis, and repair or replacement of defective components.

D. As-Built Drawings: During system installation, the Contractor shall maintain a separate hard copy set of drawings, elementary diagrams, and wiring diagrams of the CCAS to be used for record drawings. This set shall be accurately kept up to date by the Contractor with all changes and additions to the CCAS. Copies of the final as-built drawings shall be provided to the end user in DXF format.

1.5 QUALITY ASSURANCE

A. The system contractor/integrator responsible for providing the CCAS shall have at least 10 years experience in furnishing and installation of such systems.

B. The system contractor integrator shall have previous experience in installation of airport security system under PART 1542 (or FAR 107.14) for at least 2 projects in the past 5 years. Contractor shall provide names of the project, year completed and references to the A/E for review and approval.

C. The system contractor's project manager and on-site superintendent shall have a minimum of 15 years experience and shall have worked on the projects listed in Art. 1.9B in similar capacity.

D. Manufacturer Qualifications
   1. Manufacturer of the CCAS shall be an established organization with referenced and documented experience delivering and maintaining Security Systems of equal or higher sophistication and complexity as compared to the system detailed in this specification.
   2. CCAS Manufacturer's manufacturing facilities shall be certified ISO-9000:2000 operations, utilize ISO-9000:2000 manufacturing procedures and maintain their ISO certifications.
   3. CCAS Manufacturer shall employ at a minimum the following methods for QA of component and assembly devices.
      a. Visual inspection of devices shall be performed to verify assembly according to defined procedures. End of line operational tests shall be performed to ensure product functionality has been correctly configured. A system burn-in period shall be utilized to screen for early life failures of electronic components.
   4. Individual functionality and system level regression testing shall be performed to ensure compliance with product specifications. Single and multiple unit system tests shall be performed to mimic end-user installation configurations. Automated hardware and software testing shall be utilized to evaluate system performance under published operational loads and shall be compared to published system capabilities.

E. Access controls and CCTV software experience: The access controls and CCTV system integrator / contractor shall have factory trained personnel from the approved manufacturer with a minimum of 5 years experience in system integration and a minimum of 2 years experience in the proposed access controls and CCTV systems for this project. Submit name of the qualified personnel.

1.6 WARRANTY – MAINTENANCE SERVICES

A. General Requirements: The Contractor shall provide all services required and equipment necessary to maintain the entire CCAS in an operational state as specified for a period of 2 year(s) after formal written acceptance of the system, and shall provide all necessary material required for performing scheduled service or other unscheduled work.

B. Personnel: Service personnel shall be factory certified in the maintenance and repair of the equipment installed under this section of the specification. These personnel shall be the same personnel responsible for service of the main Terminal Building system. The owner shall be advised in writing of the name of the designated service representative, and of any change in personnel.

C. Schedule of Work: Routine service and upgrade work shall be performed during regular working hours, Monday through Friday, excluding holidays at St. George Airport.

1. Inspections: The Contractor shall perform two minor inspections at 6 month intervals (or more often if required by the manufacturer), and two major inspections offset equally between the minor inspections to effect quarterly inspection of alternating magnitude.
2. Minor Inspections: These inspections shall include:
   a. Visual checks and operational tests of all console equipment, peripheral equipment, field hardware, sensors, and electrical and mechanical controls.
   b. Mechanical adjustments if required on any mechanical or electromechanical devices.
   3. Major Inspections: These inspections shall include all work described under paragraph Minor Inspections and the following work:
   a. Clean all CCAS equipment, including interior and exterior surfaces.
   b. Perform diagnostics on all equipment.
   c. Check, walk test, and if required by the manufacturers' maintenance procedures, calibrate each sensor.
   d. Run all system software diagnostics and correct all diagnosed problems.

D. Operation: Performance of scheduled adjustments and repair shall verify operation of the CCAS as demonstrated by the applicable tests of the performance verification test.

E. Emergency Service: The owner will initiate service calls when the CCAS is not functioning properly. Qualified personnel shall be available to provide service to the complete CCAS. The owner shall be furnished with a telephone number where the service supervisor can be reached at all times. Service personnel shall be at site within 4 hours after receiving a request for service. The CCAS shall be restored to proper operating condition within 8 hours after service personnel arrive on site.

F. Records and Logs: The Contractor shall keep records and logs of each task, and shall organize cumulative records for each component, and for the complete system chronologically. A continuous log shall be maintained for all devices. The log shall contain all initial settings. Complete logs shall be kept and shall be available for inspection on site, demonstrating that planned and systematic adjustments and repairs have been accomplished for the CCAS.

G. Work Requests: The Contractor shall separately record each service call request on a service request form. The form shall include the model and serial number identifying the component involved, its location, date and time the call was received, specific nature of trouble, names of service personnel assigned to the task, instructions describing what has to be done, the amount and nature of the materials used, the time and date work started, and the time and date of completion. The Contractor shall deliver a record of the work performed within 5 days after work is accomplished.

H. System Modifications: The Contractor shall make any recommendations for system modification in writing to the Owner. No system modifications, shall be made without prior approval of the Owner. Any modifications made to the system shall be incorporated into the operations and maintenance manuals, and other documentation affected.

I. Software: The Contractor shall provide all software updates during the period of the warranty and verify operation in the system. These updates shall be accomplished in a timely manner, fully coordinated with CCAS operators, shall include training for the new changes / features enabled, and shall be incorporated into the operations and maintenance manuals, and software documentation.

1.7 DELIVERY, STORAGE AND HANDLING

A. CCAS components shall be delivered properly packaged in factory-fabricated type containers or wrappings which properly protect equipment from damage. The Contractor shall be responsible for all damaged equipment due to improper preparation for shipment.

B. Equipment subject to deterioration by humidity at the project site shall be provided with plastic covers forming a vapor seal and an adequate quantity of desiccant. Desiccant shall be either visible or stored in a manner which can be easily reached for inspection and replacement. Equipment so protected shall be noted on the packing list.

C. CCAS components shall be stored in original cartons in a clean dry space protected from weather and construction traffic. The Contractor shall be responsible for observing the equipment manufacturers storage and handling procedures as required to maintain any implied or stated warranty.

D. CCAS components shall be handled carefully to avoid breakages, impacts, denting and scoring finishes. Damaged equipment shall not be installed but returned for replacement.

PART 2 – PRODUCTS

2.1 GENERAL REQUIREMENTS

A. The Computer Controlled Access System (CCAS) as outlined in this section and detailed in Part 2 of this document is the key central component for managing physical security and the bridge between physical and logical security for this project. The system shall provide a variety of integral functions including the ability to regulate access and egress; provide identification credentials; monitor, track and interface alarms; and view, record and store digital surveillance video linked to CCAS events.

B. The CCAS shall be able to seamlessly interface with and monitor intelligent system controllers, reader interface modules, I/O panels, burglar alarm panels, burglar alarm panel receivers, biometric devices, personal protection devices, intercom systems, fire alarm panels (secondary monitoring only), building management systems and digital video recorders approved for use by the CCAS manufacturer.

C. The CCAS shall be able to communicate with intelligent system controllers via RS-485, RS-232, TCP-IP/Ethernet and Dial-up via Modem.

D. Surge Protection
1. All CCAS power lines shall be equipped with surge protection provisions in accordance with ANSI C62.41, "Guide for Surge Voltage in Low Voltage AC Power Circuits," and UL 1449, "Standard for Safety Transient Voltage Surge Suppressors," as applicable.
2. All data communications lines and sensor inputs shall be equipped with surge protection provisions in accordance with IEEE Transaction Volume COM-21, "Lightning Surges in Open Wire, Coaxial and Paired Cables," as applicable.
3. All protection devices shall be self-restoring and non-destructing and online at all times. Protection devices shall respond within 1 nanosecond on data circuits and within 5 nanoseconds on power circuits.

E. Electromagnetic Interferences

1. Noise suppression shall be provided as required for total system immunity from internally and externally generated sources of electromagnetic and RF interference including that from portable two-way radios. Noise suppression provisions shall comply with ANSI C63.12, "Recommended Practice on Procedures for Control of System Electromagnetic Compatibility," as applicable.
2. All CCAS equipment shall comply with the standards for electromagnetic interference in FCC Rules and Regulations, Part 15, Subpart J, "Class A Computing Devices," as applicable.

F. Fabrication
1. All metalwork shall be free of sharp edges, burrs, and other imperfections.
2. The interior and exterior surfaces of all enclosures shall be thoroughly cleaned so that the surfaces are free of all rust, mill, scale, oil, and foreign matter. All non-permanent marks and coatings shall be removed.

2.2 MANUFACTURERS

A. CCAS field hardware, authentication hardware, third party integrated devices, and computer work stations shall operate seamlessly as an extension of the existing system provided for the Terminal Building.

B. Equipment provided shall utilize interchangeable replacement parts and software with the Terminal Building system.

2.3 ACCESS CONTROL FIELD HARDWARE DEVICES

A. General
1. The system shall be equipped with the access control field hardware required to receive alarms and administer all access granted/denied decisions. All field hardware must be designed to meet UL 294 and ULC requirements. Depending upon the configuration, the system field hardware must be able to include any or all of the following components:
   a. Intelligent Field Panels (IFP)
   b. Input Control Module (ICM)
   c. Output Control Module (OCM)
   d. Dual Reader Interface Module (DRI)
   e. Proximity Card Readers
   f. Panel Power Supplies

B. Intelligent Field Panel (IFP)
1. The Intelligent Field Panel (IFP) shall link the CCAS Software to all down-stream field hardware components (RIMs, ICMs and IOMs). The IFP shall provide full distributed processing of access control / Alarm Monitoring rules and operations. A fully loaded and configured IFP with shall respond in less than one-half (0.5) second to grant or deny access to cardholder.
2. The IFP shall continue to function normally (stand-alone) in the event that it loses communication with the CCAS software. While in this off-line state, the IFP shall make access granted/denied decisions and maintain a log of the events that have occurred. Events shall be stored in local memory, and then uploaded automatically to the CCAS database after communication has been restored.
3. In addition, the IFP shall incorporate the following features:
   a. UL 294, ULC, and CE Certified
   b. Support for Host Communications Speed of 38,400 bps
   c. Support for Direct Connect, Remote Dial Up, or Local Area Network (LAN) Connection

d. Support for Dual Path Host Communications - Secondary Path shall be Local Area Network (LAN) Connection, or Remote Dial Up Connection via Lantronix Ethernet controller.
e. Support for up to 32 MB of On-Board Memory, min 6MB.
f. LAN Support shall utilize RJ45 (10/100baseT) Ethernet Interface
g. Flash Memory for real time program updates and overall host communications
h. Support for four 2 wire downstream ports, two 4 wire downstream ports, or combination one 4 wire downstream port and two 2 wire downstream ports. Downstream ports shall be for connecting card readers and data gathering and output control panels via RS-485 multi-drop wiring configuration
i. Memory storage of up to 250,000 card holders and 65,000 transactions.
j. Initial base memory download between IFP with standard memory from the CCAS shall require no more than ten (10) seconds
k. k. Support for up to 32 devices consisting of RIMs, ICMs, and OCMs in any combination desired with a maximum of 16 I/OCM devices
l. Support of multiple card technologies
m. Supervised Communications between IFP and CCAS Software
n. AES 128 bit Symmetrical Block Encryption conforming to the FIPS- 197 standard between IFP and CCAS Software communications driver.
o. Multi drop support for up to eight IFPs per CCAS communications port
p. Support of up to eight card formats and facility codes
q. Support for SEIWG card formats
r. RS-485 Full Duplex, UL 1076 Grade AA communication channel to the CCAS head-end
s. Integration to other manufacturer's card readers
t. Uninterruptible Power Supply (UPS) with battery backup
u. 32-bit Microprocessor
v. Biometric Interface Support
w. An IFP downstream serial port shall multi-drop 16 access control field hardware devices using an RS-485 UL 1076 Grade A communication format allowing a distance of 4,000 feet using Belden 9842 cable or equivalent
x. 12 VDC input power
y. Issue Code Support for both Magnetic and Wiegand Card Formats
z. Individual Shunt Times (ADA Requirement)
aa. Up to four Digit PIN Codes
bb. Downstream serial RS-232 device support
cc. Status LEDs for normal component and communication status
dd. RoHS Compliance

C. Input Control Module (ICM)

1. The Input Control Module shall provide 16 UL 1076 Grade A or AA alarm input zones and monitor / report line fault conditions, alarm conditions, power faults and tampers. Status LEDs shall provide information about the sixteen alarm zone inputs, cabinet tamper, and power fault.
2. In addition, the ICM shall incorporate the following features:
   a. UL 294, ULC, and CE Certified
   b. Alarm contact status scanning at up to 180 times per second for each zone
   c. Eight configuration DIP switches to assign unit addresses and communications speed
   d. Elevator control support for 64 floors
   e. Variable resistor values for line supervision

f. A low power CMOS microprocessor
g. Filtered data for noise rejection to prevent false alarms
h. Up to 16 Grade A, or AA Supervised Inputs in any combination
i. 12 VDC Input Power
j. 2 Form C 2A, 30 VDC Contacts for load switching
k. 2 dedicated inputs for tamper and power status
l. RoHS Compliance

D. Output Control Module (OCM)
1. The Output Control Modules shall provide 12 Form-C 2A 30 VDC relay contacts for load switching. The relays shall be configurable for fail-safe or fail-secure operation. Each relay shall support “On” “Off” and “Pulse”
a. 12 VDC input power
b. Two dedicated digital inputs for tamper and power failure status
c. RS-485 communications, multi-dropped (2-wire or 4-wire RS-485)
d. Up to 16 OCMs per Intelligent System Controller
e. Onboard termination jumpers
f. DIP switch selectable addressing
g. Status LEDs for communication to the host, heartbeat and relay status
h. Elevator control, support for 64 floors
i. RoHS Compliance

E. Dual Reader Interface Module (DRI)
1. The DRI shall provide a dual interface between the IFP and authentication devices. The DRI must operate with any authentication device that produces a standard Wiegand (Data 1 / Data 0 or Clock and Data) communication output.
2. In addition the DRI shall incorporate the following features:
a. 12 VDC power supply
b. Reader communications (Clock/Data or Wiegand Data1 / Data0) - more than 150 different readers approved for use
c. 4 Form-C 2A at 30 VDC relay outputs
d. Up to 16 different formats (8 card and 8 asset)
e. Issue code support for Magnetic and Wiegand formats
f. Door contact supervision (Open / Closed)
g. REX push-button monitor
h. Strike Control output
i. Bi-color status LED support and 2-wire LED support
j. Beeper control
k. Dedicated tamper and power failure circuits
l. Support for offline reader access mode
m. Onboard jumpers for termination
n. Elevator control, native support for 6 floors
o. DIP switch selectable addressing
p. UL 294 listed and CE approved
q. RoHS Compliance

F. Card Readers
1. All readers shall be configured with the card reader and reader interface module mounted separately. The reader interface module shall be mounted in the EIB located on the secure side of the door.
2. Smart Access Control Reader with Keypad: Provide *iCLASS*, contactless smart card reader or equivalent where shown on the drawings. Card reader shall be "single-package" type, combining controller, electronics and antenna in 1 package, in the following configurations:
a. RK40 - Card Reader, Wall Mounting (Single-Gang Mounting Applications):

1) Provide “single-gang” mounting style contactless smart card reader for wall mounting, Vehicle Stanchions and Pedestals, and where shown on plans.
2) The reader shall be of potted, polycarbonate material, sealed to a NEMA rating of 4X (IP65)
3) The reader shall contain an integral magnet for use with an external magnetic reed switch to provide tamper protection when connected to an external alarm system. Provide external magnet reed switch and tamper indication
4) The reader shall be UL/C 294 listed, and shall be FCC and CE certified, and shall conform to the following ISO Standards: 15693, 14443A (CSN read-only), 14443B1 (read-only), and 14443B2
5) Transmit Frequency: 13.56 MHz) The reader shall have an approximate read range of 1 inch to 4.5 inches when used with the compatible access card
7) The reader shall require that a card, once read, must be removed from the RF field for 1 second before it will be read again, to prevent multiple reads from a single card presentation and anti-passback errors.
8) The reader shall be capable of reading access control data from any *iCLASS* contactless smart card or equivalent, and transmitting that data in SIA standard Wiegand format
9) The reader shall be capable of reading the CSN (card serial number B a permanent, unique identification number) from any MIFARE card using the S50 chip or equivalent, and transmitting that data in SIA standard Wiegand format
10) The reader shall be capable of writing to the compatible access card in compliance with ISO 15693 or 14443B2
11) The reader shall provide 1 Wiegand port, for connection to standard access control panels
12) The reader shall provide Internal Control for Read-only Access Control applications, transmitting Wiegand Data.
13) The reader shall have separate terminal control points for the green and red LEDs, and for the audible indicator
14) The reader shall have multiple LEDs for increased visibility
15) The reader shall have a 12-position keypad, with metal keycaps, and backlighted numbers located above each key.
16) The reader keypad shall be rugged, waterproof and backlit, and impervious to liquid spills, dirt, and water spray from any direction.
17) The reader shall be configurable so that keypad data may be sent as individual keystrokes or buffered and formatted in a card data format, as required by the Host System
18) The reader shall allow users to enter a PIN code as a primary, secondary or alternate means of identification, based on configuration of the Host System.
19) The reader shall optionally be configurable to verify the user’s PIN entry locally, based on a comparison with PIN data stored on the user’s card, transmitting Wiegand data to the host only if the PIN code is valid
20) The reader keypad shall have keys of sufficient size and with sufficient separation such that users wearing gloves can easily press the individual keys.
21) The reader keypad shall work in conjunction with the audio

transducer, such that each keypress shall produce a click or beep signifying that the keypress was received by the microprocessor.

22) The reader keypad should have definite tactile “snap” when depressed, giving the user confirmation that the key was pressed correctly.
23) The reader shall have an audio transducer capable of producing unique tone sequences for various status conditions
24) The reader shall have a configurable hold input, which when asserted shall either buffer a single card read or disable the reader, until the line is released. This input may be used for special applications or with loop detectors
25) Access control data shall be protected using 64-bit diversified security keys, encrypted RF data transmission, and mutual authentication using a proprietary symmetrical key-based algorithm.
26) Security keys in the cards and readers shall be required to match, and may be customized for individual sites by using the *iCLASS* Card Programmer (or equivalent) or by special order from the factory
27) The reader shall have flash memory to allow future feature enhancements to be added in the field
28) The reader shall have a lifetime warranty against defects in materials and workmanship
29) Color shall be selected by the Architect: gray, black or white
30) HID Model RK40, or equivalent, compatible with selected card media.

b. Biometric Card Reader

1) Reader shall use the combination of the fingerprint and *iCLASS* contactless smart card technology from HID. Both the fingerprint and *iCLASS* technology shall be designed to meet the needs of access control. The card reader shall be as manufactured by Bioscript or HID.
2) Reader shall offer a RS-232, RS-485 and Weigand connection.
3) Using the ISO 7816 protocol, the standard for contact smart card applications, the RWKLB575 allow connection to a PC or microcontroller to support read/write applications. Provide RS-232 to USB converter.
4) Keypad: Offers twelve discrete switches with metal keycaps. Raised tactile mark on "5" key for visually impaired users. Configurable audio feedback. Backlit numbers in bezel overlay, above each key. Lighting is configurable: "Always On", "Always Off", "Triggered by Card Read", or "Triggered by Key Press".
5) User Function Keys: Four programmable user function keys with metal keycaps. User function keys are available with factory default settings or can be customized. In either case, user function keys are easily defined in the graphical LCD display.
6) Security: 64 bit authentication keys are extremely secure. Readers and cards require matching keys to function. All RF data transmission between the card and keypad reader is encrypted, using a secure algorithm. The key management system reduces the risk of compromised or duplicated cards.
7) Cards and keypad readers with site-specific keys shall be provided from the factory
8) Audiovisual Indication: Audio transducer provides configurable

tone sequences to signify access granted, access denied, power up, and configuration card read. A light bar provides a clear visual status indication in red, green, or amber. All units contain an LED to light the sensor area if the biometric option is included.

9) Graphical Display: The backlit graphical LCD display offers a 60 x 18 mm viewing area, 120 x 32 resolution. It is factory preset to provide written instructions to the user. Fully customizable, the display also describes the function of the user function keys.

10) Indoor Design: Rugged, weatherized polycarbonate enclosure provides reliable performance and resistance to vandalism. Permanent magnet built into housing facilitates tamper alarm when used with a magnetic reed switch.

11) Enrollment: Enrollment software and a reader unit shall be provided to write the biometric template to the cards. The template never enters the PC – it is collected by the reader and written to the *iCLASS* card all in one simple process. To alleviate privacy and database management concerns, the biometric template is stored on the *iCLASS* card rather than in the unit.

12) *iCLASS* Credential Compatibility: The reader shall be compatible with all *iCLASS* credentials. The units shall read or read/write to credentials compatible with several ISO standards including:
    a) 15693 - read/write; 2kbits (256Bytes) and 16kbits (2kBytes) *iCLASS* credentials.
    b) 14443A - read only; MIFARE® Standard (serial number), Ultralight, or DESFire™.
    c) 14443B2 - read/write; 16kbits (2kBytes) *iCLASS* credentials.

13) Reader shall be HID Model RWKLB575 with high security key management and programmable LED/Beeper/LCD key operation or approved equal.

G. Field Hardware Power Supplies: Power Supplies for field hardware shall be designed specifically for the equipment installed. These power supplies shall be regulated, isolated versions for the IFP, ICM, Card Readers and other equipment. Each shall be available in UPS with battery back-up. All power supplies shall be housed in locked enclosures that also allow mounting space for the IFP, ICM, DRI or other device / panel required.

H. Audible Annunciators
1. The audible annunciators and associated volume and reset controls shall be rack-mounted.
2. The audible annunciators shall not conflict with other audible signals at the SCC.
3. Each audible annunciator shall provide a maximum sound output of at least 60 dbA at 1 foot.

I. Local Audible Annunciators
1. Local audible annunciators shall be self-contained units of rugged, vandal-resistant construction.
2. Each annunciator shall incorporate the following features, as a minimum:
    a. Audible alarm.
    b. Visual indicator with a solid-state flasher.
    c. Solid-state power supply.
    d. Contacts for remote reset.
    e. Operates on low voltage dc.
3. The audible alarm shall provide a sound output of at least 60 dbA at 1 foot.

2.4 SURVEILLANCE AND ASSESSMENT SUBSYSTEM (SAS)

A. System Description: Video

1. Provide a complete and operational IP-based Digital Video Management System (IPDVMS) as specified here and shown on the drawings.
2. IPDVMS shall provide the following functions:
   a. IPDVMS shall store video from video cameras. Provide access to video in real-time ("live"), and stored on computer-based storage devices for review at a later time.
   b. Recorders and servers will consist of rack-mountable PCs connected to a LAN.
   c. Video and other data managed by the IPDVMS accessible from workstation PCs connected directly to the LAN, WAN or modem connections.
   d. Includes GUI software designed to run on PCs equipped with the Microsoft Windows latest operating system.
   e. GUI application software functions include system setup, administration and monitoring; live video viewing and PTZ camera control; video playback; video export; alarm monitoring; and other capabilities as detailed in the following paragraphs.
   f. Provide access and control cameras via wireless handheld devices.
3. Compatibility with Digital Video Equipment: The IPDVMS shall be designed to work with a wide variety of IP Cameras. The recorders shall utilize a standard Ethernet connection for video input via TCP/IP.
4. Scalability and Expandability:
   a. Cameras: The IPDVMS family of products to include cost-effective solutions for any number of cameras including large sites with 1000 or more cameras in a single system.
   b. Storage: The IPDVMS to support a wide range of automated storage options ranging from as little as a few hours of online storage capacity to months of long-term storage using digital tape or other cost-effective long-term storage media.
   c. Workstations: The IPDVMS shall be a distributed, multiuser, multitasking system capable of supporting simultaneous requests from multiple workstations.
   d. Sites: The IPDVMS shall be capable of supporting large organizations with systems at multiple sites connected via LAN, WAN or dial-up modem connections.

2.5 CONTROLLED ACCESS SUBSYSTEM (CAS)

A. Card Reader Electronics Interface Box (EIB)

1. Each card reader EIB shall consist of a tamper-resistant enclosure equipped with a tamper switch and a UL-approved cylinder lock (per UL 437, "Key Locks"). The card reader EIB shall normally be mounted on the secure side of each card reader-controlled access point. Mounting screws for surface mounting shall be provided inside the enclosure or, if exposed, shall be tamper-resistant requiring a special tool for removal.
2. Card reader EIBs shall incorporate the required local power supply and battery backup unit equipment for operating the card reader(s), and the associated electrical locking device(s) at card reader controlled access points. A trouble signal shall be provided to indicate failure of any portion of this power supply equipment.
3. Each card reader EIB shall be capable of supplying power to a minimum of 2 card reader controlled access points. Power cabling from the card reader EIB to the card reader shall be a maximum of 50 feet.

B. Exit Pushbutton
   1. Each exit pushbutton shall consist of a momentary switch within an enclosure. Mounting screws for surface mounting shall be provided inside the enclosure or, if exposed, shall be tamper-resistant requiring a special tool for removal.
   2. Each switch shall provide 1 set of normally open and normally closed contacts. The switches shall be rated for a minimum of 1,000,000 activations without malfunction.
   3. The exit pushbuttons shall be provided with a 1-1/2 inch mushroom button.

C. Panic Hardware (Push Bars) - Refer to access point schedule for scope of work in the terminal contract.
   1. Push bars shall be external surface-mounted rim devices, UL-listed for accident hazard installations.
   2. Each push bar shall incorporate the following features, as a minimum:
      a. Nonhanded.
      b. Field sizeable.
      c. Both time delay exit and lock/unlock operation
   3. Each push bar shall be provided with a surface-mounted rim strike with a signal switch. The signal switch shall be a normally open momentary switch rated for a minimum of 1,000,000 activations without malfunction.
   4. The device finish shall match existing door hardware.

D. Signage - Refer to access point schedule for scope of work in the terminal contract.
   1. Signage shall be provided as indicated on the drawings at selected access points to provide information for the users.
   2. Signs shall be black acrylic plastic with graphics silk-screen applied to the back side of the sign. Lettering shall be white Helvetica medium. Signs shall be square, with rounded corners and white border line. Provide samples of the signs for approval.
   3. The signs shall be applied with adhesive tape to the door or to metal plates which are mechanically attached on the wall adjacent to the door at a height of 5 feet, 7 inches as follows:
      a. Wood screws for anchoring to wood.
      b. Toggle bolts for anchoring to hollow masonry or gypsum board.
      c. Expansion shields and lag bolts for anchoring to concrete or solid masonry.

E. Gate Control Panels
   1. Each gate control panel shall consist of a tamper-resistant weatherproof NEMA 4X (stainless steel) enclosure equipped with a tamper switch and a UL-approved cylinder lock (per UL 4379 "Key Locks") or padlock. The gate control panel shall normally be mounted on the secure side of the card reader-controlled vehicle gate. Mounting screws for surface mounting shall be provided inside the enclosure or, if exposed, shall be tamper-resistant requiring a special tool for removal.
   2. The gate control panel shall incorporate the required local power supply and battery backup equipment for operating the card reader(s), PINpad(s), and gate operator at card reader-controlled vehicle gates. A trouble signal shall be provided to indicate failure of any portion of this power supply equipment.
   3. The gate control panel shall be provided with a heating element to assure continued gate operation during severe cold temperatures.
   4. A concrete foundation shall be provided for the gate control panel.

2.6 INTRUSION DETECTION SUBSYSTEM (IDS)

A. Balanced Magnetic Switches

1. Balanced magnetic switches will be designed for intrusion detection in security applications.
2. Each balanced magnetic switch will consist of 2 cast nonferrous metal enclosures. Mounting screws for surface mounting will be provided inside the enclosure or, if exposed, will be tamper resistant requiring a special tool for removal. Each magnet will be 778ALNICO V or better.
   a. The switch enclosure will be mounted on the door frame or other non-movable surface. Each switch enclosure will contain a reed switch, an adjustable bias magnet, a tamper switch, and 1 set of normally open and normally closed contacts. (Note: In lieu of a tamper switch, the enclosure may be encased in epoxy.) Arc protection will be provided to prevent the reed switch from being fused together by transient current conditions. Each switch will be rated for a minimum of 1,000,000 activations without malfunction. The switch enclosure will be provided with a 1/2-inch threaded conduit connector at one end.
   b. The magnet enclosure will be mounted on the door or other movable surface, so that when the door is closed, the magnet will be within 1 inch of the reed switch.
3. Balanced magnetic switches will comply with the applicable requirements of UL 634, Connectors and Switches for Use with Burglar-Alarm Systems and UL 639, Intrusion Detection Units.

B. Gate Position Switches

1. Gate position switches shall be designed for wide gap (up to 3 inches) applications.
2. Each gate position switch shall consist of 2 cast nonferrous metal enclosures. Mounting screws for surface mounting will be provided inside the enclosure or, if exposed, shall be tamper resistant requiring a special tool for removal. Each magnet shall be ALNICO V or better.
   a. The switch enclosure shall be mounted on the fence post or other non-movable surface. Each switch enclosure shall contain a reed switch, an adjustable bias magnet, a tamper switch, and 1 set of normally open and normally closed contacts. (Note: In lieu of a tamper switch, the enclosure may be encased in epoxy.) Arc protection shall be provided to prevent the reed switch from being fused together by transient current conditions. Each switch shall be rated for a minimum of 1,000,000 activations without malfunction. The switch enclosure shall be provided with a 1/2-inch threaded conduit connector at one end.
   b. The magnet enclosure shall be mounted on the gate post or other movable surface, so that when the door is closed, the magnet shall be within 1 inch of the reed switch.
3. Gate position switches shall comply with the applicable requirements of UL 634, Connectors and Switches for Use with Burglar-Alarm Systems and UL 639, Intrusion Detection Units.

C. Tamper Switches

1. Each tamper switch shall consist of a single-pole, double-throw momentary switch rated for 5 amps at 120 volts. Each switch shall be rated for a minimum of 1,000,000 activations without malfunction.
2. Tamper switches shall comply with the applicable requirements of UL 634, Connectors and Switches for Use with Burglar-Alarm Systems and UL 639, Intrusion Detection Units.

D. End-of-line Termination Networks

1. End-of-line termination networks required to provide the proper impedance for supervision specified in Paragraph 1.09G.5 shall be provided on printed circuit cards. A terminal block shall be provided on each card for connection to the individual devices.

E. Duress Alarm Devices
1. Each duress alarm device shall consist of a momentary switch and a tamper-resistant enclosure.
2. The momentary switch shall be rated for 1,000,000 activations. The switch shall be provided with a latched output.
3. Mounting screws for surface mounting shall be provided inside the enclosure or, if exposed, shall be tamper-resistant requiring a special tool for removal.
4. The duress alarm devices shall be hand-actuated.

2.7 UNINTERRUPTIBLE POWER SUBSYSTEM (UPS)

A. Uninterruptible Power Supply (UPS) Units
1. Refer to specification Section 263353 for details.

B. Battery Backup Units for IFP, EIB and Gate Control Panels.
1. Each battery backup unit shall incorporate an inverter, battery charger, batteries and a sensing and transfer relay housed in a cabinet.
2. The battery backup unit inverters shall be the filtered rectangular waveform type with an efficiency of not less than 80 percent at 0.9 power factor, full load and rated output.
3. The battery chargers shall be solid-state and designed for taper charge operation.
4. Batteries shall be completely sealed and ready for service. The batteries shall be capable of accommodating a minimum of 500 full discharges / recharges.
5. The sensing and transfer relays shall monitor the ac input and initiate a transfer to the battery supply upon failure or low voltage. Transfer shall be automatic and shall be completed within 20 milliseconds. The sensing and transfer relays shall continue to monitor battery voltage and shall disconnect the load if the voltage drops below 85 percent of its rated output.
6. Front panel indication of critical status information shall be provided with contacts for remote monitoring via the DPS. A local audible signal shall be provided for off-normal conditions.

2.8 MAINTENANCE AIDS AND SPARE PARTS

A. Nonstandard Test Equipment, Tools, Adaptors and Fittings
1. One set of all special or nonstandard test equipment, tools, adaptors and fittings required to install, maintain and service the CCAS shall be provided to include card extenders for each different type of printed circuit card in the system, tools for removing tamper resistant screws and a portable IFP analyzer.
2. The portable analyzer unit shall be able to test the IFPs in either an on-line or off-line mode. This unit shall be capable of exercising all devices connected to the IFP and all functions of the IFP itself.
3. All test equipment and tools provided shall be new, unused, of first-class quality and of suitable material.
4. All test equipment and special tools furnished shall be provided with complete operating instructions.

B. Spare Parts

1. Provide spare parts in the amount of 10% of all hardware furnished on the project. The spare parts shall include, but not be limited to, mag locks, card readers, power supplies, balance magnetic contacts, REX switches, tamper switches and other similar components.
2. Provide at least one quantity when 10% results in a quantity of lss than one.
3. Provide two IFP panels completely equipped to support six card readers.
4. Provide two IFP hardware components located in the gate control terminal cabinets.
5. Provide two network switches located in GCTC cabinet.

2.9 SOFTWARE REQUIREMENTS

A. Local and device firmware and software shall match corresponding firmware and software installed for Terminal Building system.

B. Contractor shall be responsible for all required software licenses.

C. The CCAS shall be supplied with 2 complete sets of software and firmware (running and backup), compiled after the completion of the Field Verification Test

PART 3 - EXECUTION

3.1 INSTALLATION REQUIREMENTS

A. Examination
1. The Contractor shall examine areas and conditions under which the CCAS components are to be installed and notify SGU, in writing, of conditions detrimental to proper completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected in an acceptable manner.

B. Installation
1. CCAS components shall be installed in accordance with equipment manufacturer's written instructions, in compliance with NFPA 70, "National Electrical Code (NEC)," and ANSI C2, "National Electrical Safety Code," and with recognized industry practices, to ensure that the CCAS meets all requirements stated herein and serves its intended purposes.
2. The Contractor shall coordinate installation of CCAS components with work performed by others.
3. Surface-mounted equipment shall be securely fastened to indicated structural supports. The Contractor shall ensure that this equipment is plumb and level.
4. Connectors and terminals, including screws and bolts, shall be tightened in accordance with equipment manufacturer's published torque tightening values. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with the tightening torques specified in UL 486A/13, "Wire Connectors and Soldering Lugs for Use with Copper / Aluminum Conductors," and the NEC.

C. Grounding
1. Equipment grounding connections for CCAS components shall be provided. Ground connections shall be tightened to comply with the tightening torques specified in UL 486A to assure permanent and effective grounds.
2. The Contractor shall ensure and demonstrate that resistance to solid earth for signals is less than, or equal to, 3 ohms.

D. Adjusting and Cleaning

1. Upon completion of installation of CCAS components, the Contractor shall set all field-adjustable controls/components and align and calibrate all equipment for the required performance and operation as specified herein.
2. The Contractor shall touch-up scratched and marred surfaces to match the original finishes.
3. Installed CCAS components shall be protected from damage during the remainder of the construction period.

E. Field Quality Control
1. Prior to energization, the Contractor shall test all field-run wires and cables for electrical continuity and short circuits and to ensure proper polarity of all connections.

3.2 INSPECTIONS AND TESTS

A. Inspections
1. The prime responsibility for inspection of all materials and work furnished by the Contractor pursuant to the Contract rests with the Contractor. The inspection or waiving of inspections by the airport shall not relieve the Contractor of any obligations or responsibilities to perform in accordance with the Contract.
2. The Contractor shall assure that components procured from Subcontractors comply with the requirements of the Contract. Suggested methods of providing this assurance are audits of the Subcontractor and its Quality Control program or receipt inspections and tests designed to demonstrate that the device(s) functions property and complies with the specified requirements. The airport's "release" of any materials being furnished by the Contractor's Subcontractors shall not be construed to imply acceptance of same in the end product and shall not in any way relieve the Contractor of its responsibility of inspection.
3. The Contractor shall cooperate fully with St. George Airport's representatives and shall grant St. George Airport free access to all documents and work areas which the airport deems necessary to perform thorough and meaningful tests and observations. The airport's representatives shall have the right to inspect the equipment, workmanship, labor, -testing procedures and any other item or task performed, furnished or used by the Contractor under the Contract, and the airport may reject, without cost or liability, any which are defective or unsuitable for the use and purposes intended or which are not in accordance with the intent of the Specification. The Contractor, upon demand by the airport, shall remedy or replace, at the Contractor's expense, such defective or unsuitable equipment or performance item. The Contractor shall act promptly to obtain the airport's approval of corrective or remedial action(s) and shall implement these actions promptly after receipt of St. George Airport's approval.
4. The Contractor shall give the airport's representatives at least 10 working days notice of events or conditions specifically requested by the representatives. Where specific inspections are required, the work involved shall not proceed beyond that point until the representatives have made or waived such inspection. The Contractor shall provide the representative with appropriate drawings and technical documentation for use during the inspection visits, as required.

B. Field Verification Tests
1. Field tests to verify that the system hardware and software, as approved for shipment, function in the same demonstrated manner after installation of the CCAS will be performed by SGU at the site. The Contractor shall provide any technical assistance required during the tests. A test procedure will be developed by Contractor and reviewed by SGU, prior to performance. These tests shall be performed on the entire system.

2. Where possible, malfunctioning components shall be corrected at the site; otherwise, the Contractor shall remove and replace. Upon correction / replacement, the component shall be retested.
3. System hardware acceptance will be provided by SGU upon satisfactory completion of the approved system hardware verification tests at the site.
4. System software acceptance will be provided by SGU upon satisfactory completion of the approved system software verification tests at the site.

C. Availability Test

1. The Contractor shall demonstrate a continuous operation of the CCAS at the site over a period of 1,440 hours with an availability of 99.5 percent or more to include all supplied hardware and software. This shall be demonstrated after the Field Verification Test of the CCAS.
2. Availability shall be calculated as follows:
   Availability = Percent (TDT - AOT) x 100 TDT where:
   a. Test Duration Time (TDT) is the total elapsed time from start of the test to completion of the test. This time shall be a minimum of 1,440 hours. The TDT shall equal the time the WAS is undergoing testing less the time allocated for pre-scheduled preventive maintenance as required by the Contractors maintenance manual.
   b. Accumulate Outage Time (AOT) is the total amount of time after start of the test when any part of the system or its function are not available (downtime) as specified below.
3. Downtime shall be calculated according to the following rules:
   a. The duration of any outage shall be calculated from the time that a functional deficiency is first recognized to the time the deficiency has been corrected to the satisfaction of SGU.
   b. If an intermittent failure (those which occur and then disappear 3 or more times) occurs, the problem shall be isolated and repaired. The system shall be considered unavailable while corrective maintenance is being performed.
   c. Central processor failure not specifically attributed to system hardware malfunctions shall be considered a system failure and downtime shall be accumulated when it occurs at any rate greater than once per week.
   d. No minimum time shall be charged against any occurrence.
   e. All time shall be recorded to the nearest minute.
   f. In the event of the failure of existing equipment, site conditions and / or accidental operator damage to the equipment caused by actions of SGU, its agents or employees, the effect of which is to render the equipment unavailable as described above, the testing shall cease. Upon return to normal operation, the testing shall begin again. No downtime shall be accumulated during this outage.
4. The CCAS shall be considered available under the following conditions:
   a. Loss of the primary central processor or any on-line memory section or I/O controller attributable specifically to hardware malfunction if backup units or features are automatically activated and all lost functions are successfully transferred to an operating unit without disruption of any real-time functions of the CCAS.
   b. Loss of either 1 printer or 1 VDT at the SCC attributable specifically to hardware malfunction, if the other display/printing items are operational during the outage.
5. Commencement of the Availability Test shall be mutually agreed upon, but in no event shall it start prior to SGU's receipt and review of all manuals, working drawings and software documentation, unless prior waiver is obtained from SGU. In addition, the test shall not begin until training of SGU's operating personnel has

been completed, recommended spare parts purchased by SGU are in stock and all scheduled preventive maintenance has been completed.

6. In the event that the AOT exceeds 22 hours, the start time shall be shifted to delete some of the earliest outages until the accumulated outages during the 1,440-hour test no longer exceed 20 hours. The shifted start date time shall be mutually agreed upon between SGU and the Contractor. No time shift shall be permitted until at least 25 percent (1100 hours) of the test has been completed.
7. A new test shall be started if major modifications are required to either hardware or software in order to conform to specified functional requirements.
8. The CCAS shall be maintained (parts and labor included) by the Contractor at its expense until completion of a successful Availability Test.
9. The Contractor shall provide a service representative on call 24 hours a day, 7 days a week for the duration of the Availability Test. The contractor has an option for on site availability of service representative or other appropriate means to ensure successful availability test as specified.
10. The CCAS must be operating at 100 percent at the end of the test.
11. During the Availability Test:
    a. Alterations to software shall not be permitted unless required to correct an error and SGU's approval is obtained.
    b. Alterations to the hardware shall not be permitted unless required to correct a failure or, if in the opinion of the Contractor, such changes will improve system reliability.
    c. SGU shall be permitted to verify system performance as specified.
    d. Any redesign or modification to the system that is a result of the Availability Test shall be made to and documented for all equipment supplied under the Contract.

3.3 TRAINING AND INSTRUCTION

A. General

1. The Contractor shall provide on-site training for operating, servicing and programming personnel designated by SGU and end-users (employees and tenant personnel).
    a. Operating personnel shall receive detailed instruction in operating procedures, routine preventive maintenance and routine servicing of console and terminal equipment. The training of operating personnel shall be completed prior to the start of the Availability Test.
    b. Servicing personnel shall receive detailed instruction in principles of operation, setup, adjustment, routine preventive maintenance, diagnosis and corrective repair of all CCAS equipment. The training of servicing personnel shall be completed at least 180 days prior to the end of the maintenance period.
    c. Programming personnel shall receive detailed instruction in software architecture, addressing and instructions, device capabilities and program capabilities. The training of programmers shall be completed at least 180 days prior to the end of the maintenance period.
    d. End-users shall receive detailed instruction in the operation and use of CCAS access point equipment.
2. Training shall be conducted by experienced, knowledgeable personnel, supported by modern training aids and shall utilize the actual system being supplied as much as possible. Participants shall receive individual copies of all pertinent technical manuals and documentation which apply specifically to the CCAS hardware and software.
3. Each training program shall be video-taped by the Contractor for use by SGU for future training.

4. Training shall be scheduled at the convenience of SGU.

B. Operator Training

1. Operating personnel must be familiar with the scope, operation and capabilities of the CCAS. This training shall include system concepts, general design features and detailed familiarization with the man machine interface. This training must be reinforced with hands-on experience on all equipment. All operator courses shall be conducted at the site and must be structured to minimize the length of the instructional periods. It shall be necessary to repeat each course several times to accommodate all personnel on each shift.
2. The Contractor shall provide the operator training for up to 20 of SGU's personnel. This course shall have a duration of at least 1 week.

C. Maintenance Training

1. SGU's servicing personnel shall attend courses designed to instruct them in the internal operations of the CCAS hardware and in diagnostic software. It is expected that the courses will be divided into a series pertinent to maintenance and troubleshooting on the console and terminal equipment including the central processors, peripherals and communications hardware and a series pertaining to field devices (IFPs, card readers, CCTV cameras etc.). This will permit selective assignment of personnel by SGU to optimize the skills of the maintenance staff.
2. Maintenance training courses shall include operation and troubleshooting using both test hardware and diagnostic programs and failure repair of actual system hardware. If actual system hardware is not available, an equivalent hardware system which simulates as closely as possible the system supplied, may be used in the training process.
3. The maintenance training program offered by the Contractor shall familiarize SGU's personnel with a comprehensive preventive maintenance program structured specifically for the system supplied.
4. The Contractor shall provide the hardware training for up to 20 of SGU=s personnel.

D. Software Training

1. The Contractor's software training program shall familiarize SGU's programming personnel with off-line and on-line procedures for generation and modification of programs and the database, operation of peripherals, use of documentation, use of the Programmer's terminal, start-up and shut-down procedures, the use of off-line and on-line diagnostics and other pertinent operating, maintenance and development procedures. The courses shall include:
   a. A course offering a detailed study of the specialized software supplied by the Contractor and the detailed logical structure of all standard software used by the system. Add No.2 Item 4.C
   b. A course detailing the programming required to expand the database to include new monitored points, new security area access points and new types of I/O devices.
2. The Contractor shall provide the software training for up to 20 of SGU's personnel.

E. End-user Training

1. Airport employees and tenant personnel shall attend courses designed to instruct them in the proper operation of each access point type and in the use of its associated CCAS equipment. The course shall cover normal and emergency access procedures.
2. The end-user course shall be repeated a sufficient number of times to accommodate all individuals assigned an ID badge / keycard.

F. ID Badge / keycard Preparation Training
   1. SGU personnel shall attend courses designed to instruct them in the preparation, encoding, printing, and controlling ID badges and Keycards.
   2. The training shall have a minimum duration of 1 week, and shall occur 60 days prior to activation of the system.
   3. The Contractor shall provide the ID badge / keycard preparation training for up to 20 of SGU's personnel.

3.4 MAINTENANCE SERVICES (WARRANTY)

A. The Contractor shall provide "on-call" warranty maintenance service for all equipment supplied under this Contract for two years after acceptance of the entire CCAS (hardware and software) by SGU. The service shall consist of all material, labor and travel expenses, as indicated in paragraph 1.10 “Maintenance Services” of this section.

END OF SECTION 137022

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SECTION 142100 — ELECTRIC TRACTION ELEVATORS

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes: Electric Traction Elevators.

Work Required:

1. The work required under this section consists of all labor, materials and services required for the complete installation (including operational verification) of all the equipment required for the elevator(s) as herein specified.

2. All work shall be performed in a first class, safe and workmanlike manner.

3. In all cases where a device or part of the equipment is herein referred to in the singular, it is intended that such reference shall apply to as many of such devices or parts as are required to make complete installation.

Related work not specified herein: The specifications sections contain requirements that relate to this section and are performed by trades other than the elevator manufacturer/installer. Contractor shall coordinate all trades as it relates to this section.

B. Products Supplied But Not Installed Under this Section:
1. Hoist Beam
2. Pit Ladder

C. Work Supplied Under Other Sections:
1. Temporary lighting, including temporary lighting in hoistway for machine space with switch located in hoistway on the strike jamb side of top landing door.
2. Hoistway ventilation shall be in accordance with local and national building code requirements.
3. Guide Rail Support shall be structurally adequate to extend from pit floor to top of hoistway, with spans in accordance with requirements of authority having jurisdiction and final layouts.
4. Removable barricades at all hoistway openings, in compliance with OSHA 29 CFR 1926.502 in addition to any local code requirements.
5. Lifeline attachments capable of withstanding 5000 lb load in accordance with OSHA 29 CFR 1926.502. Provide a minimum of 2 at the top, front of each hoistway.
6. Pit lighting: Fixture with switch and guards. Provide illumination level equal to or greater than that required by ASME A17.1/CSA B44 2000, or applicable version.
7. Control space lighting with switch. Coordinate switch with lighting for machine space as allowable by code.
8. Access Doors: As required for access to governor. Access door shall be self-closing, self-locking if necessary and operable from the inside without a key.

D. Related sections:
1. Section 015000 – Construction Facilities and Temporary Facilities and Controls
2. Section 312000 –Earth Moving
3. Section 033000 – Cast-in-Place Concrete
4. Section 055000 - Metal Fabrications
5. Section 071700 - Bentonite Waterproofing
6. Division 23 – Mechanical
7. Section 283111 – Digital, Addressable Fire Alarm System

E. Industry and government standards:
   1. ICC/ANSI A117.1 Accessible and Usable Buildings and Facilities
   2. ADAAG - Accessibility Guidelines for Buildings and Facilities
   3. ANSI/NFPA 70, National Electrical Code
   4. ANSI/NFPA 80, Standard for Fire Doors and Fire Windows
   5. ASME/ANSI A17.1, Safety Code for Elevators and Escalators.

1.02 DESCRIPTION OF ELEVATOR

A. Elevator Equipment: KONE EcoSpace™ gearless traction elevator

B. Equipment Control: KCM831

C. Quantity of Elevators: 1

D. Landings: 4

E. Openings: 5 Front Openings, 0 Back Openings

F. Travel: 28'-0"

G. Rated Capacity: 2500 lbs (1134 kg)

H. Rated Speed: 150 fpm

I. Clear Inside Dimensions (W x D): 6'-8" x 4'-3"

J. Cab Height: 8'

K. Clear height under suspended ceiling: 7'-7"

L. Entrance Width & Type: 3'-6" & Left Opening

M. Entrance Height: 7'

N. Main Power Supply: 480 Volts + 5%, three-phase

O. Operation: Simplex

P. Machine Location: Inside the hoistway mounted on car guide rail

Q. Control Space Location: Remote Closet

R. Elevator Equipment shall conform to the requirements of seismic zone: Non-Seismic

S. Maintenance Service Period: None

T. 6.9 Horsepower

1.03 PERFORMANCE REQUIREMENTS

1.04 SUBMITTALS

A. Product Data: Submit manufacturer's product literature for each proposed system.
   1. Cab design, dimensions and layout.
   2. Layout, finishes, and accessories and available options.

3. Controls, signals and operating system.
4. Color selection charts for cab and entrances.

B. Shop Drawings shall be signed and sealed by a Professional Engineer licensed in the State of Virginia.
1. Clearances and travel of car.
2. Clear inside hoistway and pit dimensions.
3. Location and layout of equipment and signals.
4. Car, guide rails, buffers and other components in hoistway.
5. Maximum rail bracket spacing.
6. Maximum loads imposed on building structure.
7. Hoist beam requirements.
8. Location and sizes of access doors.
9. Location and details of hoistway door and frames.
10. Electrical characteristics and connection requirements.

C. Operation and maintenance data:
1. Provide manufacturer's standard maintenance and operation manual.

1.05 QUALITY ASSURANCE

A. Manufacturer: Minimum of ten years experience in the fabrication, installation and service of elevators of the type and performance of the specified. The manufacturer shall have a documented quality assurance program.

B. Installer: The equipment manufacturer shall install the elevator.

C. Inspection and Testing: In accordance with requirements of local jurisdiction, obtain required permits, inspections and tests.

1.06 DELIVERY, STORAGE AND HANDLING

A. If the construction site is not prepared to receive the elevator equipment at the agreed ship date, the General Contractor shall be responsible to provide a safe, dry, and easily accessible storage area on or off the premises. Additional lablor costs for double handling will be the responsibility of the general contractor.

B. Delivered elevator materials shall be stored in a protected environment in accordance with manufacturer recommendations. A minimum storage area of 10 feet by 20 feet is required adjacent to the hoistway.

1.07 WARRANTY

A. Provide manufacturer warranty for a period of one year. The warranty period is to begin upon Substantial Completion of the Contract. Warranty covers defects in materials and workmanship. Damage due to ordinary use, vandalism, improper or insufficient maintenance, misuse, or neglect do not constitute defective material or workmanship.

1.08 MAINTENANCE SERVICE

A. The elevator manufacturer shall provide maintenance service consisting of regular examinations and adjustments of the elevator equipment for a period of 12 Months after date of substantial completion. Replacement parts shall be produced by the original equipment manufacturer.

B. Maintenance service be performed during regular working hours of regular working days and

shall include regular time call back service.

C. Maintenance service shall not include adjustments, repairs or replacement of parts due to negligence, misuse, abuse or accidents.

PART 2 PRODUCTS

2.01 MANUFACTURER

A. Provide AC gearless machine room-less elevator systems subject to compliance with the design and performance requirements of this specification. Elevator manufacturers may include but are not limited to one of the following:
1. Basis of Design: EcoSpace™ traction elevators by KONE, Inc. (www.kone.com).
2. Other acceptable machine room-less products:
a. Otis Elevator Co. - Gen2™ Product
b. Schindler Elevator Corp. - 400A Product

2.02 EQUIPMENT: CONTROL COMPONENTS AND CONTROL SPACE

A. Controller: Provide microcomputer based control system to perform all of the functions.
1. All high voltage (110V or above) contact points inside the controller cabinet shall be protected from accidental contact in a situation where the controller doors are open.
2. Controller shall be separated into two distinct halves; Motor Drive side and Control side. High voltage motor power conductors shall be routed and physically segregated from the rest of the controller.
3. Provide a serial cardrack and main CPU board containing a non-erasable EPROM and operating system firmware.
4. Variable field parameters and adjustments shall be contained in a non-volatile memory module.

B. Drive: Provide Variable Voltage Variable Frequency AC drive system to develop high starting torque with low starting current.

C. Controller Location: Within 100'-0" (30.48m) Controller(s) shall be located in a remote cabinet or room within 140"-0" (42.6 m) wire feet of the elevator machine.

2.03 EQUIPMENT: HOISTWAY COMPONENTS

A. Machine: AC gearless machine, with permanent magnet synchronous motor, direct current electro-mechanical disc brakes and integral traction drive sheave, mounted to the car guide rail at the top of the hoistway.

B. Governor: Friction type over-speed governor rated for the duty of the elevator specified.

C. Buffers, Car and Counterweight: Polyurethane buffer.

D. Hoistway Operating Devices:
1. Emergency stop switch in the pit
2. Terminal stopping switches.
3. Emergency stop switch on the machine

E. Positioning System: System consisting of magnets and proximity switches.

F. Guide Rails and Attachments: Steel rails with brackets and fasteners.

2.04 EQUIPMENT: HOISTWAY ENTRANCES

A. Hoistway Entrances
   1. Sills: extruded.
   2. Doors: Hollow metal construction with vertical internal channel reinforcements.
   3. Fire Rating: Entrance and doors shall be UL fire-rated for 1-1/2 hour.
   4. Entrance Finish: Brushed Stainless Steel.
   5. Entrance Markings Jamb Plates: Provide standard entrance jamb tactile markings on both jambs, at all floors. Plate Mounting: Refer to manufacturer drawings.

2.05 EQUIPMENT: CAR COMPONENTS

A. Car Frame: Provide car frame with adequate bracing to support the platform and car enclosure.

B. Platform: Platform shall be all steel construction.

C. Car Guides: Provide guide-shoes mounted to top and bottom of both car and counterweight frame. Each guide-shoe assembly shall be arranged to maintain constant contact on the rail surfaces. Provide retainers in areas with Seismic design requirements.

D. Steel Cab
   1. Car Wall Finish: Brushed stainless steel.
   2. Car Front Finish: Brushed stainless steel.
   3. Car Door Finish: Brushed stainless steel.
   4. Ceiling:
      a. Aurora Standard Translucent Panels suspended ceiling shall consist of white translucent polycarbonate panels set in frame of extruded natural satin finish with fluorescent lighting fixtures.
   5. Handrail:
      a. Round tube brushed stainless steel of 3/8-inch thick by 2 inches wide. Rails to be located on Back Wall - Front opening only of car enclosure.
   6. Flooring: By others. (Not to exceed 2sqft & 1/2" finished depth.)
   7. Threshold: Aluminum

E. Emergency Car Signals
   1. Emergency Siren: Siren mounted on top of cab that is activated when the alarm button in the car operating panel is engaged. Siren shall have rated sound pressure level of 80 dB(A) at a distance of three feet from device. Siren shall respond with a delay of not more than one second after activation of alarm button.
   2. Emergency Car Lighting: Provide emergency power unit employing a 12-volt sealed rechargeable battery and totally static circuits shall illuminate the elevator car and provide current to the alarm bell in the event of building power failure.
   3. Emergency Exit Contact: An electrical contact shall be provided on the car-top exit.

F. Ventilation: Fan.

2.06 EQUIPMENT: SIGNAL DEVICES AND FIXTURES

A. Car Operating Panel: Provide car operating panel with all push buttons, key switches, and message indicators for elevator operation.
   1. Car operating panel shall contain a bank of round, mechanical, illuminated buttons marked to correspond to landings served, emergency call button, door open button, door close button, and key switches for lights, inspection, and exhaust fan. Buttons have amber illumination (halo) and shall be [car operating panel button type]. All buttons to have raised text and Braille marking on left hand side. The car operating display panel shall be a 7-segment amber display. All texts, when illuminated, shall be amber. The car operating panel shall have a brushed stainless steel finish.

2. Additional features of car operating panel shall include:
   a. Car Position Indicator within operating panel (amber).
   b. Elevator Data Plate marked with elevator capacity and car number on car top.
   c. [help button markings] with raised markings.
   d. In car stop switch per local code.
   e. Firefighter's hat.
   f. Firefighter's Phase II Key-switch.
   g. Call Cancel Button.
   h. Pre-programmed integrated ADA phone (complete description of krms features included as standard)
   i. Help Button/Communicator. Activation of help button will initiate two-way communication between car and a location inside the building, switching over to alternate location if call is unanswered, where personnel are available to take the appropriate action. Visual indicators are provided for call initiation and call acknowledgement.
   j. Firefighter's Phase II emergency in-car operating instructions.

B. Hall Fixtures: Wall mounted hall fixtures shall be provided with necessary push buttons and key switches for elevator operation. Wall mounted hall fixtures shall have a brushed stainless steel finish.
   1. Hall fixtures shall feature round, mechanical, illuminated buttons in raised fixture housings. Hall fixtures shall correspond to options available from that landing. Buttons shall be flat flush in vertically mounted fixture. Hall fixtures should not be jamb-mounted. Hall lanterns shall feature amber illumination.

C. Car Lantern and Chime: A directional lantern visible from the corridor shall be provided in the car entrance. When the car stops and the doors are opening, the lantern shall indicate the direction in which the car is to travel and a chime will sound. The chime will sound once for up and twice for down.

2.07 EQUIPMENT: ELEVATOR OPERATION AND CONTROLLER

A. Elevator Operation
   1. Simplex Collective Operation: Using a microprocessor-based controller, operation shall be automatic by means of the car and hall buttons. If all calls in the system have been answered, the car shall park at the last landing served.
   2. Zoned Car Parking.
   3. Relative System Response Dispatching.

B. Standard Operating Features to include:
   1. Full Collective Operation
   2. Fan and Light Control.
   3. Load Weighing Bypass.
   4. Ascending Car Uncontrolled Movement Protection
   5. Top of Car Inspection Station.

C. Additional Operating Features to include:
   1. Car Secure Access.
   2. Provision for Card Reader in Car (Card Reader provided and Installed by others).
   3. Automatic Standby Power Operation with Manual Override.
      a. This operation shall return each car automatically to a designated landing when the system is initially switched to standby power. Preference is given to loaded cars.
      b. Manual Override of Standby Power Operation is achieved by a manual input for each car via a rotary selector, individual key switch for each car switch. A manually selected car may be run either in a return operation to a designated

landing or in normal operation under standby power. If a manually selected car has not yet returned to the designated landing, it will perform this operation first then immediately go into normal operation.

D. Elevator Control System for Inspections and Emergency
1. Provide devices within controller to run the elevator in inspection operation.
2. Provide devices on car top to run the elevator in inspection operation.
3. Provide within controller an emergency stop switch to disconnect power from the brake and prevents motor from running.
4. Provide the means from the controller to mechanically lift and control the elevator brake to safely bring car to nearest available landing when power is interrupted.
5. Provide the means from the controller to reset the governor over speed switch and also trip the governor.
6. Provide the means from the controller to reset the emergency brake when set because of an unintended car movement or ascending car over speed.
7. Provide the means for the control to reset elevator earthquake operation.

2.08 EQUIPMENT: DOOR OPERATOR AND CONTROL

A. Door Operator: A closed loop permanent magnet VVVF high-performance door operator shall be provided to open and close the car and hoistway doors simultaneously. Door movement shall be cushioned at both limits of travel. Electro-mechanical interlock shall be provided at each hoistway entrance to prevent operation of the elevator unless all doors are closed and locked. An electric contact shall be provided on the car at each car entrance to prevent the operation of the elevator unless the car door is closed.

B. The door operator shall be arranged so that, in case of interruption or failure of electric power, the doors can be readily opened by hand from within the car, in accordance with applicable code. Emergency devices and keys for opening doors from the landing shall be provided as required by local code.

C. Doors shall open automatically when the car has arrived at or is leveling at the respective landings. Doors shall close after a predetermined time interval or immediately upon pressing of a car button. A door open button shall be provided in the car. Momentary pressing of this button shall reopen the doors and reset the time interval.

D. Door hangers and tracks shall be provided for each car and hoistway door. Tracks shall be contoured to match the hanger sheaves. The hangers shall be designed for power operation with provisions for vertical and lateral adjustment. Hanger sheaves shall have polyurethane tires and pre-lubricated sealed-for-life bearings.

E. Electronic Door Safety Device. The elevator car shall be equipped with an electronic protective device extending the full height of the car. When activated, this sensor shall prevent the doors from closing or cause them to stop and reopen if they are in the process of closing. The doors shall remain open as long as the flow of traffic continues and shall close shortly after the last person passes through the door opening.

PART 3 EXECUTION

3.01 EXAMINATION

A. Field measure and examine substrates, supports, and other conditions under which elevator work is to be performed.

B. Do not proceed with work until unsatisfactory conditions are corrected.

C. Prior to start of Work, verify hoistway is in accordance with shop drawings. Dimensional tolerance of hoistway from shop drawings: -0 inches +2 inches. Do not begin work of this section until dimensions are within tolerances.

D. Prior to start of Work, verify projections greater then 2 inches (4 inches if ASME A17.1/CSA B44 2000 applies) must be beveled not less then 75 degrees from horizontal.

E. Prior to start of Work, verify landings have been prepared for entrance sill installation. Traditional sill angle or concrete sill support shall not be required.

F. Prior to start of Work, verify elevator pit has been constructed in accordance with requirements, is dry and reinforced to sustain vertical forces, as indicated in approved submittal. Verify that sumps or sump pumps located within pit will not interfere with installed elevator equipment.

G. Prior to start of Work, verify control space has been constructed in accordance with requirements, with access coordinated with elevator shop drawings, including Sleeves and penetrations.

H. Verify installation of GFCI protected 20-amp in pit and adjacent to each signal control cabinet in control space.

3.02 PREPARATION

A. Coordinate installation of anchors, bearing plates, brackets and other related accessories.

3.03 INSTALLATION

A. Install equipment, guides, controls, car and accessories in accordance with manufacturer installation methods and recommended practices.

B. Properly locate guide rails and related supports at locations in accordance with manufacturer's recommendations and approved shop drawings. Anchor to building structure using isolation system to minimize transmission of vibration to structure.

C. All hoistway frames shall be securely fastened to fixing angles mounted in the hoistway. Coordinate installation of sills and frames with other trades.

D. Lubricate operating system components in accordance with manufacturer recommendations.

E. Perform final adjustments, and necessary service prior to substantial completion.

3.04 CONSTRUCTION

A. Interface with Other Work:
   1. Guide rail brackets attached to steel shall be installed prior to application of fireproofing.
   2. Coordinate construction of entrance walls with installation of door frames and sills. Maintain front wall opening until elevator equipment has been installed.
      a. Ensure adequate support for entrance attachment points at all landings.
      b. Coordinate wall openings for hall push buttons, signal fixtures and sleeves. Each elevator requires sleeves within the hoistway wall.
      c. Coordinate emergency power transfer switch and power change pending signals as required for termination at the primary elevator signal control cabinet in each group.
      d. Coordinate interface of elevators and fire alarm system.

e. Coordinate interface of dedicated telephone line.

3.05 TESTING AND INSPECTIONS

A. Perform recommended and required testing in accordance with authority having jurisdiction.

B. Obtain required permits and provide originals to Owner's Representative.

3.06 DEMONSTRATION

A. Prior to substantial completion, instruct Owner's Representative on the proper function and required daily maintenance of elevators. Instruct personnel on emergency procedures.

END OF SECTION 142100

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SECTION 213230 - ELECTRONIC-DRIVE, VERTICAL IN-LINE FIRE PUMPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including the General and Supplementary Conditions and Division 1 Specification sections, apply to this section.

1.2 SUMMARY

A. This section includes electric-drive, vertical in-line fire pumps and accessories for fire-protection service.

B. Related Sections: The following sections contain requirements that relate to this section:

1. Division 21, Section 213250 – STANDPIPE AND SPRINKLER SYSTEMS.

2. Division 23, Section 230010 – BASIC MECHANICAL REQUIREMENTS.

3. Division 28, Section 283111 – DIGITIAL, ADDRESSABLE FIRE ALARM SYSTEMS for electrical wiring and connection to alarm panel.

4. Division 26 sections for power and connections to fire pump and pressure-maintenance pump controllers. Controller shall be soft start, and rated for service entrance (with main breaker – mag only).

1.3 DEFINITIONS

A. Fire Pump: Pump used to supply water at rated capacity and total rated head required for fire-protection service.

B. Fire Pump Unit: Assembled unit consisting of fire pump, driver, controller, and accessories.

C. In-Line Fire Pump: Vertical-mounting, electric-drive, in-line fire pump.

D. Pressure-Maintenance Pump: Pump used to maintain water pressure in a sprinkler system.

E. Pressure-Maintenance Pump Unit: Assembled unit consisting of pressure-maintenance pump, driver, controller, and accessories.

1.4 SYSTEM PERFORMANCE REQUIREMENTS

A. Provide fire pump systems that include fire pump units, pressure-maintenance pump units, accessories, and piping that comply with performance requirements specified and are compatible with building fire-protection systems.

B. Pump, Equipment, Accessory, and Piping Pressure Rating: 175 psig minimum, except where a higher rating is indicated.

1.5 SUBMITTALS

A. General: Submit the following according to the Conditions of the Contract and Division 1 Specification sections.

B. Product data for fire pump units and pressure pump units. Include clearly stated rated capacities of each selected model, performance curve with each selection point indicated, driver, pump controller, furnished specialties, and accessories; plus weights (shipping and installed).

C. Test curves of fire pump manufacturer's factory tests for each fire pump, and certificates signed by manufacturer verifying that the test results comply with specified requirements.

D. Shop drawings showing layout and connections for fire pump units and pressure-maintenance pump units. Show pumps, drivers, controllers, accessories, and piping. Include setting drawings with templates and directions for installation of foundation bolts, anchor bolts, and other anchorages.

1. Shop drawings may be incorporated into other Division 15 fire-protection piping system shop drawings.

E. Wiring diagrams detailing field-installed wiring for power, signal, and control systems.

F. Field-acceptance test data showing proper performance according to provisions specified.

G. Maintenance data for each fire pump and pressure-maintenance pump unit to include in the "Operating and Maintenance Manual" specified in Division 1, Section 017700 – CLOSEOUT PROCEDURES.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: Firms whose fire pumps, pressure-maintenance pumps, drivers, controllers, and accessories are listed by product name and manufacturer in the UL "Fire Protection Equipment Directory" and FM "Approval Guide" and that comply with requirements indicated. The following listings are not required:

1. FM approval of pressure-maintenance pump controllers.

B. Single-Source Responsibility: Obtain fire pump units and pressure-maintenance pump units, components, and accessories from a single source. Include a source with responsibility and accountability to answer and resolve problems regarding compatibility, installation, performance, and acceptance of units.

C. Provide listing/approval stamp, label, or other marking on equipment made to specified standards.

D. Comply with local fire department/marshal standards pertaining to material, hose threads, and installation.

E. Comply with requirements of NFPA 20 "Standard for the Installation of Centrifugal Fire Pumps" for fire pumps, drivers, controllers, accessories, and installation.

F. Comply with requirements of NFPA 70 "National Electrical Code" for electrical materials and installation.

G. Comply with requirements of FM "Approval Guide" applicable to fire pumps, drivers, controllers, and accessories, and provide system capable of FM acceptance.

H. Manufacturer's Factory Tests: Perform factory test for each fire pump.

I. Design Criteria: The Drawings indicate sizes, profiles, connections, and dimensional requirements of fire pump and pressure-maintenance pump units and are based on specific manufacturer types and models indicated. Pump units having equal performance characteristics by other manufacturers may be considered, provided that deviations in dimensions and profiles do not change the design concept or intended performance as judged by the Architect. The burden of proof for equality of units is on the proposer.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Preparation for Shipping: After assembling and testing fire pumps and pressure-maintenance pumps, clean flanges and exposed machined metal surfaces and treat with an anticorrosion compound. Protect flanges, pipe openings, and nozzles.

B. Store fire pumps, pressure-maintenance pumps, drivers, controllers, and accessories in a clean dry place.

C. Retain shipping flange protective covers and protective coatings during storage.

D. Protect bearings and couplings against damage from sand, grit, or other foreign matter.

E. Extended Storage Greater Than 5 Days: Dry internal parts with hot air or vacuum-producing device to prevent rusting. Upon drying, coat internal parts with protective liquid, such as light oil. Dismantle bearings and couplings, dry and coat with acid-free heavy oil, and then tag and store in a dry location.

F. Comply with manufacturer's rigging instructions for handling.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. In-Line Fire Pumps:

a. Aurora Pump, General Signal Corp.

b. ITT A-C Pump, ITT Fluid Technology Corp.

c. Patterson Pump Co. Subsid., Gorman-Rupp Co.

d. Peerless Pump, Sterling Fluid Products, Inc.

2. Multistage Pressure-Maintenance Pumps:

a. Aurora Pump, General Signal Corp.

b. Grundfos Pumps Corp.

c. ITT A-C Pump, ITT Fluid Technology Corp.

d. Patterson Pump Co. Subsid., Gorman-Rupp Co.

e. Peerless Pump, Sterling Fluid Products, Inc.

f. Taco, Inc.

3. Regenerative-Turbine, Pressure-Maintenance Pumps:

a. Aurora Pump, General Signal Corp.

b. Burks Pumps, Inc.

c. Fairbanks Morse Pump Div., Colt Industries.

d. ITT A-C Pump, ITT Fluid Technology Corp.

e. MTH Tool Co., Inc.

4. Pump Controllers and Alarm Panels:

a. Firetrol, Inc.

b. Hubbell Industrial Controls, Inc.

c. Joslyn Clark Controls, Inc. Subsid., Joslyn Corp.

d. Master Control Systems, Inc.

e. Cutler-Hammer.

2.2 IN-LINE FIRE PUMPS

A. Description: UL 448, factory-assembled and -tested, in-line, horizontal fire pump with electric-motor driver directly mounted to pump casing.

1. Characteristics: Capable of furnishing not less than 150 percent of rated capacity at not less than 65 percent of total rated head. Shutoff head is limited to 140 percent of total rated head.

2. Casing: Radially split cast iron with suction and discharge flanges machined to ASME B16.1, Class 125 dimensions.

3. Impeller: Cast bronze, statically and dynamically balanced, closed, overhung, single suction, and keyed to shaft.

4. Wear Rings: Replaceable, bronze.

5. Shaft and Sleeve: Steel shaft with bronze sleeve.

6. Shaft Bearings: Grease-lubricated ball bearings in cast-iron housing.

7. Seals: Stuffing box with minimum of four rings of graphite-impregnated braided yarn and bronze packing gland.

8. Finish: Manufacturer's standard red paint applied to factory-assembled and - tested units before shipping.

9. Nameplate: Complete with capacities, characteristics, and other pertinent data.

2.3 DRIVERS

A. Description: NEMA MG 1, open-dripproof, squirrel-cage, induction motors. Include construction that complies with NFPA 20 and NFPA 70, and wiring compatible with controller used.

B. Finish: Manufacturer's standard red paint applied to factory-assembled and tested unit before shipping.

C. Nameplates: Complete with motor horsepower, characteristics, and other pertinent data.

2.4 CONTROLLERS

A. Description: Combined automatic and nonautomatic operation, complying with UL 508, UL listed and FM approved, factory assembled and wired, factory tested for capacities and electrical characteristics, and with features indicated.

B. Enclosure: NEMA ICS 6, Type 2, dripproof, indoor, except where special-purpose enclosure is indicated.

C. Include controls, devices, alarms, functions, and operations listed in NFPA 20 as required for driver and controller types used, and specific items listed for each controller type.

D. Nameplates: Provide nameplate complete with capacity, characteristics, approvals and listings, and other pertinent data on enclosure door.

E. Fire-Pump-Controller Enclosure Mounting: Wall mounting for field electrical connections.

F. Finish: Manufacturer's standard red paint applied to factory-assembled and tested unit before shipping.

G. Controller Sensing Pipes: Fabricate pipe and fittings according to NFPA 20 with nonferrous-metal sensing piping, 1/2-inch size, with globe valves for testing controller mechanism from system to pump controller as indicated. Include a bronze check valve with a 3/32-inch orifice in the clapper or a ground-face union with a noncorrosive diaphragm having a 3/32-inch orifice.

2.5 FULL-SERVICE CONTROLLERS

A. Description: Reduce Voltage, Part Winding, listed for electric-drive fire pump service and service entrance.

B. Rate controllers for scheduled horsepower. Include short-circuit withstand rating at least equal to short-circuit current available at controller location. Take into account cable size and distance from substation or supply transformers.

C. Automatic Transfer Switches: Enclosures complying with UL 1008 and requirements for and attached to fire pump controllers. Include automatic transfer switches with rating at least equal to fire-pump-driver motor horsepower (kW). When motor is rated in amperes, include ampere rating not less than 115 percent of motor full-load current and suitable for switching motor-locked rotor current.

D. Controllers: Capable of performing or containing the following features:

1. Isolating means and circuit breaker.

2. "Power On" pilot lamp.

3. Fire alarm system connections for indicating motor running condition, loss of line power, and line power phase reversal.

4. Automatic and manual operation, and minimum run-time relay to prevent short cycling.

5. Water-pressure-actuated switch having independent high and low calibrated adjustments responsive to water pressure in fire-protection system.

6. Manual and automatic shutdown.

2.6 ALARM PANELS

A. Enclosure: NEMA ICS 6, Type 1 remote wall-mounting-type panel with audible and visible alarms matching controller type.

B. Features: Include the following features and manufacturer's standard features:

1. Motor-operating condition.

2. Loss of line power.

3. Phase reversal.

4. Low-water alarm.

C. Mounting: Wall mounting.

D. Finish: Manufacturer's standard red paint applied to factory-assembled and tested unit before shipping.

2.7 ACCESSORIES

A. Match fire pump suction and discharge ratings as required for fire pump capacity rating. Include the following accessories:

1. Automatic air-release valve.

2. Casing relief valve.

3. Suction and discharge pressure gauges.

4. Eccentric tapered reducer at suction inlet.

5. Concentric tapered reducer (increaser) at discharge outlet.

6. Test-Header Manifold: Ductile-iron or brass body for hose valves. Include nozzle outlets arranged in a single line; horizontal flush-wall mounting attachment; and rectangular, brass escutcheon plate with lettering equivalent to "PUMP TEST CONNECTION."

   a. Escutcheon Plate Finish: Polished chrome plate.

7. Hose Valves: UL 668, straightway pattern, bronze. Include cap attached to valve with chain and NFPA 1963 hose thread that conforms to local fire department standards on valve outlet. Valve and cap finish is same as test-header-manifold escutcheon plate finish.

8. Ball Drip Valve: UL 1726.

9. Main Relief Valve: UL1478 spring-loaded.

10. Discharge Cone: Closed.

B. Finish: Manufacturer's standard factory-applied red paint except where brass or another finish is specified.

2.8 PRESSURE-MAINTENANCE PUMPS

A. Regenerative-Turbine, Pressure-Maintenance Pumps: Close-coupled construction for pad mounting, factory assembled, and factory tested for capacities and characteristics indicated.

1. Capacities: Not less than rated capacity at not less than total rated head indicated.

2. Construction: Cast-iron pump casing with suction and discharge connections of size indicated, threaded, or flanged and machined to ASME B16.1 dimensions, and 125-psig minimum pressure rating, except where 250-psig rated flanges are indicated.

   a. Impeller: Bronze or stainless steel.

   b. Shaft: Stainless steel.

   c. Seals: Mechanical.

B. Nameplates: Provide nameplate complete with capacity, characteristics, and other pertinent data.

C. Finish: Manufacturer's standard color paint applied to factory-assembled and -tested unit before shipping.

2.9 PRESSURE-MAINTENANCE PUMP CONTROLLERS

A. Description: Across-the-line type; complying with UL 508; UL listed; factory assembled, wired, and tested; combined automatic and nonautomatic operation. Include types, capacities, characteristics, and features indicated for electric-drive, pressure-maintenance pump service.

B. Enclosure: NEMA ICS 6, Type 2, wall mounted, for field electrical wiring.

C. Include controls, devices, alarms, functions, and operations listed in NFPA 20, and specific items listed.

D. Rate controller for scheduled horsepower and provide the following items:

1. Fusible disconnect switch.

2. Pressure switch.

3. "HAND-OFF-AUTO" selector switch.

4. Pilot light.

E. Nameplates: Complete with capacity, characteristics, approvals and listings, and other pertinent data on enclosure door.

F. Mounting: Wall type for field electrical connections.

G. Finish: Manufacturer's standard color paint applied to factory-assembled and tested unit before shipping.

H. Controller Sensing Pipes: Fabricate pipe and fittings according to NFPA 20 with nonferrous-metal sensing piping, 1/2-inch (13 mm) size, with globe valves for testing controller mechanism from system to pump controller as indicated. Include a bronze check valve with a 3/32-inch (2.4 mm) orifice in the clapper or a ground-face union with a noncorrosive diaphragm having a 3/32-inch (2.4 mm) orifice.

2.10 PRESSURE-MAINTENANCE PUMP ACCESSORIES

A. Pressure-Maintenance Pump Accessories: Match pressure-maintenance pump suction and discharge ratings as required for pump capacity rating:

1. Casing relief valve.

2. Suction and discharge pressure gauges.

2.11 SOURCE QUALITY CONTROL

A. Factory Tests: Hydrostatically test and test run fire pumps before shipping. Test at 150 percent of shutoff head plus suction head, but not less than 250 psig . Produce certified test curves showing head capacity and brake-horsepower of each pump.

2.12 GROUT

A. Nonshrink, Nonmetallic Grout: ASTM A1107, Grade B.

B. Characteristics: Post-hardening, volume-adjusting, dry, hydraulic-cement grout.

C. Properties: Nonstaining, noncorrosive, and nongaseous.

D. Recommended Uses: Interior and exterior applications.

E. Design Mix: 5,000 psi, 28-day compressive strength.

F. Packaging: Factory premixed and packaged.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, equipment foundations, and conditions with Installer present for compliance with requirements for installation and other conditions affecting fire pump performance. Do not proceed with installation until unsatisfactory conditions have been corrected.

B. Examine fire-protection piping systems. Verify actual locations of piping connections prior to installation.

3.2 CONCRETE EQUIPMENT BASES

A. Install concrete equipment bases of dimensions indicated for fire pumps, pressure-maintenance pumps, and controllers. Refer to Division 3, Section 033000 - CAST-IN-PLACE CONCRETE and Division 23, Section 230050 - BASIC MECHANICAL MATERIALS AND METHODS.

3.3 INSTALLATION

A. Comply with fire pump and pressure-maintenance pump manufacturer's written installation and alignment instructions and with NFPA 20 and FM standards.

B. Install pumps in locations indicated and arrange to provide access for periodic maintenance, including removal of motors, impellers, couplings, and accessories.

C. Set base-mounted pumps on concrete equipment bases. Disconnect coupling halves before setting. Do not reconnect couplings until alignment operations have been completed.

1. Support pump base plate on rectangular metal blocks and shims or on metal wedges having small taper, at points near foundation bolts to provide a gap of 3/4 to 1-1/2 inches between pump base and foundation for grouting.

2. Adjust metal supports or wedges until pump and driver shafts are level. Check coupling faces and pump suction and discharge flanges to verify that they are level and plumb.

D. Install suction and discharge pipe sizes equal to or greater than the diameter of fire pump nozzles.

E. Install valves of types and at locations indicated that are same size as the piping connecting fire pumps, bypasses, test headers, and other piping systems.

F. Install pressure gauges on fire pump suction and discharge at integral pressure gauge tappings provided.

G. Support pumps and piping separately so that weight of piping system does not rest on pumps.

H. Install piping accessories, hangers and supports, anchors, valves, meters and gauges, and equipment supports as indicated for complete installation.

I. Electrical Wiring: Install electrical devices furnished by equipment manufacturers but not specified to be factory mounted. Furnish copy of manufacturer's wiring diagram submittal to electrical Installer.

1. Verify that electrical wiring is installed according to manufacturer's submittal and installation requirements of Division 26 sections. Do not proceed with equipment startup until wiring installation is acceptable.

3.4 ALIGNMENT

A. Align fire pump and driver shafts after complete unit has been leveled on foundation and after grout has set and foundation bolts have been tightened.

B. After alignment is correct, tighten foundation bolts evenly but not too firmly. Fill base plate completely with nonshrink, nonmetallic grout, with metal blocks and shims or wedges in place. After grout has hardened, fully tighten foundation bolts. Check alignment and take corrective measures required.

C. Make piping connections, check alignment, and take corrective measures required.

1. Adjust alignment of pump and driver shafts for angular and parallel alignment by 1 of 2 methods specified in Hydraulic Institute Standards Section "Centrifugal Pumps--Instructions for Installation, Operation and Maintenance."

2. Alignment Tolerances: Meet manufacturer's recommendations.

D. Align vertically mounted, pump and driver shafts after complete unit has been made plumb on foundation and after grout has set and foundation bolts have been tightened. Follow pump manufacturer's written instructions.

3.5 CONNECTIONS

A. Connect water supply to fire pumps and pressure-maintenance pumps.

B. Connect fire pump and pressure-maintenance pump discharge piping to building fire-protection water systems.

C. Connect fire pump controllers to building fire alarm system. Refer to Division 28, Section 283111- DIGITAL, ADDRESSABLE FIRE ALARM SYSTEM.

D. Electrical wiring and connections are specified in Division 26 sections.

3.6 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Provide services of factory-authorized service representative to supervise field assembly of components, installation of fire pump units and pressure-maintenance pump units, including piping and electrical connections, field acceptance tests. Report test results in writing.

B. Check suction line connections for tightness to avoid drawing air into pumps.

C. Perform field-acceptance tests for each fire pump unit (fire pump, driver, and controller) and system piping when fire pump unit installation is complete. Comply with operating

instructions and procedures of NFPA 20 to demonstrate compliance with requirements. Where possible, field-correct malfunctioning equipment, then retest to demonstrate compliance. Replace equipment that cannot be satisfactorily corrected or that does not perform as specified and as indicated, then retest to demonstrate compliance. Verify that each fire pump unit performs as specified and as indicated.

3.7 COMMISSIONING

A. Startup Services: Provide services of factory-authorized service representative to provide startup service and to demonstrate and train Owner's maintenance personnel as specified below.

1. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and components.

2. Train Owner's maintenance personnel on procedures and schedules related to startup and shutdown, troubleshooting, servicing, and preventive maintenance.

3. Review data in the "Operating and Maintenance Manual." Refer to Division 1, Section 017700 – CLOSEOUT PROCEDURES.

4. Schedule training with at least 7 days' advance notice.

5. Provide fire hoses in number, size, and of length required to reach a storm drain or other acceptable location to dispose of fire pump test water. These fire hoses are for field acceptance tests only and are not intended to become property of the Owner.

B. Final Checks Before Startup: Perform the following preventive-maintenance operations and checks before startup:

1. Lubricate oil-lubricated bearings.

2. Remove grease-lubricated bearing covers and flush bearings with kerosene and thoroughly clean. Fill with new lubricant according to manufacturer's recommendations.

3. Disconnect coupling and check electric motor for proper rotation. Rotation shall match direction of rotation marked on pump casing.

4. Check that the pump is free to rotate by hand. Do not operate the pump if it is bound or if it drags even slightly until cause of trouble is determined and corrected.

C. Starting procedure for pumps:

1. Prime pump by opening suction valve and closing drains, and prepare pump for operation.

2. Open sealing liquid supply valve if pump is so fitted.

3. Start motor.

4. Open discharge valve slowly.

5. Observe leakage from stuffing boxes and adjust sealing liquid valve for proper flow to ensure lubrication of packing. Do not tighten gland immediately, but let packing run in before reducing leakage through stuffing boxes.

6. Check general mechanical operation of pump and motor.

END OF SECTION 213230

SECTION 213250 – STANDPIPE AND SPRINKLER SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this section.

1.2 SUMMARY

A. This section specifies standpipe and sprinkler systems for buildings and structures.

B. Related Sections: The following sections contain requirements that relate to this section:

1. Division 7, Section 078413 – PENETRATION FIRESTOPPING for fire barrier sealers.

2. Division 9, Section 099000 - PAINTING.

3. Division 10, Section 104400 - FIRE PROTECTION SPECIALTIES for fire extinguishers and cabinets for fire extinguishers, hose valves, and rack and hose assemblies.

4. Division 23, Section 230010 - BASIC MECHANICAL REQUIREMENTS.

5. Division 23, Section 230050 - BASIC MECHANICAL MATERIALS AND METHODS.

6. Division 15, Section 230513 – COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT.

7. Division 15, Section 230519 - METERS AND GAUGES FOR HVAC PIPING.

8. Division 23, Section 230529 - HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

10. Division 23, Section 230553 - IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT.

11. Division 16, Section 283111 – DIGITAL, ADDRESSABLE FIRE ALARM SYSTEMS for alarm devices not specified in this section.

1.3 DEFINITIONS

A. Pipe sizes used in this section are nominal pipe size (NPS) specified in inches. Tube sizes are standard tube size specified in inches.

B. Working plans as used in this section refer to documents (including drawings and calculations) prepared pursuant to requirements in NFPA 13 for obtaining approval of authority having jurisdiction.

C. Other definitions for fire protection systems are included in referenced NFPA standards.

1.4 SYSTEM DESCRIPTION

A. Wet-Pipe Sprinkler System: System with automatic sprinklers attached to piping system containing water and connected to water supply so that water discharges immediately from sprinklers when they are opened by fire.

B. Sprinkler System Protection Limits: All spaces within areas indicated. Include closets, toilet and locker room areas, and special applications areas.

C. Standpipe Systems: Systems that are wet type have water supply valve open and pressure maintained at all times and include branches extending from standpipes to sprinkler zone valves.

D. Class I, Standpipe and Hose System: Arrangement of piping, valves, hose connections, hose, and accessories for use by persons trained in use of heavy fire streams. Valves are 2-1/2-inch size.

1.5 SYSTEM PERFORMANCE REQUIREMENTS

A. Design and obtain approval from authority having jurisdiction for fire protection systems specified.

B. Minimum Pipe Sizes: Not smaller than sizes indicated on the contract drawings.

C. Conduct fire hydrant flow tests as required to obtain hydraulic data needed to prepare design for hydraulically calculated systems. The system will contain a fire pump.

D. Hydraulically design sprinkler systems as indicated on the drawings and in accordance with NFPA 13. The design area shall include all sprinklers in the Cab and level below.

E. Components and Installation: Capable of producing piping systems with the following minimum working pressure ratings except where indicated otherwise.

1. Sprinkler Systems: 175 psig.

2. Standpipe and Hose Systems: 175 psig.

1.6 SUBMITTALS

A. Product data for fire protection system components. Include the following:

1. Backflow preventers.

2. Valves.

3. Specialty valves, accessories, and devices.

4. Alarm devices. Include electrical data.

5. Fire department connections. Include type of fire department connection; number, size, type, and arrangement of inlets; size and direction of outlet; and finish.

6. Hose valves. Include size, type, and finish.

7. Sprinklers, escutcheons, and guards. Include sprinkler flow characteristics, mounting, finish, and other data.

B. Sprinkler system drawings identified as "working plans," prepared according to NFPA 13. Submit required number of sets to authority having jurisdiction for review, comment, and approval. Include system hydraulic calculations, product data information and cut sheets..

C. Submit required number of sets of planned underground piping shop drawings to authority having jurisdiction for review, comment and approval.

C. Test reports and certificates as described in NFPA 13. Include "Contractor's Material & Test Certificate for Aboveground Piping" and "Contractor's Material & Test Certificate for Underground Piping."

D. Maintenance data for each type of fire protection specialty specified, for inclusion in "Operating and Maintenance Manual" specified in Division 1, Section 017700 - CLOSEOUT PROCEDURES.

E. NFPA 25 "Standard for Inspection, Testing and Maintenance of Water Based Fire Protection Systems" for inclusion in "Operating and Maintenance Manual" specified in Division 1, Section 017700 – CLOSEOUT PROCEDURES.

F. NFPA 1962 "Standard for the Care, Use, and Service Testing of Fire Hose Including Couplings and Nozzles" for inclusion in "Operating and Maintenance Manual" specified in Division 1, Section 017700 – CLOSEOUT PROCEDURS.

1.7 QUALITY ASSURANCE

A. Manufacturer Qualifications: Firms whose equipment, specialties, and accessories are listed by product name and manufacturer in UL Fire Protection Equipment Directory and FM Approval Guide and that conform to other requirements indicated.

B. Listing/Approval Stamp, Label, or Other Marking: On equipment, specialties, and accessories made to specified standards.

C. Listing and Labeling: Equipment, specialties, and accessories that are listed and labeled.

D. Comply with requirements of authority having jurisdiction for submittals, approvals, materials, hose threads, installation, inspections, and testing.

E. Comply with requirements of Owner's insurance underwriter for submittals, approvals, materials, installation, inspections, and testing.

F. Installer's Qualifications: Firms qualified to install and alter fire protection piping, equipment, specialties, and accessories, and repair and service equipment. A qualified firm is one that is experienced (minimum of 5 previous projects similar in size and scope to this project) in such work, familiar with precautions required, and in compliance with the requirements of the authority having jurisdiction. Submit evidence of qualifications to the Architect upon request. Refer to Division 1, Section 014200 - REFERENCES for definition of "Installer."

G. NFPA Standards: Equipment, specialties, accessories, installation, and testing complying with the following:

1. NFPA 13 "Standard for the Installation of Sprinkler Systems."

2. NFPA 14 "Standard for the Installation of Standpipe and Hose Systems."

3. NFPA 26 "Recommended Practice for the Supervision of Valves Controlling Water Supplies for Fire Protection."

4. NFPA 70 "National Electrical Code."

5. NFPA 72 "National Fire Alarm Code."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Backflow Preventers:

a. Ames Co., Inc.

b. Cla-Val Co.

c. Conbraco Industries, Inc.

d. Febco.

2. Waterflow Indicators and Supervisory Switches:

a. Tyco

b. Potter Electric Signal Co.

c. Reliable Automatic Sprinkler Co., Inc.

d. System Sensor Div., Pittway Corp.

e. Victaulic Company of America.

3. Fire Department Connections:

a. Badger-Powhatan, Figgie International Co.

b. Croker Div., Fire-End and Croker Corp.

c. Elkhart Brass Mfg. Co., Inc.

d. Tyco

e. Guardian Fire Equipment, Inc.

f. Potter-Roemer Div., Smith Industries, Inc.

4. Sprinklers:

a. Tyco

b. Reliable Automatic Sprinkler Co., Inc.

c. Viking Corp.

d. Victaulic Company of America

5. Hose Valves and Racks and Hose:

a. Tyco

b. Elkhart Brass Mfg. Co., Inc.

c. Guardian Fire Equipment, Inc.

d. Potter-Roemer Div., Smith Industries, Inc.

6. Indicator Posts and Indicator Post Gate Valves:

a. Clow Valve Co. Div., McWane, Inc.

b. Tyco

c. Kennedy Valve Div., McWane, Inc.

d. Nibco, Inc.

e. Stockham Valves and Fittings, Inc.

7. Indicator Valves:

a. Tyco

b. Kennedy Valve Div., McWane, Inc.

c. Milwaukee Valve Co., Inc.

d. Nibco, Inc.

e. Victaulic Company of America.

8. Fire Protection Service Gate and Check Valves:

a. Tyco

b. Kennedy Valve Div., McWane, Inc.

c. Nibco, Inc.

d. Stockham Valves and Fittings, Inc.

e. Victaulic Company of America.

9. Grooved Couplings for Steel Piping:

a. Tyco

b. Stockham Valves and Fittings, Inc.

c. Victaulic Company of America.

10. Grooved Couplings for AWWA Ductile-Iron Piping:

a. Gustin-Bacon Div., Tyler Pipe Subsid., Tyler Corp.

b. Victaulic Company of America.

2.2 PIPES AND TUBES

A. Refer to Part 3 Articles "Sprinkler System Piping Applications" and "Standpipe System Piping Applications" for identification of systems where pipe and fitting materials specified below are used.

B. Ductile-Iron Pipe: AWWA C115, ductile-iron barrel with iron-alloy threaded flanges, 250 psig minimum working pressure rating, and AWWA C104 cement-mortar lining.

1. Option: Pipe may be AWWA pattern, cut-grooved for grooved-coupling joints.

C. Steel Pipe: ASTM A 53, Schedule 40 in sizes 6 inches and smaller and Schedule 30 in sizes 8 inches and larger, black and galvanized, plain and threaded ends, for welded, threaded, cut-groove, and rolled-groove joints.

D. Steel Pipe: ASTM A 135 or ASTM A 795, Schedule 10 through 5-inch sizes and NFPA 13 specified wall thickness for 6-inch through 10-inch sizes, with plain ends, black and galvanized, for rolled-groove and welded joints.

2.3 PIPE AND TUBE FITTINGS

A. Cast-Iron Threaded Flanges: ASME B16.1, Class 125, raised ground face, bolt holes spot faced.

B. Ductile-Iron and Gray-Iron Flanged Fittings: AWWA C110, 250-psig minimum pressure rating, with AWWA C104 cement-mortar lining.

C. Cast-Iron Threaded Fittings: ASME B16.4, Class 125, standard pattern, with threads according to ASME B1.20.1.

D. Malleable-Iron Threaded Fittings: ASME B16.3, Class 150, standard pattern, with threads according to ASME B1.20.1.

E. Grooved-End Fittings for Ductile-Iron Pipe: ASTM A 536 ductile-iron or ASTM A 47 malleable-iron, AWWA pipe-size, designed to accept AWWA C606 grooved couplings. Include cement lining or Food and Drug Administration (FDA)-approved interior coating.

F. Steel Fittings: ASTM A 234/A 234M, seamless or welded; ASME B16.9, buttwelding; or ASME B16.11, socket-welding type for welded joints.

G. Steel Flanges and Flanged Fittings: ASME B16.5.

H. Grooved-End Fittings for Steel Pipe: UL-listed and FM-approved, ASTM A 536, Grade 65-45-12 ductile iron or ASTM A 47 Grade 32510 malleable iron, with grooves or shoulders designed to accept grooved couplings.

2.4 JOINING MATERIALS

A. Refer to Division 15, Section 230050 - BASIC MECHANICAL MATERIALS AND METHODS for joining materials not included in this section.

B. Flanged Joints for Ductile-Iron Pipe and Ductile-Iron or Cast-Iron Fittings: AWWA C115 ductile-iron or gray-iron pipe flanges, rubber gaskets, and high-strength steel bolts and nuts.

C. Couplings for Grooved-End Steel Pipe and Grooved-End Ferrous Fittings: UL 213, AWWA C606, ASTM A 536 ductile-iron or ASTM A 47 malleable-iron housing, with enamel finish. Include synthetic-rubber gasket with central-cavity, pressure-responsive design; ASTM A 183 carbon-steel bolts and nuts; and locking pin, toggle, or lugs to secure grooved pipe and fittings.

D. Couplings for Grooved-End Ductile-Iron Pipe and Fittings: UL 213, AWWA C606, ASTM A 536 ductile-iron housing, with enamel finish. Include synthetic-rubber gasket with central-cavity, pressure-responsive design, and ASTM A 183 carbon-steel bolts and nuts to secure grooved pipe and fittings.

2.5 GENERAL-DUTY VALVES

A. Refer to Division 23 for general-duty gate, ball, butterfly, globe, and check valves.

2.6 FIRE PROTECTION SERVICE VALVES

A. General: UL-listed and FM-approved, with 175 psig non-shock minimum working pressure rating.

1. Option: Valves for use with grooved piping may be grooved type.

B. Gate Valves, 2 Inches and Smaller: UL 262, cast-bronze, threaded ends, solid wedge, outside screw and yoke, rising stem.

C. Indicating Valves, 2-1/2 Inches and Smaller: Butterfly or ball type, bronze body with threaded ends, and integral indicating device.

1. Indicator: Visual and Electrical 115 volts a.c., prewired, 2-circuit, supervisory switch.

D. Gate Valves, 2-1/2 Inches and Larger: UL 262, iron body, bronze mounted, taper wedge, outside screw and yoke, rising stem. Include replaceable, bronze, wedge facing rings and flanged ends.

E. Gate Valves, 2-1/2 Inches and Larger for Use with Indicator Posts: UL 262, iron body, bronze mounted, solid wedge disc, non-rising stem with operating nut and flanged ends.

F. Indicator Posts: UL 789, wall type, cast-iron body, with windows for target plates that indicate valve position, extension rod and coupling, locking device, and red enamel finish.

G. Swing Check Valves: UL 312, cast-iron body and bolted cap, with bronze disc or cast-iron disc with bronze disc ring and flanged ends.

H. Butterfly Check Valves: UL 213, split-clapper style, cast-iron body with rubber seal, bronze alloy discs, stainless-steel spring and hinge pin.

2.7 SPECIALTY VALVES

A. Ball Drip Valves: UL 1726, automatic drain valve, 3/4-inch size, spring-loaded, ball check device with threaded ends.

2.8 BACKFLOW PREVENTERS

A. General: ASSE standard backflow preventers, of size indicated for maximum flow rate indicated and maximum pressure loss indicated.

1. Working Pressure: 150 psig minimum except where indicated otherwise.

2. Bronze, cast-iron, steel, or stainless-steel body with flanged ends.

3. Interior Lining: FDA-approved epoxy coating, for backflow preventers having cast-iron or steel body.

4. Interior Components: Corrosion-resistant materials.

5. Strainer on inlet, where strainer is indicated.

B. Reduced-Pressure Detector Assembly Backflow Preventers: UL 312 and ASSE 1047, consisting of OS&Y gate valves on inlet and outlet, and strainer on inlet. Include pressure-differential relief valve having ASME A112.1.2 air-gap fitting located between 2 positive-seating check valves, test cocks, and bypass with displacement-type water meter, valves, and reduced-pressure backflow preventer, for continuous pressure application.

5. Pressure Loss: 12 psig maximum, through middle third of flow range.

C. Double-Check Detector Assembly Backflow Preventers: UL 312 and ASSE 1048, consisting of OS&Y gate valves on inlet and outlet and strainer on inlet. Include 2 positive-seating check valves and test cocks, and bypass with displacement-type water meter, valves, and double-check backflow preventer, for continuous pressure application.

5. Pressure Loss: 7 psig maximum, through middle third of flow range.

2.9 SPRINKLERS

B. Automatic Sprinklers: With heat-responsive element conforming to:

1. UL 199, for applications except residential.

C. Sprinkler types and categories are as indicated and as required by application. Furnish automatic sprinklers with nominal 1/2- inch orifice for "Ordinary" temperature classification rating except where otherwise indicated and required by application.

C. Sprinkler types, features, and options include:

1. Coated, painted, or plated sprinklers.

2. Concealed ceiling sprinklers, including cover plate.

3. Pendent sprinklers.

4. Quick-response sprinklers.

5. Recessed sprinklers, including escutcheon.

6. Sidewall sprinklers.

7. Upright sprinklers.

D. Sprinkler Finishes: Chrome-plated, bronze, and painted.

E. Special Coatings: Wax, lead, and corrosion-resistant paint.

F. Sprinkler Escutcheons: Materials, types, and finishes for following sprinkler mounting applications. Escutcheons for concealed, flush, and recessed-type sprinklers are specified with sprinklers.

1. Ceiling Mounting: Chrome-plated steel, 2-piece, with 1-inch vertical adjustment.

2. Sidewall Mounting: Chrome-plated steel, 1-piece, flat.

G. Sprinkler Guards: Wire-cage type, including fastening device for attaching to sprinkler.

H. Sprinkler Cabinets: Finished steel cabinet and hinged cover, with space for minimum of 6 spare sprinklers plus sprinkler wrench, suitable for wall mounting. Include number of sprinklers required by NFPA 13 and 1 wrench for sprinklers. Include separate cabinet with sprinklers and wrench for each style sprinkler on project.

2.10 SPECIALTY SPRINKLER FITTINGS

A. Specialty Fittings: UL-listed and FM-approved, made of steel, ductile iron, or other materials compatible with system materials and applications where used.

B. Mechanical-"T" Fittings: UL 213, ductile-iron housing with pressure-responsive gasket, and 360 degree fasteners (i.e., U-bolts) and threaded.

C. Sprinkler Alarm Test Fittings: Ductile-iron housing with 1-1/2-inch inlet and outlet, integral test valves, combination orifice and sight glass, and threaded.

2.11 NONADJUSTABLE HOSE VALVES

A. General: UL 668, 300 psig minimum rating, brass, nonadjustable type, hose valve for connection of fire hose. Include 90 degree angle pattern design, female NPS inlet and male hose outlet, and lugged cap, gasket, and chain. Size 1-1/2 inches or 2-1/2 inches as indicated. Hose valve threads are according to NFPA 1963 and match local fire department threads.

1. Finish: Rough chrome plated.

2.12 FIRE DEPARTMENT CONNECTIONS

A. Exposed, Wall-Type Fire Department Connections: UL 405, cast-brass body; NH-standard thread inlets according to NFPA 1963 and matching local fire department threads; and threaded NPS outlet. Include lugged cap, gasket, and chain; lugged swivel

connection and drop clappers for each hose connection inlet; and round wall escutcheon plate with marking "AUTO SPKR & STANDPIPE."

1. Connections: Two 2-1/2-inch inlets and 4-inch outlet.

2. Finish: Polished chrome plated.

2.13 ALARM DEVICES

A. Alarm Devices: Types and sizes that will match piping and equipment connections.

B. Waterflow Indicators: UL 346, electrical-supervision type, vane-type waterflow detector, rated to 250 psig, and designed for horizontal or vertical installation. Include 2 SPDT (single-pole, double-throw) circuit switches to provide isolated alarm and auxiliary contacts, 7 ampere, 125 volts a.c. (7 A, 125 V a.c.) and 0.25 ampere, 24 volts d.c. (0.25 A, 24 V d.c.); complete with factory-set, field-adjustable retard element to prevent false signals and tamper-proof cover that sends a signal when cover is removed.

C. Supervisory Switches: UL 753, for valves, electrical-supervision type, SPDT (single-pole, double-throw), normally closed contacts, designed to signal controlled valve in other than full open position.

D. Supervisory Switches: UL 753, for indicator posts, electrical-supervision type, SPDT (single-pole, double throw), normally closed contacts, designed to signal controlled valve in other than full open position.

2.14 PRESSURE GAUGES

A. Pressure Gauges: UL 393, 3-1/2 to 4-1/2 inches diameter dial with dial range of 0-250 psig.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in for hose valves, hose racks, and cabinets to verify actual locations of piping connections prior to installing cabinets.

B. Examine walls and partitions for suitable thickness, fire- and smoke-rated construction, framing for cabinets, and other conditions where cabinets are to be installed.

C. Do not proceed until unsatisfactory conditions have been corrected.

3.2 SPRINKLER AND STANDPIPE SYSTEM PIPING APPLICATIONS

A. Refer to Part 2 of this section for detailed specifications on pipe and fittings products. Use pipe, tube, fittings, and joining methods as identified in Part 2. Piping may be joined with flanges instead of indicated joints. Use grooved-end fittings with grooved couplings that are made by the same manufacturer and that comply with listing when used together for grooved-coupling joints.

B. Pipe Between Fire Department Connections and Check Valves: Use galvanized-steel pipe instead of black-steel pipe when steel pipe is specified for applications below. Do not use welded joints.

3.3 VALVE APPLICATIONS

A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:

1. Shutoff Duty: Use gate, ball, or butterfly valves.

2. Throttling Duty: Use globe, ball, or butterfly valves.

3.4 JOINT CONSTRUCTION

A. Refer to Division 23, Section 230050 - BASIC MECHANICAL MATERIALS AND METHODS for basic piping joint construction.

B. Grooved-End Pipe and Grooved-End Fitting Joints: Use grooved-end fittings and grooved couplings that are made by the same manufacturer and that are listed for use together. Groove pipe and assemble joints with grooved coupling, gasket, lubricant, and bolts according to coupling and fitting manufacturer's written instructions.

C. Mechanically Formed Outlet Joints: Use UL-listed procedure and follow forming equipment manufacturer's written instructions. Drill pilot hole in tube, form branch for collar, dimple tube to form seating stop, and braze branch tube into formed-collar outlet.

3.5 WATER SUPPLY CONNECTION

A. Connect fire protection piping to water supply piping of size and in location indicated.

B. Install shutoff valve, backflow preventer, pressure gauge, drain, and other accessories indicated at connection to water supply piping.

3.6 PIPING INSTALLATIONS

A. Refer to Division 23, Section 230050 - BASIC MECHANICAL MATERIALS AND METHODS for basic piping installation.

B. Locations and Arrangements: Drawings (plans, schematics, and diagrams) indicate general location and arrangement of piping. Install piping as indicated, as far as practical.

2. Deviations from approved "working plans" for sprinkler piping require written approval from authority with jurisdiction. File written approval with the Architect prior to deviating from approved "working plans."

C. Use approved fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.

D. Install unions adjacent to each valve in pipes 2 inches and smaller. Unions are not required on flanged devices or in piping installations using grooved couplings.

E. Install flanges or flange adapters on valves, apparatus, and equipment having 2-1/2-inch and larger connections.

F. Install "Inspector's Test Connections" in sprinkler piping, complete with shutoff valve, sized and located according to NFPA 13. All test connections shall discharge to the exterior with appropriate splash protection (e.g., splash block).

G. Install sprinkler piping with drains for complete system drainage. All drain lines shall discharge to the exterior with appropriate splash protection.

H. Install sprinkler zone control valves, test assemblies, and drain headers adjacent to standpipes.

I. Install drain valves on standpipe systems, of sizes and in locations indicated. All drain lines shall discharge to the exterior with appropriate splash protection.

J. Install ball drip valves to drain piping between fire department connections and check valves, and where indicated. Drain to floor drain or outside building.

K. Install alarm devices in piping systems.

L. Hangers and Supports: Comply with NFPA 13. Install according to NFPA 13 and NFPA 14.

2. Install hanger and support spacing and locations for steel piping joined with grooved mechanical couplings according to manufacturer's written instructions for rigid systems.

M. Install pressure gauges on riser or feed main, at each sprinkler test connection, and at top of each standpipe. Include pressure gauges with connection not less than 1/4 inch and with soft metal seated globe valve, arranged for draining pipe between gauge and valve. Install gauges to permit removal, and install where they will not be subject to freezing.

3.7 SPECIALTY SPRINKLER FITTING INSTALLATIONS

A. Install specialty sprinkler fittings according to manufacturer's written instructions.

3.8 VALVE INSTALLATIONS

A. Refer to Division 23 for installation of general-duty valves. Install fire-protection specialty valves, trim, fittings, controls, and specialties according to NFPA 13 and NFPA 14, manufacturer's written instructions, and the authority having jurisdiction.

B. Gate Valves: Install fire-protection service valves supervised-open, located to control sources of water supply except from fire department connections. Where there is more than 1 control valve, provide permanently marked identification signs indicating portion of system controlled by each valve.

C. Install check valve in each water supply connection. Install backflow preventers instead of check valves in potable water supply sources.

D. Alarm Check Valves: Install valves in vertical position for proper direction of flow, including bypass check valve and retard chamber drain line connection.

3.9 BACKFLOW PREVENTER INSTALLATION

D. Install backflow preventers of type, size, and capacity indicated. Comply with plumbing code and authority with jurisdiction. Install air-gap fitting on units with atmospheric vent connection and pipe relief outlet drain to nearest floor drain. Do not install bypass around backflow preventer.

3.10 SPRINKLER APPLICATIONS

D. All sprinklers shall be quick response.

B. Rooms without Ceilings: Upright or pendent sprinklers.

D. Cab: Concealed sprinklers.

D. Other rooms with Suspended Ceilings: Pendent, recessed, and concealed sprinklers.

E. Wall Mounting: Sidewall sprinklers.

F. Sprinkler Finishes: Use sprinklers with following finishes:

1. Upright, Pendent, and Sidewall Sprinklers: Chrome-plated in finished spaces exposed to view; rough bronze in unfinished spaces not exposed to view; wax-coated where exposed to acids, chemicals, or other corrosive fumes.

2. Concealed Sprinklers: Rough brass, with factory-painted white cover plate.

3. Recessed Sprinklers: Bright chrome, with bright chrome escutcheon.

3.11 SPRINKLER INSTALLATIONS

A. Install sprinklers in uniform patterns.

B. Install sprinklers in suspended ceilings in center of acoustical panels and tiles.

C. Install headguards in all mechanical rooms, storage rooms and other areas required by NFPA 13.

D. Do not install pendent or sidewall, wet-type sprinklers in areas subject to freezing. Use dry-type sprinklers supplied from heated space.

3.12 HOSE VALVE INSTALLATIONS

A. Hose Outlet Valves: Install 2-1/2-inch hose outlet valves with quick-disconnect 2-1/2-inch to 1-1/2-inch reducing coupling and flow restriction device at each standpipe outlet for hose connections.

3.13 FIRE DEPARTMENT CONNECTION INSTALLATIONS

A. Install fire department connections of types and features indicated in locations indicated.

B. Install ball drip valves at each check valve for fire department connection to mains and where indicated. Drain to floor drain or outside building.

3.14 CONNECTIONS

A. Connect to specialty valves, hose valves, specialties, fire department connections, and accessories.

B. Connect water supplies to standpipe and sprinkler systems. Include backflow preventers.

C. Connect water supply piping to fire pump system piping. Fire pumps, pressure maintenance pumps, controllers, and accessories are specified in Division 21, Section 213250- ELECTRONIC-DRIVE, VERTICAL IN-LINE FIRE PUMPS.

D. Electrical Connections: Power wiring is specified in Division 26.

E. Connect alarm devices to fire alarm system.

3.3 FIELD QUALITY CONTROL

A. Perform field acceptance tests of each fire protection system.

1. Flush, test, and inspect sprinkler piping systems according to NFPA 13 Chapter "System Acceptance."

2. Flush, test, and inspect standpipe systems according to NFPA 14 Chapter "Tests and Inspection."

B. Replace piping system components that do not pass test procedures specified. Then retest to demonstrate compliance. Repeat procedure until satisfactory results are obtained.

1. Report test results promptly and in writing to Architect.

2. Report test results promptly and in writing to authority having jurisdiction when required.

3.4 CLEANING

A. Clean dirt and debris from sprinklers and escutcheons. Replace sprinklers having paint other than factory finish with new sprinklers. Cleaning and reuse of painted sprinklers is prohibited.

3.5 COMMISSIONING

A. Starting Procedures: Follow manufacturer's written procedures. If no procedures are prescribed by manufacturer, proceed as follows:

1. Verify that specialty valves, trim, fittings, controls, and accessories have been installed correctly and operate correctly.

2. Verify that specified tests of piping are complete.

3. Check that damaged sprinklers and sprinklers with paint or coating not specified have been replaced with new, correct type of sprinklers.

4. Check that sprinklers are correct type, have correct finish and temperature ratings, and have guards where required for applications.

5. Check that potable water supplies have correct type of backflow preventer.

6. Check that hose valves and fire department connections have threads compatible with local fire department equipment and have correct pressure rating.

7. Fill wet-pipe sprinkler systems with water.

8. Fill wet standpipe systems with water.

9. Check for correct type and size hose valves.

10. Energize circuits to electrical equipment and devices.

11. Adjust operating controls and pressure settings.

B. Coordinate with fire alarm system tests. Operate systems as required.

C. Coordinate with fire pump tests. Operate systems as required.

3.6 DEMONSTRATION

A. Demonstrate equipment, specialties, and accessories. Review operating and maintenance information.

B. Schedule demonstration with at least 7 days' advance notice.

END OF SECTION 213250

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SECTION 221000 – PLUMBING PIPING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Conditions and Division 01 Specification Sections, apply to this Section.

B. Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them.

1.02 SUMMARY

A. Provide materials and installation for complete first class plumbing systems, within and to five feet beyond building perimeter unless noted otherwise on Contract Drawings; Sanitary Waste and Vent Piping, Storm Drain Piping, Domestic Water Piping, Domestic Water Valves, Testing and other normal parts that make the systems operable, code compliant and acceptable to the authorities having jurisdiction.

1.03 REFERENCE STANDARDS

A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.

B. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this Project.

C. All materials, installation and workmanship shall comply with the applicable requirements and standards addressed within the following references:

1. 2012 Edition of the International Plumbing Code.

2. NOTE: MD Anderson takes various exceptions to the International Plumbing Code and has adopted the more stringent requirements within the Uniform Plumbing Code. These exceptions are included within Project Specifications and/or Project Design Drawings.

3. NSF/ANSI 61 : Drinking Water System Components - Health Effects.

4. NSF/ANSI 372 : Drinking Water System Components – Lead Content

1.04 QUALITY ASSURANCE

A. Manufacturer’s name and pressure rating shall be permanently marked on valve body.

B. The Contractor shall notify the manufacturer's representative prior to installing any copper press fittings. The Contractor shall obtain the representative’s guidance in any unfamiliar installation procedures. The manufacturer's representative of copper press fittings shall conduct periodic inspections of the installation and shall report in writing to the Contractor and Owner of any observed deviations from manufacturer’s recommended installation practices.

C. Manufacturer Qualifications: Company shall have minimum three years documented experience specializing in manufacturing the products specified in this section.

D. All grooved joint couplings, fittings, flanges, valves, and specialties of the same type shall be the products of a single manufacturer. Grooving tools shall be of the same manufacturer as the grooved components.

E. Installer Qualifications:

1. Company shall have minimum three years documented experience specializing in performing the work of this section.

2. Installation of plumbing systems shall be performed by individuals licensed by the Texas State Board of Plumbing Examiners as a Journeyman or Master Plumber. Installation may be performed by Apprentice Plumbers provided they are registered with the Texas State Board of Plumbing examiners and under direct supervision of a licensed plumber. All installation shall be supervised by a licensed Master Plumber.

3. All installers of copper press fittings shall be trained by the fitting manufacturer's appointed representative. Written notification of training shall be submitted to Owner prior to any installation.

4. All installers of copper grooved fittings shall be trained by the fitting manufacturer's appointed representative. Written notification of training shall be submitted to Owner prior to any installation.

1.05 SUBMITTALS

A. Product Data:

1. Code and Standards compliance, manufacturer's data for pipe, fittings, valves and all other products included within this specification section.

2. Grooved joint valves, couplings and fittings shall be specifically identified with the applicable style or series designation.

3. Manufacturer’s installation instructions.

B. Record Documents:

1. Record actual locations of valves, etc. and prepare valve charts.

2. Test reports and inspection certification for all systems listed herein.

3. Provide a certificate of completion detailing the domestic water system chlorination procedure and all laboratory test results.

4. Submit proposed location of access panels which vary from quantities or locations indicated on Contract Drawings.

5. Provide full written description of manufacturer’s warranty.

C. Operation and Maintenance Data:

1. Include components of system, servicing requirements, Record Drawings, inspection data, installation instructions, exploded assembly views, replacement part numbers and availability, location and contact numbers of service depot.

1.06 DELIVERY, STORAGE AND HANDLING

A. All materials shall be new, undamaged, and free of rust.

B. Accept valves on Site in shipping containers and maintain in place until installation.

C. Provide temporary protective coating and end plugs on valves not packaged within containers. Maintain in place until installation.

D. Provide temporary end caps and closures on pipe and fittings. Maintain in place until installation.

E. Protect installed piping, valves and associated materials during progression of the construction period to avoid clogging with dirt, and debris and to prevent damage, rust, etc. Remove dirt and debris and repair materials as work progresses and isolate parts of completed system from uncompleted parts.

F. Protect all materials that are to be installed within this project from exposure to rain, freezing temperatures and direct sunlight. EXCEPTION: Materials manufactured for exterior locations.

1.07 EXTRA MATERIALS

A. Provide the Owner with one differential pressure meter kit for use with domestic hot water return circuit balancing valves installed within this project. Kit shall include differential pressure gauge, hoses with 90 micron inline filters, readout probes, circuit setter calculator and carrying case.

PART 2 - PRODUCTS

2.01 GENERAL

A. All materials shall meet or exceed all applicable referenced standards, federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction.

B. Provide materials as specified herein and indicated on Contract Drawings. All materials and work shall meet or exceed all applicable Federal and State requirements and conform to adopted codes and ordinances of authorities having jurisdiction.

C. Pressure ratings of pipe, fittings, couplings, valves, and all other appurtenances shall be suitable for the anticipated system pressures in which they are installed.

2.02 SANITARY WASTE AND VENT AND STORM DRAINAGE PIPING

A. Cast iron soil pipe and fittings with hubless connections using clamp type gasketed mechanical fasteners above ground and hub and spigot DWV pipe and fittings with neoprene compression gasket joints for all buried pipe. Cast iron soil pipe, fittings and hub gaskets shall be manufactured by Tyler Pipe or Charlotte Pipe and Foundry. All cast iron pipe and fittings shall be of the same manufacturer.

B. Secondary (emergency overflow) roof drain piping that discharges onto face of exterior building wall shall be CPVC Type IV, manufactured in accordance with ASTM F 2618, with CPVC drainage pattern fittings meeting ASTM D 3311. Joining method for CPVC pipe and fittings shall be with CPVC solvent cement manufactured in accordance with ASTM F 493. CPVC pipe and fittings shall meet 25/50 flame/smoke requirement for use in return air plenums when tested to ASTM E 84. All pipe, fittings and cement shall be supplied together and warranted as a system, manufactured by Spears Manufacturing Company or Owner approved equal. EXCEPTION: Secondary roof drain piping that discharges at grade level shall be as specified within paragraphs 2.02 A and/or C.

C. Unburied primary storm drainage and sanitary waste and vent piping for sizes 4” and smaller may be seamless copper DWV tube with wrought copper or wrought copper alloy solder joint drainage pattern DWV fittings.

D. Indirect waste piping sizes 1-1/4” through 2” serving fixtures and equipment shall be seamless copper DWV tube with wrought copper or wrought copper alloy solder joint drainage pattern DWV fittings.

E. Indirect waste piping sizes 1” and smaller serving equipment shall be type "L" hard drawn copper pipe and wrought copper or cast copper alloy solder joint fittings using lead-free solder and non-corrosive flux. Elbows shall be long radius type. Tee fittings shall be combination wye with 45 degree elbow.

F. Cast iron soil pipe compression gaskets shall be monolithically molded from an elastomer meeting ASTM C 564 and shall be of same manufacturer as pipe and fittings.

G. Clamps for joining hubless cast iron pipe and fittings sizes 1-1/2” through 15” shall meet the performance criteria of FM 1680, have type 304 stainless steel jacket, ASTM C 564 neoprene gasket and type 305 stainless steel band screws designed to be installed with a pre-set torque wrench. Couplings shall be manufactured by Clamp-All, Inc. HI-TORQ 125 or Husky, Inc., Orangeshield SD 4000.

H. Hubless piping systems shall not be used in a directly buried, underground application. EXCEPTION: No-hub type fittings with clamp type coupling joints may be used below ground for pipe sizes up to 10” at connections to existing cast iron sewers provided couplings are cast iron with stainless steel bolts as manufactured by MG Piping Products.

I. Solder for copper piping shall be lead-free Tin/Copper/Silver/Nickle(optional) solder conforming to ASTM B32, Wolverine Silvabrite 100 Lead-Free Solder or Harris Nick Lead-Free Solder. Use water soluble flux recommended by solder manufacturer and conforming to ASTM B813 and NSF 61, Wolverine Silvabrite 100 Water Soluble Flux or Bridgit Water Soluble Paste Flux.

J. Lubricant for drainage cleanout plugs shall be Loctite Marine Grade Anti-Seize or approved equal by Bostik Chemical Group, or Dow Corning Corporation.

K. Double sanitary tee fittings shall be not be used as a drainage fitting.

L. Provide IAPMO figure one, IAPMO figure five or double wye and eighth bend fittings on vertical lines serving back-to-back fixture drains.

M. Double wye and eighth bend fittings shall not be installed in horizontal drain lines.

N. All P-traps for floor drains, floor sinks and hub drains shall be deep-seal type.

O. Provide DWV copper trap adaptors or threaded brass marvel rings to connect fixture waste outlet to service piping within walls. Galvanized nipples shall not be acceptable.

2.03 DOMESTIC WATER PIPING (INCLUDING COLD & HOT)

A. All materials within domestic water distribution systems that may come in contact with the potable water delivered shall be UL classified in accordance with ANSI / NSF-61 for hot and cold potable water service, and shall be certified to the low lead requirements of NSF-372. Manufacturer must provide written documentation of compliance.

B. All brass and bronze piping materials within domestic water distribution systems that may come in contact with the potable water delivered shall have no more than 15% zinc content.

C. Unburied piping shall be type "L" hard drawn copper pipe and wrought copper or cast copper alloy solder joint fittings using lead-free solder and non-corrosive flux. Piping sizes 2-1/2” and larger may be type “L” hard drawn copper and wrought copper or cast copper alloy roll groove fittings Style 607 Quick Vic utilizing no-sweat coupling with NSF 61 and NSF 372 approved gasket for hot and cold water, and flange adaptor Style 641 assemblies as manufactured by Victaulic or Owner approved equal by Anvil.

1. Flaring of tube and fitting ends to IPS dimensions is not allowed.

2. Provide a phenolic flange washer with flange when the mating flange face is not a smooth, hard surface. Refer to manufacturer’s installation instructions for additional details.

D. Unburied piping sizes ½” through 4" installed within occupied buildings for modifying existing systems may utilize copper press fittings when the following conditions are met:

1. Written approval of the Owner's Property Manager shall be obtained prior to bidding.

2. Fittings shall be installed in portions of systems having an operating pressure that will not exceed 200 p.s.i.g.

3. Fittings shall conform to the material and sizing requirements of ASME B16.18 or ASME B16.22.

4. O-rings for copper press fittings shall be EPDM. Copper press fittings shall be rated at 200 psi working pressure and 250 degree working temperature.

5. All copper press fittings, couplings and specialties shall be manufactured by Viega.

6. Installation tools shall be as recommended by the fittings manufacturer.

E. Solder for copper piping shall be lead-free Tin/Copper/Silver/Nickle(optional) solder conforming to ASTM B32, Wolverine Silvabrite 100 Lead-Free Solder or Harris Nick Lead-Free Solder. Use water soluble flux recommended by solder manufacturer and conforming to ASTM B813 and NSF 61, Wolverine Silvabrite 100 Water Soluble Flux or Bridgit Water Soluble Paste Flux.

F. Buried domestic water service entrance piping 4” and larger shall be cement mortar lined Class 53 ductile iron pipe and 350 psi working pressure ductile iron fittings using mechanical joints. All buried ductile iron pipe and fittings shall be encased in polyethylene per ANSI/AWWA Standard C105/A21.5, Method A. Minimum thickness of polyethylene shall be 8 mil.

G. Buried pressurized piping sizes 1” and smaller shall be type “K” soft copper. No joints shall be allowed below slab. Encase piping within ½” thick un-slit flexible tube type elastomeric thermal insulation up to 1” above slab at both ends. Insulation shall be AP/Armaflex or Rubatex Insul-Tube 180.

H. Unburied trap primer piping shall be same as specified for domestic water except all elbows shall be long radius type.

I. Buried trap primer piping shall be type “K” soft copper. No joints shall be allowed below slab except at connection to drain. Encase piping within ½” thick un-slit flexible tube type elastomeric thermal insulation up 1” above slab. Insulation shall be AP/Armaflex or Rubatex Insul-Tube 180.

J. Dielectric waterway fittings shall have a copper-silicon casting or a zinc electroplated steel pipe body with high temperature stabilized polyolefin polymer liner; manufactured by Victaulic, Style 647 or PPP, Inc. Series 19000, or Owner approved equal by Anvil.

K. Dielectric unions shall be rated at 250 psi, ground-joint type with inert, non-corrosive thermoplastic sleeve. End connection materials shall be compatible with respective piping materials; manufactured by EPCO Sales, Inc or Watts. Provide models to suit applicable transitions.

L. Dielectric flanges shall be rated at 175 psi, have nylon bolt isolators and dielectric gasket. Materials shall be compatible with respective piping materials; manufactured by EPCO Sales, Inc or Watts. Provide models to suit applicable transitions.

M. Pipe joint compound shall be lead-free, non-toxic, non-hardening and compliant with ANSI/NSF 61 and Federal Specification TT-S-1732. Temperature service range of -15ºF to +400ºF, manufactured by Hercules “MegaLoc” or approved equal by Rectorseal, La-Co or Oatey.

N. All exterior water piping sizes 2” and smaller installed above grade shall be provided with electric heat in the form of 120 volt, single phased tape rated at 5 watts per lineal foot at 50°F. Heat tracing shall be manufactured for freeze protection service and be self-regulating to energize at 50°F. Provide an accessible temperature sensing thermostat between electrical power supply and connections to heat tracing to prevent power from activating tracing unless outside ambient temperature is at or below 40°F. This Contractor shall coordinate with the electrical Contractor to provide electrical power supply and connection. Heat tracing shall be by Raychem XL-TRACE or Thermon FLX. Thermostats shall be Raychem AMC-F5 or Thermon N4X-40.

2.04 DOMESTIC WATER VALVES: (INCLUDING COLD & HOT)

A. Similar types of valves shall be the product of one manufacturer; i.e., all butterfly valves shall be of the same manufacturer, all ball valves shall be of the same manufacturer, etc.

B. Line Shut-Off Valves up to and including 2” shall be two-piece bronze body of ASTM B584 Alloy 844, ASTM B61, or ASTM B62, full port ball type rated at 600 WOG with threaded connections, blow-out proof stem, plastic coated lockable lever handle, Teflon packing, 316 stainless steel ball and stem. Acceptable valves are NIBCO Model T-585-70-66-LL-LF, or approved equivalent model by Crane, Milwaukee or Apollo.

C. Line Shut-Off Valves 2-1/2” and larger where system operating pressure will not exceed 160 p.s.i.g. shall be 200 WOG threaded lug type ductile iron body butterfly valve with extended neck, lockable lever handle, 416 stainless steel stem, aluminum bronze disc, EPDM liner and seal, suitable for bi-directional flow and dead end service with downstream flange removed. Acceptable valves are NIBCO Model LD-2000, or approved equivalent model by Keystone, Jamesbury, Milwaukee, Crane or Apollo.

D. Line Shut-Off Valves 2-1/2” and larger installed within systems having design operating pressures between 160 and 250 p.s.i.g. shall be threaded lug type ductile iron body butterfly valve with extended neck, lockable lever handle, 316 stainless steel stem and disc, EPDM liner and seal, suitable for bi-directional flow and dead end service with downstream flange removed. Acceptable valves are NIBCO Model LD-3022, or approved equivalent model by Keystone, Jamesbury, Dezurik, Milwaukee, Crane or Apollo.

E. Line Shut-Off Valves 2-1/2” and larger installed in roll grooved copper systems may be 300 psi roll grooved end type bronze body butterfly valve with lockable lever handle, aluminum bronze disc, with pressure responsive Grade CHP Fluoroelastomer seat, stem shall be offset from the disc centerline to provide complete 360-degree circumferential seating, suitable for bi-directional flow and dead end service. Manufactured by Victaulic Series 608N or Anvil Model B680.

F. Provide stem extensions of a non-thermal conducting material for valves in insulated lines to allow unobstructed operation.

G. Provide memory stops on all ball valves installed in domestic hot water return lines. Memory stops shall be adjustable after pipe insulation is applied.

H. Provide line shut-off valves that have the same inside diameter of the upstream pipe in which they are installed.

I. Domestic Hot Water Return Circuit Balancing Valves 1/2" through 3" shall be machined ball type calibrated balancing valve with lead free ASTM B283-C69300 Brass body/304 Stainless Steel ball construction, glass and carbon filled TFE seat rings, EPDM stem "O" ring, threaded NPT inlet/outlet connections, 400 psig maximum working pressure at 250ºF. Valve shall have differential pressure read-out ports across valve seat area fitted with internal EPT inserts/check valves. Valve body shall have 1/4" NPT tapped drain/purge port. Valve shall have calibrated nameplate and memory stop feature to allow valve to be closed for service and then reopened to set point without disturbing balance position. Valve shall contain less than 0.25% lead content by weight on wetted surfaces and be designed for positive shut-off.. Valves shall be same size as the pipe installed. Provide valves as scheduled on Contract Drawings manufactured by Bell & Gossett Circuit Setter Plus CB series, or Owner approved equal.

J. Swing Check Valves, 2" and smaller - “Y” or “T” pattern bronze, Class 150, with threaded connections and screw-in cap. Manufactured by NIBCO Model T-433-Y or approved equivalent model by Milwaukee or Crane.

K. Spring Loaded Check Valves, 2" and smaller - Silent closing, bronze, Class 125, with threaded connections, Buna disc, bronze or stainless steel spring. Manufactured by NIBCO Model T-480 or approved equivalent model by Milwaukee or Crane.

L. Swing Check Valves, 2-1/2" and larger - 200 pound CWP, Iron body, with bronze or stainless steel trim. Manufactured by NIBCO Model F-918-B or approved equivalent model by Milwaukee or Crane.

M. Swing Check Valves, 2-1/2" and larger - 285 pound CWP, Iron body, with stainless steel trim. Manufactured by NIBCO Model F-938-33 or approved equivalent model by Milwaukee or Crane.

N. Spring Loaded Check Valves, 2-1/2" and larger - 200 pound CWP, Iron body, with bronze or stainless steel trim. Manufactured by NIBCO Model F-910 or approved equivalent model by Milwaukee or Crane.

O. Spring Loaded Check Valves, 2-1/2" and larger - 400 pound CWP, Iron body, with bronze or stainless steel trim. Manufactured by NIBCO Model F-960 or approved equivalent model by Milwaukee or Crane.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify that excavations are to required grade, dry and not over-excavated. Do not install underground piping when bedding is wet or frozen.

B. Before commencing work, check final grade and pipe invert elevations required for drain terminations and connections to ensure proper slope.

3.02 PREPARATION

A. Ream pipes and tubes. Remove burrs, scale and dirt, inside and outside, before assembly. Remove foreign material from piping.

B. Prepare piping connections to equipment with flanges or unions.

3.03 INSTALLATION

A. Installation shall meet or exceed all applicable federal, state and local requirements, referenced standards and conform to codes and ordinances of authorities having jurisdiction.

B. All installation shall be in accordance with manufacturer's published recommendations.

C. General

1. Care shall be exercised to avoid all cross connections and to construct the plumbing systems in a manner which eliminates the possibility of water contamination.

2. Install all materials and products in accordance with manufacturer's published recommendations. Use tools manufactured for the installation of the specific material or product.

3. Wipe all paste residue and excess solder from all solder joints.

4. Heat generated by soldering procedures shall not be transmitted to valves, copper alloy roll groove fittings, copper press fittings, no-hub clamps, or any other components installed within the piping system that may be damaged due to high temperatures. Contractor shall take all precautions necessary, including utilizing wet wrapping or allowing heated piping to cool to ambient temperature before attachment.

5. Pipe joints, no-hub clamps, flanges, unions, etc., shall not directly contact or be encased in concrete, or be located within wall, floor or roof penetrations.

   a. Exception: No-hub clamps may be located within floor penetrations where job conditions require fittings that dimensionally cannot extend completely through floor slab. Fire stopping submittal must include a U.L. listed assembly that indicates the no-hub clamp within the penetration.

6. Route piping in direct orderly manner and maintain proper grades. Installation shall conserve headroom and interfere as little as possible with use of spaces. Route exposed piping parallel to walls. Group piping whenever practical at common elevations.

7. Install piping to allow for expansion and Contraction without stressing pipe, joints or connected equipment.

8. Furnish all supports required by the piping included in this specification section.

9. Penetrations through fire rated walls, floors and partitions shall be sealed to provide a U.L. rating equal to or greater than the wall, floor or partition.

10. Seal all penetrations through floors, exterior building walls and grade beams air and water tight.

11. Each plumbing pipe projecting through roof shall be installed in accordance with Contract Specifications and Drawings. Penetrations shall be sealed air and water tight. Refer to details on Contract Drawings and coordinate with General Contractor for flashing requirements.

12. Furnish and install all necessary valves, traps, gauges, strainers, unions, etc. for each piece of equipment (including Owner furnished equipment) having plumbing connections, to facilitate proper functioning, servicing and compliance with code.

13. Provide code-approved transition adaptors when joining dissimilar piping materials. Adaptors installed shall be manufactured specifically for the particular transition.

14. All piping shall have reducing fittings used for reducing or increasing where any change in the pipe sizes occurs. No bushing of any nature shall be allowed in piping.

15. Close nipples shall not be installed in plumbing piping systems.

16. Bury outside water and drainage pipe minimum one foot below recorded frost depth.

17. Buried piping shall be supported throughout its entire length.

18. All excavation required for plumbing work is the responsibility of the plumbing Contractor and shall be done in accordance with Contract Documents.

19. Piping shall be insulated in accordance with Contract Documents.

20. Provide clearance for installation of insulation and for access to valves, air vents, drains, unions, etc.

21. Provide dielectric isolation device where non-ferrous components connect to ferrous components. Devices shall be dielectric union, coupling or dielectric flange fitting.

22. All piping shall be isolated from building structures, including partition studs, to prevent transmission of vibration and noise.

23. Isolate all bare copper pipe from ferrous building materials. “Tape is not an acceptable isolator.

D. Drainage and Vent Systems

1. Slope drainage lines uniformly at 1/4" per foot, for lines 3" and less, and 1/8" per foot for larger lines, unless noted otherwise on Contract Drawings. Maintain gradients through each joint of pipe and throughout system.

2. Buried pipe shall be laid on a smoothly graded, prepared subgrade soil foundation true to alignment and uniformly graded. Bell holes shall be hand-excavated so that the bottom of the pipe is in continuous contact with the surface of the prepared subgrade material. Piping invert shall form a true and straight line.

3. The size of drainage piping shall not be reduced in size in the direction of flow. Drainage and vent piping shall conform to the sizes indicated on the Contract Drawings. Waste lines from water closets shall not be smaller than four inches. Under no circumstances shall any drain or vent line below slab be smaller than two inches.

4. Unburied horizontal cast iron soil piping shall be supported at least at every other joint except that when the developed length between supports exceeds four feet, they shall be provided at each joint. Supports shall also be provided at each horizontal branch connection and at the base of each vertical rise. Supports shall be placed immediately adjacent to the joint. Suspended lines shall be braced to prevent horizontal movement. Unburied vertical cast iron soil piping rising through more than one floor level shall be supported with riser clamps at each floor level.

5. Install couplings for hubless pipe and fittings in accordance with manufacturer's published recommendations. Use pre-set torque wrench and tighten band screws as required by manufacturer’s published instructions.

6. All unburied change of direction fittings within the roof drainage system shall be braced against thrust. Bracing shall incorporate galvanized steel pipe clamps and tie rods.

7. Provide cleanouts within sanitary waste systems at locations and with clearances as required by the code, at the base of each waste stack and at intervals not exceeding 75 feet in horizontal runs.

8. Provide cleanouts at the base of each vertical downspout and at intervals not exceeding 75 feet in horizontal building storm drain. Provide clearances as required by code. Horizontal roof drain piping located above building ground floor level will not require cleanouts.

9. A removable sink or lavatory p-trap with cleanout plug shall be considered as an approved cleanout for 2” diameter pipe.

10. All interior cleanouts shall be accessible from walls or floors. Provide wall cleanouts in lieu of floor cleanouts wherever possible. A floor cleanout shall be installed only where installation of a wall cleanout is not practical.

11. Provide a wall cleanout for each water closet or battery of water closets. Locate wall cleanouts above the flood level rim of the highest water closet but no more than twenty four inches above the finished floor.

12. Coordinate the location of all cleanouts with the architectural features of the building and obtain approval of locations from the Project Architect.

13. Lubricate cleanout plugs with anti-seize lubricant before installation. Prior to final completion, remove cleanout plugs, re-lubricate and reinstall using only enough force to provide a water and gas tight seal.

14. Install trap primer supply to floor drains, hub drains and floor sinks that are susceptible to trap seal evaporation and where indicated on Project Drawings. Primer unit installation shall comply with manufacturer's published recommendations. Trap primer lines shall slope to drain at a minimum ¼” per foot.

15. Capped waste and vent connections for future extensions shall be located accessibly and not extend more than 24” from active main. Waste connections and vent connections shall be located at elevations that will allow future installation of properly sloped piping without the need to dismantle or relocate installed ductwork, piping, conduit, light fixtures, etc.

16. Unless indicated otherwise within Contract Documents, all sanitary vent pipes passing through the roof shall be provided with lead roof flashings constructed of 2-1/2 pound sheet lead with bases extending no less than ten inches on each side of the pipe. The vertical portion of the flashing shall extend upward the entire length of pipe and be turned tightly inside the pipe at least two inches and shall not reduce the inside diameter of vent pipe more than the thickness of the flashing. Lead flashings shall be furnished by Plumbing Contractor and turned over to Roofing Contractor for installation.

17. Locate all sanitary vent terminals a minimum of 25 feet horizontally from or 3 feet vertically above all air intakes, operable windows, doors and any other building openings.

18. Wastewater when discharged into the building drainage system shall be at a temperature not higher than 140°F. When higher temperatures exist, approved cooling methods shall be provided.

E. Domestic Water System

1. On each water supply line serving a plumbing fixture, item of equipment, or other device which has a water supply discharge outlet below the overflow rim, or where cross contamination may occur, provide and install an approved vacuum breaker or backflow preventer. Installation of vacuum breakers shall prevent any possible backflow through them.

2. Provide thrust blocking and clamps for mechanical joint or gasketed underground water pipe at fittings with 3/4" rods, and properly anchor and support. Restraining rods, clamps and hardware shall be thoroughly coated with bituminous material to prevent corrosion.

3. Copper piping shall be supported at no greater than six foot intervals for piping 1-1/2" and smaller and ten foot intervals for piping 2" and larger in diameter.

4. Install all water piping to allow all piping within the system to be drained at low points.

5. Air chambers, dead-legs, or any other piping arrangement that may allow water to stagnate shall not be installed within domestic water systems. Valves installed for future connections shall not extend more than 24” from an active main.

6. Provide manufactured water hammer arrestors in water supply lines as indicated on Contract Drawings and in accordance with Standard PDI-WH201.

7. Pipe insulation shall be applied over installed freeze protection heat tracing tape.

8. Install union type fitting downstream of isolation valves at equipment connections.

9. Solder joint fittings shall not be installed within 24" of a copper press fitting.

10. Identify piping utilizing copper press fittings in accordance with project specification section 230553.

F. Domestic Water Valves

1. Domestic water shut-off valves shall be installed where shown on Drawings, at each fixture and piece of equipment, at each branch take-off from mains, at the base of each riser, and at each battery of fixtures.

2. Install shut-off valves in accessible locations. Provide access panels where valves would otherwise be inaccessible. Coordinate quantity, size and location requirements of access panels with General Contractor.

3. When altering or connecting to existing domestic water systems, verify that existing line shut-off valves provide positive isolation from the sections of piping serving areas outside of the Project Boundaries. Install new line shut-off valves where valves do not exist to provide positive isolation.

4. Install shut-off valves with stems upright or horizontal, not inverted.

5. Where threaded valves are installed in copper piping systems special care shall be taken to avoid damaging the valve or its parts due to overheating. Install copper or bronze male adaptors in each inlet of threaded valves. Sweat solder adaptors to pipe prior to connecting to valve body.

6. Provide spring loaded type check valves on discharge of water pumps.

7. Provide accessible check valves in the individual cold and hot water fixture supply lines serving mixing valve type faucets or assemblies having hose connection outlets that are not equipped with integral check stops.

8. Install a shutoff valve immediately upstream of each strainer

9. Install domestic hot water return circuit balancing valves where indicated on Contract Drawings and locate a minimum length of unrestricted straight pipe diameters downstream and upstream of all fittings and/or line shut-off valves as recommended by the valve manufacturer. Location of valves shall allow unobstructed access for monitoring and adjustment.

10. Adjust and set domestic hot water return circuit balancing valves to flows indicated on Contract Drawings and in accordance with valve manufacturer's published instructions. Use flow meter recommended by valve manufacturer.

11. Provide a line shut-off valve, strainer, temperature gauge and union, upstream of each hot water return circuit balancing valve.

12. Provide check valve and isolation valve immediately downstream of each hot water return circuit balancing valve.

3.04 TESTING AND CLEANING

A. General

1. Equipment, material, power, and labor necessary for the cleaning, flushing, sterilization, inspection and testing of systems covered within this Specification Section shall be furnished by the Plumbing Contractor. All testing and inspection procedures shall be in accordance with Division 01 and Special Condition requirements of this Contract.

2. For any requested inspection, the Contractor shall complete prior inspections and tests to ensure that items are ready for inspection and acceptance by the Owner and/or Architect/Engineer. The Contractor shall be responsible for any and all costs incurred by Owner and/or Owner representatives, including consultants, resulting from a review or inspection that was scheduled prematurely.

3. The Contractor shall conduct the tests and the Owner's Construction Inspector will witness and approve the results.

4. Verify systems are complete, flushed and clean prior to testing. Isolate all equipment subject to damage from test pressure. Test and inspect for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. Piping being tested shall not leak nor show any loss in test pressure for duration specified.

5. Leave piping uninsulated, uncovered and unconcealed until it has been tested and approved. Where any portion of piping system must be concealed before completion of entire system, the portion shall be tested separately as specified for the entire system prior to concealment. Contractor shall expose all untested covered or concealed piping.

6. In cases of minor installation and repairs where specified water and/or air test procedures are deemed impractical, Contractor shall obtain written approval from Owner's Representative to perform alternate testing and inspection procedures. Alternate testing and inspection procedures for minor installation and repairs shall include visual evaluation of installed components by Owner's Representative during a simulation of use.

7. The water utilized for tests shall be obtained from a potable source of supply.

8. Prepare testing reports. If testing is performed in segments, submit separate report for each segment, complete with diagram or clear description of applicable portion of piping. After inspection has been approved or portions thereof, certify in writing the time, date, name and title of the persons reviewing the test. This shall also include the description of what portion of the system has been approved. Obtain approval signature by Owner's Representative. A complete record shall be maintained of all testing that has been approved, and shall be made available at the job Site. Upon completion of the work, all records and certifications approving testing requirements shall be submitted to the Owner's Representative before final payment is made.

9. Gauges used for testing shall have increments as follows:

   a. Tests requiring a pressure of 10 psi or less shall utilize a testing gauge having increments of 0.10 psi or less.

   b. Tests requiring a pressure of greater than 10 psi but less than or equal to 100 psi shall utilize a testing gauge having increments of 1 psi or less.

   c. Tests requiring a pressure of greater than 100 psi shall utilize a testing gauge having increments of 2 psi or less.

10. Separately test above and below ground piping.

11. Do not introduce test water into piping systems when exposure to freezing temperatures is possible.

12. Do not introduce test water into sections of piping located above existing sensitive areas and/or equipment that may be damaged or contaminated by water leakage. Coordinate with Owner's Representative to determine areas and/or equipment considered as being sensitive.

13. Defective work or material shall be reworked and replaced, and inspection and test repeated. Repairs shall be made with new materials. Pipe dope, caulking, tape, dresser couplings, etc., shall not be used to correct deficiencies.

14. The Contractor shall be responsible for cleaning up any leakage during flushing, testing, repairing and disinfecting to the original condition any building parts subjected to spills or leakage.

B. Drainage and Vent System

1. Testing:

a. Subject gravity drainage and vent piping and joints to a vertical water column pressure of at least ten feet. If after 12 hours the level of the water has been lowered by leakage, the leaks must be found and stopped and the water level shall again be raised to the level described and the test repeated until, after a 12 hour retention period, there shall be no perceptible lowering of the water level in the system being tested. This pressure shall be held for a test period of at least 15 minutes while being witnessed by the Owner's Representative.

1) Portions of drainage and vent piping located on uppermost level of building shall be subjected to a water column pressure created by filling the system to point of overflow at roof vent terminals and roof drains. The pipes for the level being tested shall be filled with water to a verifiable and visible level as described above and be allowed to remain so for 12 hours. This pressure shall be held for a test period of at least 15 minutes while being witnessed by the Owner's Representative.

b. Piping located above sensitive areas and/or equipment that may be damaged or become contaminated due to test water leakage shall be tested with air. Isolate the test section from all other sections and slowly fill pipe with oil-free air until there is a uniform gauge pressure of 5 pounds per square inch (34.5 kPa) or sufficient pressure to balance a 10-inch (254 mm) column of mercury. The air pressure shall be regulated to prevent the pressure inside the pipe from exceeding 5.0 PSIG. This pressure shall be held for a test period of at least 15 minutes. Any adjustments to the test pressure required because of changes in ambient temperature or the seating of gaskets shall be made prior to the beginning of the test period. This pressure shall be held for a test period of at least 15 minutes while being witnessed by the Owner's Representative.

2. Test forced (pumped) drainage piping by plugging the end of the piping at the point of connection with the gravity drainage system and applying a pressure of 5psi (34.5 kPa) greater than the pump rating, and maintaining such pressure for 15 minutes while being witnessed by the Owner's Representative.

3. Should the completion of these tests leave any reasonable question of a doubt relative to the integrity of the installation, additional tests or measures shall be performed to demonstrate the reliability of these systems to the complete satisfaction of the Owner’s Representative.

4. Test plugs must extend outside the end of pipe to provide a visible indication for removal after the test has been completed.

5. Cleaning and Flushing:

a. During the Plumbing Systems Functional Performance Tests, each floor drain p-trap that has successfully passed pressure testing shall be proven clean and free of debris as follows:

1) An inspection request shall be submitted to the Owner, identifying the quantity and location of drain(s) to be inspected.

2) Vacuum out each floor drain p-trap in the presence of the Owner’s Representative. A visual inspection of the trap shall be performed to verify that the trap is debris free.

3) Perform a free flowing test by pouring two five gallon buckets of water down the floor drain.

4) After the Owner's Representative has confirmed that the floor drain trap is clean and free of debris, insure that the trap is filled with water.

5) Install Trap Guard if required.

6) At the discretion of the Owner's Representative, a visual inspection of the trap utilizing a sewer scope may be required in addition to, or in lieu of, a vacuum procedure.

b. During the Plumbing Systems Functional Performance Tests, the Owner's Representative may require that any portion of the drainage, waste and vent systems installed under this Project Contract be proven undamaged, clean and free of debris. Verification of the interior condition of piping shall be accomplished utilizing a sewer scope or other method as determined by the Owner's Representative.

C. Domestic Water System

1. Testing:

a. Subject piping system to a hydrostatic pressure of at least 125 pounds per square inch gauge, but not less than the operating pressure under which it is to be used, for a period of no less than 12 hours. During test period, all pipe, fittings and accessories in the particular piping system that is being tested shall be carefully inspected. If leaks are detected, such leaks shall be stopped and the hydrostatic test shall again be applied. This procedure shall be repeated until no leaks are detected for an entire 12 hour period. This pressure shall be held for a test period of at least 15 minutes while being witnessed by the Owner's Representative.

b. EXCEPTION: Piping located above sensitive areas and/or equipment that may be damaged or become contaminated due to test water leakage shall be tested with oil-free air in lieu of water.

2. Flushing, Cleaning and Disinfection:

a. Where specified procedures are deemed impractical, Contractor shall obtain written approval from Owner's Representative to perform alternate flushing, cleaning and/or disinfection procedures.

b. All active existing domestic water piping and plumbing fixtures within the Project Boundaries that will remain in service after completion of this Project shall be periodically flushed during the duration of the Project to insure potability and sanitation.

1) Operate all plumbing fixtures and equipment that is connected to the domestic water system twice each week on Monday and Friday as follows:

a) Flush each water closet and urinal.

b) Flush water outlets (hot & cold) for a minimum of three minutes on each lavatory, sink, shower, drinking fountain, hose bib, and all other connected fixtures/equipment.

c. All existing water piping within the Project Boundaries that will remain in service after completion of this Project and has been dormant for two weeks or longer shall be flushed and disinfected as required within this specification section.

d. A bacteria test is not necessary for small scale work. However, disinfection is required. Examples of small scale work are less than 20 feet of pipe, replacement and/or installation of a sink, drinking fountain, eyewash, backflow preventer, isolation valve, etc. Disinfect individual parts, fixtures, isolation valves, pipes, etc. by swabbing with full strength bleach (5.25%) or soaking for at least 30 minutes in a 500 ppm chlorine solution. The 500 ppm solution can be made by adding one part 5.25% bleach (household bleach) to 100 parts drinking water. For example 3-1/2 ounces of bleach can be added to 2-1/2 gallons drinking water. Materials should then be thoroughly rinsed before putting into service.

e. After completion of the testing, all new and/or altered water piping systems shall be thoroughly sterilized with a solution containing not less than 50 parts per million of available chlorine. Do not exceed 150 parts per million at any time. Introduce chlorine into the supply stream at a rate sufficient to provide a uniform concentration throughout the system. All outlets shall be opened and closed several times. When the specified level of chlorine is detected at every outlet in the system, close all valves to prevent release of water from the system for 24 hours. At the completion of the 24 hour disinfection period, test every outlet for a minimum chlorine residual of fifty parts per million. This minimum residual must be present to proceed with flushing. Flush the system with clean water at a sufficient velocity until the residual chlorine detected at every outlet is within 0.2 parts per million of the normal water supply's level.

f. Sufficient samples must be taken no sooner than 24 hours after sterilization and flushing to represent the extent and complexity of the affected water system, along with a control sample to indicate municipal water quality at the time of testing. Send water samples to an accredited laboratory to perform qualitative and quantitative bacteriological analysis in accordance with AWWA C651. Contractor shall obtain written certification from the independent testing agency stating that the water samples meet Federal and State guidelines for safe drinking water. Upon satisfactory completion of all procedures, and receipt of acceptable laboratory test results, obtain written approval by Owner's representative. Failure to fully comply with the above procedures will result in a requirement to repeat the procedure until acceptable results are achieved, at no additional cost to the Owner.

g. Isolate or bypass equipment that would be detrimentally affected by disinfecting solution. Isolate all other sections of the domestic water system not being disinfected to prevent migration of chlorine.

h. Prior to injection of chlorine into the piping system, strategically place signs stating "Heavily Chlorinated Water - Do Not Drink", and protect all outlets to prevent use during disinfection and flushing procedures.

3.05 TRAINING

A. Obtain services of the copper press fitting manufacturer to provide on-site training for Contractor's field personnel in the use of pressing tools and installation of fittings. The manufactures representative shall periodically visit the jobsite and provide the contractor information concerning the best recommended practices in product installation. A distributor's sales representative is not considered qualified to conduct the training or jobsite visit(s).

B. Obtain services of the grooved copper fitting manufacturer to provide on-site training for Contractor's field personnel in the use of grooving tools, application of groove, and installation of grooved end couplings. The manufactures representative shall periodically visit the jobsite and provide the contractor information concerning the best recommended practices in grooved product installation. A distributor's sales representative is not considered qualified to conduct the training or jobsite visit(s).

END OF SECTION 221000

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SECTION 221030 – PLUMBING SPECIALTIES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Conditions and Division 01 Specification Sections, apply to this Section.

B. Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them.

1.02 SUMMARY

A. Provide all materials and installation for plumbing specialties within building domestic water, sanitary waste and storm drainage systems; floor drains, floor sinks, hub drains, roof drains, cleanouts, backflow preventers, vacuum breakers, pressure regulating valves, water hammer arrestors, wall hydrants, hose bibbs, trap primer units, strainers, temperature gauges, pressure gauges and other normal parts that make the systems complete, operable, code compliant and acceptable to the authorities having jurisdiction.

1.03 REFERENCE STANDARDS

A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.

B. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this Project.

C. All materials, installation and workmanship shall comply with the applicable requirements and standards addressed within the following references:

1. 2012 Edition of the International Plumbing Code.

2. NOTE: MD Anderson takes various exceptions to the International Plumbing Code and has adopted the more stringent requirements within the Uniform Plumbing Code. These exceptions are included within Project Specifications and/or Project Design Drawings.

3. ANSI/NSF Standard 61 - Drinking Water System Components - Health Effects.

1.04 QUALITY ASSURANCE

1. Manufacturer’s name and pressure rating shall be permanently marked on valve body.

2. All materials shall be new, undamaged, and free of rust. Protect installed products and associated materials during progression of the construction period to avoid clogging with dirt, and debris and to prevent damage, rust, etc. Remove dirt and debris as work progresses.

3. Manufacturer Qualifications: Company shall have minimum three years documented experience specializing in manufacturing the products specified in this section.

4. Installer Qualifications: Company shall have minimum three years documented experience specializing in performing the work of this section. Installation of plumbing systems shall be performed by individuals licensed by the Texas State Board of Plumbing Examiners as a Journeyman or Master Plumber. Installation may be performed by Apprentice Plumbers provided they are registered with the Texas State Board of Plumbing examiners and under direct supervision of a licensed plumber. All installation shall be supervised by a licensed Master Plumber.

1.05 SUBMITTALS

A. Product Data:

1. Provide Code and Standards compliance, component dimensions, service sizes and finishes.

B. Record Documents:

1. Manufacturer's certification documentation for backflow preventers.

2. Submit proposed location of access panels which vary from quantities or locations indicated on Contract Drawings.

3. Provide full written description of manufacturer's warranty.

4. Record actual locations of plumbing specialties installed.

C. Operation and Maintenance Data:

1. Include testing procedures for backflow preventers, adjustment procedures for water pressure regulating valves.

2. Include installation instructions, exploded assembly views. servicing requirements, inspection data, installation instructions, spare parts lists, replacement part numbers and availability, location and contact numbers of service depot, for all plumbing specialties installed

1.06 DELIVERY, STORAGE AND HANDLING

A. Accept specialties on site in shipping containers and maintain in place until installation.

B. Provide temporary protective coating and end plugs on valves not packaged within containers. Maintain in place until installation.

C. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work and isolating parts of completed system.

D. Protect all materials before and after installation from exposure to rain, freezing temperatures and direct sunlight. EXCEPTION: Materials manufactured for installation within exterior environments.

1.07 EXTRA MATERIALS

A. Provide two loose keys for each type of wall hydrant box.

B. Provide manufacturer's standard test kit for each type of backflow preventer installed.

PART 2 - PRODUCTS

2.01 GENERAL

A. All materials shall meet or exceed all applicable referenced standards, federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction.

B. Provide plumbing specialties as indicated and scheduled on the Contract Drawings and as specified herein. All materials and work shall meet or exceed all applicable Federal and State requirements and conform to adopted codes and ordinances of authorities having jurisdiction.

C. Pressure and temperature ratings of plumbing specialties shall be suitable for the anticipated system pressures and temperatures in which they are installed.

D. All materials within domestic water distribution systems that may come in contact with the potable water delivered shall be UL classified in accordance with ANSI / NSF-61 for hot and cold potable water service, and shall be certified to the low lead requirements of NSF-372. Manufacturer must provide written documentation of compliance..

E. All brass and bronze plumbing specialties within domestic water distribution systems that may come in contact with the potable water delivered shall have no more than 15% zinc content.

F. Specialties of same type shall be product of one manufacturer.

2.02 ACCEPTABLE MANUFACTURERS

A. Floor Drains:	Wade, Zurn, Smith, Josam.
B. Roof Drains:	Wade, Zurn, Smith, Josam.
C. Wall/Floor Cleanouts:	Wade, Zurn, Smith, Josam.
D. Backflow Preventers and Vacuum Breakers:	Watts Regulator, Febco, Conbraco.
E. Water Pressure Regulating Valves:	Wilkins, Watts Regulator, Cla-Val.
F. Water Hammer Arrestors:	Wade, Zurn, Smith, Josam.
G. Wall Hydrants:	Wade, Zurn, Smith, Josam.
H. Hose Bibbs:	Chicago.
I. Trap Primer Units:	As Specified Herein
J. Strainers:	Conbraco, Wilkins, Watts
K. Temperature Gauges:	Ashcroft, Trerice, Weksler
L. Pressure Gauges:	Ashcroft, Trerice, Weksler

2.03 FLOOR DRAINS (FD)

A. All floor drains shall be furnished and installed with all options and accessories required for a waterproof installation within the particular construction in which they are to be mounted.

B. Each floor drain shall be provided with a deep-seal p-trap unless noted otherwise.

C. Floor drains installed for general floor area drainage within toilet rooms and other finished spaces shall have cast iron body with flange, adjustable top and sediment bucket, integral reversible clamping collar, seepage openings, 1/2" plugged primer tap, and 6” diameter nickel bronze or stainless steel strainer with vandal proof screws.

D. Floor drains installed for general floor area drainage and light to medium flow indirect equipment discharge within mechanical rooms shall have cast iron body with plugged 1/2" primer tap, integral clamping collar, seepage openings, adjustable top and 11-1/2” diameter ductile iron loose set tractor grate.

E. Floor drains installed for non-monolithic shower stall floors shall have cast iron body with flange, adjustable top, integral reversible clamping collar, seepage openings and 5” diameter nickel bronze or stainless steel strainer with vandal proof screws.

F. All floor drains shall be as sized and scheduled on Contract Drawings.

2.04 HUB DRAINS (HD)

A. Hub drains shall be cast iron soil pipe manufactured hubs or hub adapters. Field cut no-hub or plain-end pipe stub-ups are not acceptable.

B. Each hub drain shall be provided with a deep-seal p-trap.

2.05 ROOF DRAINS (RD)

A. Primary roof drains shall be furnished and installed with all options and accessories required for a waterproof installation within the particular construction in which they are to be mounted and have lacquered cast iron body with sump, removable cast iron or bronze dome strainer, flashing flange and clamp, gravel stop, deck clamp and drain receiver. Provide extension where required.

B. Secondary (emergency overflow) roof drains shall be furnished and installed with all options and accessories required for a waterproof installation within the particular construction in which they are to be mounted and have minimum 2” high water dam, acid resistant epoxy coated cast iron body and sump, removable bronze dome strainer, flashing flange and clamp, gravel stop, deck clamp and drain receiver. Provide extension where required.

C. Roof drains shall be sized as indicated on Contract Drawings.

2.06 CLEANOUTS:

A. Cleanouts shall be the same nominal size as the pipe they serve up to four inches.

B. Cleanouts shall have cast iron body with tapered cast brass or bronze plug providing gas and watertight seal.

C. Interior floor cleanouts shall have stainless steel or nickel bronze scoriated top. Provide carpet marker when installed in areas to be covered by carpet.

D. Exterior cleanouts at grade shall have scoriated cast iron top.

E. Wall cleanouts shall be provided with stainless steel access covers of adequate size to allow rodding of drainage system. Wall cleanouts incorporating cover screws that extend completely through the access plug are not acceptable.

2.07 BACKFLOW PREVENTERS (INCLUDES BACKPRESSURE AND BACKSIPHONAGE)

A. Reduced Pressure Zone Type (Not For Use In Fire Protection Water Supply):

1. The assembly shall meet the requirements of ASSE 1013, AWWA C511.

2. The assembly shall consist of a pressure differential relief valve located in a zone between two positive seating check valves and captured springs. Backsiphonage protection shall include provision to admit air directly into the reduced pressure zone via a separate channel from the water discharge channel. The assembly shall include two tightly closing shutoff valves before and after the valve and test cocks.

3. Test cocks

4. Seats: Bronze, removable and replaceable without removing valve from the line.

5. Checks: Independently operating.

6. Relief Valve: Independently operating, located between the two check valves.

7. Rated 175 psi maximum working pressure with continuous temperature range of 33 to 140°F.

8. Unit to be complete with vent-port funnel to maintain the air gap and to provide a drain connection point.

9. Sizes 1/4" and 1/2" - Bronze body, bronze strainer, upstream and downstream quarter-turn ball valves, union connections: Watts Regulator Company Series 009.

10. Sizes 3/4" through 2" - Bronze body, bronze strainer, upstream and downstream quarter-turn ball valves, union connections: Watts Regulator Company Series 919.

11. Sizes 2-1/2" through 10" - FDA epoxy coated cast iron body, FDA epoxy coated strainer, upstream and downstream OSY – UL/FM outside stem and yoke resilient seated gate valves, flange connections: Watts Regulator Company Series 909.

B. Reduced Pressure Zone Type (For Use In Fire Protection Water Supply):

1. The assembly shall meet the requirements of ASSE 1013, be U.L. classified and FM Approved.

2. The assembly shall consist of a pressure differential relief valve located in a zone between two positive seating check valves and captured springs. Backsiphonage protection shall include provision to admit air directly into the reduced pressure zone via a separate channel from the water discharge channel. The assembly shall include two tightly closing shutoff valves before and after the valve and test cocks.

3. Test cocks

4. Replaceable seats

5. Checks: Independently operating.

6. Relief Valve: Independently operating, located between the two check valves.

7. Rated 175 psi maximum working pressure with continuous temperature range of 33 to 110°F.

8. Unit to be complete with vent-port funnel to maintain the air gap and to provide a drain connection point.

9. Sizes 2-1/2" through 10" - Schedule 40 stainless steel body, upstream and downstream UL/FM outside stem and yoke resilient seated gate valves or UL/FM grooved gear operated butterfly valves with tamper switches: Watts Regulator Company Series 957.

C. Double Check Valve Assembly (Not for Fire Protection Water Supply):

1. The assembly shall meet the requirements of ASSE 1015, AWWA C510

2. Top entry access points for each check assembly

3. Replaceable seats

4. Test cocks

5. Rated 175 psi maximum working pressure with continuous temperature range of 33 to 140°F.

6. Sizes 1/2" through 2" - Bronze alloy body, bronze strainer, upstream and downstream quarter-turn ball valves, union connections: Watts Regulator Company Series 719.

7. Sizes 2-1/2" through 10" - FDA epoxy coated cast iron body, FDA epoxy coated strainer, upstream and downstream OSY – UL/FM outside stem and yoke resilient seated gate valves, flange connections: Watts Regulator Company Series 709.

D. Double Check Valve Assembly (For Use In Fire Protection Water Supply):

1. The assembly shall meet the requirements of ASSE 1015, be U.L. classified and FM Approved.

2. Two independent tri-link check modules within a single housing

3. Sleeve access port

4. Four test cocks

5. Rated 175 psi maximum working pressure with continuous temperature range of 33 to 110°F.

6. Sizes 2-1/2" through 10" - Schedule 40 stainless steel body, upstream and downstream UL/FM outside stem and yoke resilient seated gate valves or UL/FM grooved gear operated butterfly valves with tamper switches: Watts Regulator Company Series 757.

E. Continuous Pressure Vacuum Breaker (Not For Use In Fire Protection Water Supply. Not to be used for backpressure protection):

1. Tested and certified under ASSE Standard 1056.

2. Suitable for continuous pressure hot and cold water.

3. Brass body and seat with silicon rubber discs.

4. Rated maximum pressure 150 psi and working temperature 33 to 180 degrees F.
5. Complete with quarter turn ball valves and test cocks.
6. Sizes 3/8” through 1” - Spill-resistant, Watts Regulator Company Series 008PCQT.

F. Dual Check Valves (For Use in Beverage Dispenser Water Supply):

1. Certified to ANSI/NSF Standard 18.
2. Tested and certified under ASSE Standard 1022.
3. Atmospheric port
4. 316 stainless steel body
5. Rated maximum pressure 150 psi and working temperature 33 to 130 degrees F.
6. Sizes ¼” and 3/8” – Watts Regulator Company Series SD-3.

2.08 WATER PRESSURE REGULATING VALVES

A. Low to Moderate Flow Systems (Less Than 70 GPM) and Individual Equipment

1. Sizes 1/2" through 2"
2. All bronze body
3. 0.25% maximum weighted average lead content
4. Integral stainless steel strainer screen
5. Built-in bypass check valve
6. FDA approved elastomers
7. Renewable seat
8. Union end connection
9. Rated for water temperature up to 180°F and minimum 300 psi inlet pressure. Provide model with inlet pressure rating, reduced pressure range and factory preset outlet pressure as scheduled on Contract Drawings.
10. Manufactured by Wilkins Series 600XL or approved equal by Watts.

B. Large Demand Systems

1. Sizes 1-1/4” through 2 - ASTM B62 bronze body
2. Sizes 2-1/2” and larger - ASTM A536 ductile iron body
3. Pressure reducing pilot control
4. Stainless steel disc guide, seat and bearing cover
5. Stainless steel stem, nut and spring

6. FDA approved Nylon reinforced Buna-N rubber diaphragm

7. Provide model(s) with size, temperature range, inlet pressure rating, reduced pressure range, outlet pressure and options as scheduled on Contract Drawings.

8. Cla-Val Company Series 90 or approved equal by Watts.

2.09 WATER HAMMER ARRESTORS (SHOCK ABSORBERS):

A. Nesting type bellows operated water hammer arrestor with male N.P.T. connection. Bellows and body casing made of Type 304 stainless steel. Water hammer arrestors shall be certified to the PDI WH-201 Standard and ASSE Standard 1010.

B. Arrestors shall be designed and manufactured for a maximum working temperature of 250F and maximum operating pressure of 125 P.S.I.G.

C. Water hammer arrestors shall be sized according to water hammer arresters standard PDI-WH-201 and as indicated on Contract Drawings.

2.10 WALL HYDRANTS (WH)

A. Provide antisiphon, non-freeze wall hydrant with brass casing, integral backflow preventer, vandalproof box with loose-key handle and finish as scheduled on Drawings.

2.11 HOSE BIBBS (HB)

A. General Areas: Provide Chicago Faucet No. 387 chrome plated brass hose bibb with ¾-inch female inlet, wall flange, tee handle and No. E27 vacuum breaker.

B. Housekeeping Mop Sinks: Provide Chicago Faucet No. 293-369COLDCP chrome plated brass hose bibb with ¾-inch female inlet, wall flange and lever handle.

2.12 FLOOR DRAIN TRAP PROTECTION INSERTS

A. Trap seal protection inserts shall only be installed where job conditions prevent the installation of water supplied trap primers.

1. Trap seal protection insert shall not be installed in drains receiving waste that may have a temperature greater than 140 degrees F.

2. Trap seal protection insert shall not be installed in drains receiving waste discharge flow of greater than 30 gallons per minute.

3. Trap seal protection insert shall not be installed in drains receiving corrosive or chemical waste.

B. Floor drain trap seal protection insert shall provide watertight seal inside the floor drain and prevent emission of sewer gas and backup of sewage.

C. Insert material shall be resistant to common cleaning solutions, lime scale and microbiological growth and incorporate a Elastomeric flexible tube that closes when water is not passing through and opens to permit water flow from an intermittent drip. Insert shall provide no restriction on water flow up to 30 gallons per minute.

D. Insert shall properly functions despite lodging of common debris such as mop strings, food residue, etc.

E. Trap seal protection insert shall be manufactured by ProSet "Trap Guard", model to suit installation.

2.13 WATER SUPPLIED TRAP PRIMER UNITS (TP)

A. Trap Priming devices that rely upon line pressure differential for activation are not allowed.

B. Electronic Trap Primers:

1. Provide model with quantity of outlets and type of mounting box as scheduled on Contract Drawings.

2. The number of traps served by a single trap priming device shall not exceed the number of header outlets provided within the device. Auxiliary distribution units are not allowed.

3. All unused header outlets shall be capped water-tight with compatible threaded fittings.

4. Each electronic trap primer device shall be provided with a readily serviceable strainer immediately upstream of the device solenoid valve.

5. Electronic trap primers shall provide 10 second water injection to traps every twenty-four hours, complete with galvanized steel box and cover, copper inlet connection, brass ball type stop valve, slow closing 24 VAC solenoid valve with integral strainer, 120-24 VAC transformer, brass atmospheric vacuum breaker, and copper waterway.

6. Electronic trap primers shall be manufactured by Zurn Z1020-CW or approved equal by Precision Plumbing Products “Prime Time”, model to suit installation.

C. Vacuum Breaker Trap Primer for use with exposed Flushometers:

1. This type of device shall not serve more than one trap.

2. One Piece, Chrome Plated Flush Connection.

3. Water Deflector to control the amount of water diverted from the flush.

4. 3/8” Elbow and Flex-bend Tube connection from Vacuum Breaker to wall.

5. Diverter Wall Flange and Fittings

6. Chrome Plated Wall Flange and Fitting to connect ½” NPT pipe.

7. High Back Pressure Vacuum Breaker.

8. One-piece Bottom Hex Coupling Nut.

9. Sloan Model VBF-72-A1

D. Trap Primer for use with Lavatory or Sink Drain Tailpiece:

1. This type of device shall not serve more than one trap.

2. Polished Chrome Plated Cast Bronze P-trap with Ground Joint Outlet.

3. Threaded Wall Tube, Slip Joint Nuts, Washers and Escutcheons.

4. 1/2" Polished Chrome Plated Bronze Primer Tube with Compression Fitting Connection at Wall.

5. Jay R. Smith Model 2698 or approved equal of a referenced acceptable manufacture.

2.14 STRAINERS

A. Strainers, 2" and smaller, bronze body, screwed ends, No. 20 mesh type 304 stainless steel screen, screwed cap with bronze blow-off valve (size to be determined by standard tap size in cap).

B. Strainers, 2-1/2" and larger, Cast iron body, isolating type flanged ends where installed in copper lines, .125” perforated type 304 stainless steel screen, flanged cap with bronze ball blow-off valve (size of blow-off valve shall be determined by standard tap size in cap). Special Note: All strainers 6" and larger shall have studs mounted in the body flange in lieu of bolts for removal of cap. Baskets for strainers 6" and larger shall have stainless steel reinforcing bands at ends to prevent collapsing.

2.15 TEMPERATURE GAUGES:

A. Thermometers shall be vapor or liquid actuated, direct-mounted, universal adjustable angle dial type with stainless steel or cured polyester powder coated cast aluminum case, stainless steel friction ring and glass window. Dial face shall be white with black figures; pointer shall be friction adjustable type. Movement shall be brass with bronze bushings. Bourdon tube shall be phosphor bronze with a brass socket.

B. Thermometer range shall be 30 - 240° Fahrenheit and have an accuracy of ±1 scale division.

C. Dial face shall be 4½” diameter where installed within eight feet of floor level and 6” diameter where installed higher than six feet above floor level. Provide remote read-out gauges for isolated or hard to access monitoring points.

D. Provide a brass or stainless steel separable thermowell for each thermometer.

E. Thermometers shall have a sensing bulb with an insertion length of roughly half of the pipe diameter; minimum insertion length shall be 2". Thermometers installed on tanks shall have a minimum insertion length of 5".

F. Where insulation thickness exceeds 2", provide proper bulb length and an extension neck separable thermowell. The extension neck shall be at least 2" long.

2.16 PRESSURE GAUGES:

A. Gauges shall comply with ASME B40.1, Grade 2A, and have ±0.5 percent of full scale accuracy, with type 304 stainless steel or aluminum case, bronze wetted parts and brass socket. Dial face shall be 3½” diameter where installed within six feet of floor level and 6” diameter where installed higher than eight feet above floor level. Dial face shall be aluminum with white background, black graduations and black markings. Pointer shall be adjustable with black finish. Provide remote read-out gauges for isolated or hard to access monitoring points.

B. Units of measure shall be in pounds per square inch (psi). The proper range shall be selected so that the average operating pressure falls approximately in the middle of the scale selected.

C. All pressure gauges shall be equipped with brass or stainless steel needle valves and pressure snubbers.

PART 3 - EXECUTION

3.01 PREPARATION

A. Coordinate cutting and forming of roof and floor construction to receive drains with General Contractor.

B. Verify location of equipment and housekeeping pads prior to installation of floor drains. Relocation due to misplacement shall be at Contractor's expense.

3.02 INSTALLATION

A. General

1. Installation shall meet or exceed all applicable federal, state and local requirements, referenced standards and conform to codes and ordinances of authorities having jurisdiction.

2. Install plumbing specialties in accordance with manufacturer's published instructions.

B. Drains and Cleanouts

1. Extreme care shall be used to set the top elevation of floor drains and floor sinks to meet the low point elevation of the finished floor.

2. Pipe connections to roof drains, above grade floor drains and floor sinks shall not directly contact or be encased in concrete.

3. Final mounting of interior cleanout top or access cover shall be set flush with the finished floor or wall surface. Lubricate threaded cleanout plugs with mixture of graphite and linseed oil.

4. Encase exterior cleanouts within 14" x 14" x 6" thick reinforced concrete pad. Set top flush with finished grade surface.

5. Locate cleanouts with required clearance for rodding of drainage system.

C. Backflow Preventers and Vacuum Breakers

1. Isolate all non-potable water requirements from the building domestic water system with backflow prevention device manufactured and certified for the particular application.

2. Pipe relief from backflow preventer indirectly to drain of sufficient size to evacuate maximum flow discharge.

3. Backflow preventers shall be duplexed full-size where located within domestic water lines serving in-patient areas, critical research areas, and/or any area or equipment where un-interruptible (24 hour) water service is required.

4. Test ports shall not be located more than 72 inches above finished floor or permanent platform.

5. Do not install vacuum breakers or backflow preventers above equipment, above ceilings, concealed within walls, or areas where water leakage can cause damage.

6. Install a strainer immediately upstream of each vacuum breaker and backflow preventer.

D. Water Hammer Arrestors (Hydraulic Shock Absorbers)-

1. Provide hydraulic shock absorbers in cold and hot water supply lines to each fixture branch, battery of fixtures and at each automatic, solenoid-operated or quick-closing valve serving equipment.

2. Locate and size hydraulic shock absorbers in accordance with PDI-WH-201 Standard and manufacturer's published recommendations.

3. Install hydraulic shock absorbers with clearances to allow inspection, removal and replacement. Provide access panels where required.

E. Water Pressure Regulating Valves

1. Provide isolation valve, strainer and pressure gauge immediately upstream of each pressure regulating valve.

2. Provide pressure gauge and isolation valve immediately downstream of each pressure regulating valve.

3. Installation shall allow sufficient access to and space around components for adjustments and servicing.

4. Provide services of a direct factory representative for start-up service, inspection and necessary adjustments for all large demand regulators.

END OF SECTION 221030

SECTION 221123 – DOMESTIC WATER PRESSURE BOOSTING SYSTEMS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Conditions and Division 01 Specification Sections, apply to this Section.

B. Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them.

1.02 SUMMARY

A. Furnish and install a factory packaged and tested, triplex variable-speed domestic water pressure boosting system including pumps, motors, controls, valves, interconnecting piping, wiring and accessories for a complete, approved system.

1.03 REFERENCE STANDARDS

A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.

B. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this Project.

C. All materials, installation and workmanship shall comply with the applicable requirements and standards addressed within the following references:

1. Underwriters Laboratories Listings

2. 2012 Edition of the International Plumbing Code

3. 2011 Edition of the National Electric Code

4. National Electrical Manufacturers Association

5. ANSI/NSF Standard 61 - Drinking Water System Components - Health Effects

1.04 QUALITY ASSURANCE

A. All equipment under this section shall be furnished by a single supplier and shall be products that the manufacturer regularly engages in. The supplier shall have sole responsibility for proper functioning of the system and equipment supplied.

B. The manufacturer of the domestic water pressure boosting system shall be responsible for compliance with all applicable codes and regulations, and be held accountable for the complete pump package and installation.

C. Manufacturer's Qualifications: Company specializing in manufacturing the products specified in this Section with minimum three years documented experience. The packaged system manufacturer shall have 24 hour local service available provided by a trained factory authorized representative.

D. All disconnects, transformers, and control devices shall be installed to provide minimum wire bending clearances per N.E.C. All wiring shall be stranded copper conductors with 90° C. insulation. Conductors shall be numbered and identified at all termination points. All wiring shall be installed in nylon wire ways and laced with nylon tie straps. All disconnects, transformers, controllers, control devices, selector switches, and indicator lights shall be provided with nameplates indicating their respective function and/or identification. A factory wiring schematic shall be permanently affixed to the inside of cabinet door. The entire assembly shall be wired and tested in accordance with the National Electrical Code (N.E.C.). All components shall be built to National Electrical Manufacturers Association (NEMA) standards and be Underwriters Laboratory (U.L.) approved. The entire control panel shall bear the U.L. Label for enclosed industrial control panels. The entire package pumping system shall comply with Federal Regulations 29 CFR 1910.399 and certified through ETL under Category 225 and ULQCZJ.

E. Installer's Qualifications: The system shall be installed by a firm having minimum three years experience regularly engaged in the installation of variable speed domestic booster pump systems.

F. Certification shall obtained by the manufacturer indicating that the function and performance characteristics of all products and materials have been determined by testing and ongoing surveillance by an approved third-party certification agency. Assertion of certification shall be in the form of identification in accordance with the requirements of the third-party certification agency.

1.05 SUBMITTALS

A. Product Data:

1. Provide manufacturers literature including general assembly, pump curves showing performance characteristics with pump and system with operating point indicated, NPSH curve, controls, wiring diagrams, and service connections.

2. Code and Standards compliance.

3. Third-Party Certification.

B. Record Documents:

1. Provide full written description of manufacturer’s warranty.

2. Shop Drawings: Indicate layout, general assembly, components, dimensions, weights, clearances, and methods of assembly.

3. Manufacturer's Installation Instruction: Indicate support details, connection requirements, and include start-up instructions for pump system.

4. Manufacturer's Certificate: Certify that pumps meet or exceed specified requirements at specified operating conditions. Submit summary and results of factory tests performed.

5. Field Reports: Submit verification statement, signed by system manufacturer representative, of start-up, adjustment service and acceptance of installation. Indicate summary of hydrostatic test and field acceptance tests performed.

C. Operation and Maintenance Data:

1. Operation Data: Include manufacturer’s instructions, start-up data, trouble-shooting check lists, for pumps, drivers, and controllers.

2. Maintenance Data: Include manufacturer's literature, cleaning procedures, replacement parts lists, and repair data for pumps, drivers and controllers, preventive maintenance schedule, preventive maintenance recommendations and procedures. Identify place of purchase, location and contact numbers of service depot and technical support for each product installed.

1.06 DELIVERY, STORAGE AND HANDLING

A. Accept pumps and components on Site in factory packing. Inspect for damage. Comply with manufacturers rigging and installation instructions.

B. Protect pumps and components from physical damage including effects of weather, water, and construction debris.

C. Provide temporary inlet and outlet caps, and maintain in place until installation.

1.07 EXTRA MATERIALS

A. Provide one (1) spare variable frequency drive for each equivalent horsepower motor included within the system.

1.08 WARRANTY

A. All components furnished shall be warranted for a period of 12 months from documented date of startup.

1.09 MAINTENANCE SERVICE

A. Furnish service and maintenance of packaged system for one year from documented date of Substantial Completion.

PART 2 - PRODUCTS

2.01 GENERAL

A. All materials shall meet or exceed all applicable referenced standards, federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction.

B. All materials that may come in contact with the potable water delivered shall comply with ANSI/NSF Standard 61.

C. All brass and bronze piping materials that may come in contact with the potable water delivered shall have no more than 15% zinc content.

D. Pressure ratings of pumps, pipe, fittings, valves, gauges and all other water carrying appurtenances shall be suitable for the anticipated system pressures in which they are installed.

E. The Contractor shall ascertain for himself the space and access available for the installation of a factory assembled packaged unit and as an option may assemble the various components in place at the Site in lieu of providing a factory assembled unit. However, all components of the system shall be compatible and be furnished by a single source manufacturer and all electrical services and interconnecting equipment wiring must be provided for within this Contractors bid.

F. The booster system shall be factory assembled on a steel skid including pumps, motors, valves, Type "L" copper or Schedule 40 300 series stainless steel suction and discharge manifolds, all interconnecting piping, wiring, variable frequency drives with logic and power controls.

G. Over pressurization of the system while operating across-the-line shall be prevented by a pilot operated diaphragm type combination pressure regulating and non-slam check valve on each pump. Main valve and cover shall be ductile iron with a fused epoxy coating and stainless steel stem and cover bolts. Construction shall be suitable for the maximum working pressure of the system.

H. All pilot lights and visual indicators shall be illuminated from the rear by long life LED lamps. Neon and incandescent lamps are not acceptable.

I. Provide isolation valves on the suction and discharge of each pump. The isolation valves shall be 600 WOG full-port ball valves (2" and smaller) and lug style butterfly valves (2½ " and larger).

J. Provide two 4 1/2" ASME grade A, panel mounted gauges for indicating system suction and system discharge pressure.

K. All skid-mounted components shall be factory finished in high quality epoxy or enamel paint. The base shall be suitable for grouting.

L. The packaged pumping system shall include all electrical wiring between components and shall be completed and tested at the factory prior to shipment.

M. Unions or flanges shall be provided for easy removal of pumps. Pipe headers shall be sized for a velocity not exceeding 7-1/2 FPS and shall be terminated with a groove joint capable of accepting a groove coupling or groove flange furnished by Contractor.

N. System shall be arranged such that single point connections are required for piping and electrical power supply.

O. Individual pumps, motors and pressure regulating or check valves shall be serviceable with the booster system in operation.

P. All similar components shall be of one manufacturer, (i.e., valves, gauges, etc.).

Q. Refer to schedules on Contract Drawings for required pump capacities and electrical characteristics.

2.02 ACCEPTABLE MANUFACTURERS

A. The following manufacturers are acceptable provided their products meet or exceed these Specifications and the Contract drawing schedules:

1. Armstrong
2. Bell and Gossett
3. Canariis
4. Grundfos
5. Namco
6. Patterson Pump

7. Syncroflo

8. Tigerflow

2.03 PUMPS AND MOTORS

A. System shall include three horizontal mounted close-coupled end suction centrifugal pumps with ANSI flanged connections. Pump features to include foot supported casing, back pull out design, top centerline discharge and hydraulically balanced impeller. Pump shall be cast iron bronze fitted construction with a replaceable shaft sleeve and mechanical seal.

B. Motor shall be NEMA close-coupled type with a JM shaft. Motors shall be open drip proof and manufactured in accordance with NEMA standards.

C. Motors shall be high efficiency and balanced to a maximum vibration amplitude of .001". Motors shall have ball bearings and operate at 40° ambient. Each motor shall be equipped with the manufacturer's nameplate and shall have a sufficient horsepower rating to operate the pump at any point on the pump's head-capacity curve without overloading the nameplate horsepower rating of the motor, regardless of service factor. The motor shall have a service factor of 1.15 for variations in voltage and frequency.

D. Each pump shall be provided with an individual temperature probe and purge valve having adjustable high temperature set point and differential to sense heat buildup in the pump casing. On sensing high temperature the probe circuit shall open a solenoid valve that allows the heated water to flow out.

2.04 VARIABLE FREQUENCY DRIVES

A. Provide and mount on the system skid three variable frequency drives of the PWM design suitable for variable torque applications using any standard NEMA Design B squirrel cage induction motor. Variable frequency drives shall sized for the maximum possible amp draw throughout the programmed sequence of pump operation.

B. The efficiency at full load and full speed shall be 97% with a fundamental power factor of .98.

C. Drives shall be pulse width modulated, start into a rotating load, follow signal from logic section of control panel when in auto mode and be provided with the following features:

1. Hand/off/auto switch and manual speed adjustment.

2. Auto Drive Shutdown for electrical fault.

3. Automatic restart after power fails shutdown.

4. Provide complete service diagnostics with fault history log.

D. Keypad Operator Device including the following:

1. 2 Line Backlit LCD Display.

2. Power On and Alarm/Fault Displays.

E. Operational data displays include:

1. Drive Speed (HZ)

2. Motor Power

3. Energy (kWh)

4. Current

5. Elapsed Time

6. RPM

7. Motor Voltage

F. No bypass shall be provided with any drive.

2.05 PRESSURE SENSOR/TRANSMITTER

A. Provide one pressure sensor/transmitter that provides a 4 to 20 mA DC output, compatible with the system controls, temperature and pressure requirements. Pressure sensor/transmitter shall have zero, span and damping devices. The transmitter shall be installed on the system discharge header and factory wired to the control panel.

2.06 SEQUENCE OF OPERATION

A. The lead pump shall run only as necessary to maintain system pressure and will be controlled automatically by means of a pressure sensor/transmitter and programmable logic controller (PLC) programmed to prevent short cycling. If the lead pump is unable to maintain system pressure the lag pump(s) will be called on after a time delay and will operate in parallel with the lead pump in accordance with the PLC program. When one pump can handle the system demand the controls will shut down the lag pump. When a low or no flow condition is reached, the controls will accelerate the lead pump to charge the system and hydro-pneumatic tank then shut the lead pump down and alternate.

B. In the event of a storage tank low level alarm condition, all pumps shall be shut down and shall be automatically restarted upon restoration of the storage tank level. In the event of a low system pressure alarm, all pumps shall be started and the alarm must be manually reset.

2.07 CONTROL PANEL

A. Logic Section - Provide, mount and wire on the skid a programmable logic controller in a NEMA 1 enclosure to interface the signal from the pressure sensor to the VFD's and provide a stabilized response to speed up or slow down or add pumps to meet system requirements. The controller shall provide setpoint adjustment, timer adjustment, PID functions and both system and controller self diagnostics via touch screen display. The touch screen display / human machine interface shall include a 5.7” STN display, resistive analog touch, numerical system keyboard. All user interface set points shall be easily accessible via a password protected display screen. Normal system operation shall be tuned to eliminate hunting. Controller shall have one RS 485 Communication port, real time calendar/clock and EEPROM memory transfer cartridge.

B. Power Section - Each system shall include a UL listed enclosed industrial control panel in a NEMA 1 enclosure, factory wired and mounted on the steel skid. The panel shall be furnished with individual pump disconnects with through the door handles, pump run lights, H-O-A selector switches and 115 volt fused control transformer and include the following features:

1. Control power (on-off) switch and light.

2. Low suction pressure shutdown circuit with auto reset, delay timer and light.

3. High system pressure shutdown circuit with auto reset and light.

4. Power failure monitoring.

5. Audible alarm with silence push button.
6. Auto alternate three equal pumps.
7. Auxiliary relay contacts for all alarm conditions.
8. PLC enable switch.
9. Individual pump temperature probe and purge valves.
10. Main Disconnect.
11. Audible and visual indication of low storage tank level (signal by others), with silence push button.
12. Elapsed time meters.
13. Flow sensor with digital display in GPM.
14. Seven day time clock for intermittent system operation.

2.08 HYDRO-PNEUMATIC TANK

A. Provide a verticle hydropneumatic tank with a carbon steel shell and a replaceable FDA approved heavy-duty bladder to separate the air and water. No water shall come in contact with the metal walls of the tank. Features shall include an air fill valve, pressure gauge connection and top system connection suitable for 100 percent drawdown.

B. The tank shall be constructed in accordance with Section VIII of the ASME code and be Nation Board stamped and shall be rated for minimum 125 psig operating pressure and maximum operating temperature of 240 degrees F.

C. Tank shall be factory finished in high quality epoxy or enamel paint.

D. The tank shall be mounted in a remote location at high-point of distribution piping system where shown on the Contract Drawings. Provide gauge to monitor bladder tank pressure.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Installation shall meet or exceed all applicable federal, state and local requirements, referenced standards and conform to codes and ordinances of authorities having jurisdiction.

B. All installation shall be in accordance with manufacturer’s published recommendations.

C. Install the system level and in accordance with manufacturer’s published recommendations.

D. Locate equipment with allowance for manufacturer's recommended clearances around unit.

E. Set entire unit on 4" high reinforced concrete equipment pad. Provide vibration isolators and bolt skid to pad. Structurally connect equipment pad to building slab to prevent movement.

F. Pipe discharge from all relief valves, drains and individual pump thermal purge protection solenoid valves, indirectly to floor drain having adequate capacity to accept discharge.

G. Provide valved Type "L" copper branch feed to the bladder tank from system distribution main as shown on the Contract Drawings.

3.02 FACTORY TESTING

A. The booster system shall be hydrostatically tested and shall undergo a complete electric and hydraulic test from 0 to 100% design flow at the factory. All control devices including transmitters and all safety features shall be factory calibrated and tested.

3.03 VERIFICATION AND TESTING

A. Verify that the pumps and prime movers have been aligned according to manufacturers' recommendations.

B. Test the system performance by verifying the operation of the pumps and system vs. the pump curves, alarms, controls, etc.

C. Contractor shall inform Owner 48 hours in advance of verification and testing so that Owner's Construction and Physical Plant personnel may observe pump alignment, performance verifications, and testing of system performance, alarms and controls.

3.04 INSTRUCTIONS AND START-UP

A. Provide for the service of a competent factory-trained supervising agent from the pump package manufacturer to inspect the completed installation, start the system and acquaint the operators with the proper operation and maintenance of the equipment.

END OF SECTION 221123

SECTION 223313 – ELECTRIC INSTANTANEOUS DOMESTIC WATER HEATERS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Conditions and Division 01 Specification Sections, apply to this Section.

B. Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them.

1.02 SUMMARY

A. This section covers providing all labor and materials for the complete first class installation of point-of-use electric instantaneous domestic water heaters indicated and scheduled on Contract Drawings complete with all controls, piping, valves, wiring, supports, accessories, testing, and other normal parts required for complete, operable installation that is acceptable to the authorities having jurisdiction.

1.03 REFERENCE STANDARDS

A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.

B. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this Project.

C. All materials, installation and workmanship shall comply with the applicable requirements and standards addressed within the following references:

1. 2009 Edition of the International Plumbing Code.

2. Underwriters Laboratories Listings.

3. 2011 Edition of the National Electric Code

1.04 QUALITY ASSURANCE

A. Heaters shall be designed to limit the maximum temperature to avoid scalding possibilities at low flow rates and provide constant set hot water temperatures whether one or multiple faucets are open simultaneously.

B. Manufacturer Qualifications: Company shall have minimum three years documented experience specializing in manufacturing the products specified in this section.

C. Water heaters shall be manufactured by a company that has achieved certification to the ISO 9001 International Quality System.

D. Provide equipment with manufacturer's name, model number, and rating/capacity permanently identified.

E. Installer Qualifications: Company shall have minimum three years documented experience specializing in performing the Work of this section. Installation of plumbing systems shall be performed by individuals licensed by the Texas State Board of Plumbing Examiners as a Journeyman or Master Plumber. Installation may be performed by Apprentice Plumbers provided they are registered with the Texas State Board of Plumbing examiners and under direct supervision of a licensed plumber. All installation shall be supervised by a licensed Master Plumber.

F. Ensure products and installation of specified products are in conformance with recommendations and requirements of the following organizations:

1. National Sanitation Foundation (NSF).

2. National Electric Code (NFPA 70).

1.05 SUBMITTALS

A. Product Data:

1. Include dimension Drawings of water heaters indicating piping, components and required connections.

2. Manufacturer's data sheets and Installation Instructions.

3. Provide wiring diagrams, electrical characteristics, minimum water pressure requirements and connection types.

B. Record Documents:

1. Provide full written description of manufacturer’s warranty.

C. Operation and Maintenance Data:

1. Include operation, maintenance, and inspection data, replacement part numbers and availability, and service depot location and telephone number.

1.06 DELIVERY, STORAGE AND HANDLING

A. Accept products on Site in factory packaging. Inspect for damage. Maintain products in factory packaging until installation.

B. Provide temporary inlet and outlet caps when not factory provided. Maintain caps in place until installation.

C. Protect components from damage after installation.

D. Do not allow use of heater for any reason, other than testing, during the construction phase of this project.

1.07 EXTRA MATERIALS

A. Furnish and hand to Owner a minimum of one heating element for each size and type of heater element provided within this project.

1.08 WARRANTY

A. Water heaters shall be warranted in writing against failure due to leaks of heater body and element assembly under normal use and service for a minimum period of five years after date of Substantial Completion.

PART 2 - PRODUCTS

2.01 GENERAL

A. All materials shall meet or exceed all applicable referenced standards, federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction.

2.02 POINT OF USE DOMESTIC WATER HEATER

A. Acceptable Manufacturers:

1. Eemax

2. Stiebel Eltron

3. Seisco

4. All point-of-use water heaters provided within this project shall be the product of one manufacturer.

B. Furnish and install instantaneous domestic hot water heaters with dimensions, capacities and electrical characteristics as scheduled on the Contract Drawings and as outlined herein. This Specification describes minimum quality and performance requirements. Variations of system components by the individual referenced manufacturers are acceptable for installation in this project provided they meet or exceed all of the requirements indicated herein, are compatible with the electrical service provided and fit properly in the allocated space.

C. Water Heater shall be tankless, thermostatic instantaneous type with microprocessing temperature control capable of maintaining set outlet temperature with +/– 1°F accuracy with a minimum water supply pressure of 25 psig.

D. Unit shall be rated for a maximum operating pressure of 150 psig.

E. Unit shall have ABS-UL 94Vo rated cover, field replaceable cartridge element, field replaceable filter in the inlet connector.

F. Heating element shall be iron free, Nickel Chrome material.

G. Heater shall be fitted with ½” pipe compression nuts (5/8” OD) or 3/8” sleeves. Solder type connections shall not be accepted.

H. Heater shall have nonadjustable thermostat, factory set at 105 F, unless indicated otherwise on Contract Drawings.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Installation shall meet or exceed all applicable federal, state and local requirements, referenced standards and conform to codes and ordinances of authorities having jurisdiction.

B. All installation shall be in accordance with manufacturer’s published recommendations.

C. Install water heaters, piping, wiring and accessories in accordance with the manufacturer’s installation instructions.

D. Furnish all supports required by the equipment included in this Contract in accordance with the manufacturer’s published instructions.

E. Furnish and install all necessary valves, strainers, unions, etc. to facilitate proper functioning and servicing of equipment.

F. Provide dielectric isolation device where copper lines connect to ferrous lines or equipment.

G. Install heater in a vertical position as close as possible to the hot water outlets with a minimum of 5" of clearance on all sides for servicing. Coordinate location of unit to avoid conflicts with piping, electrical outlets, casework and handicap access to plumbing fixture. Do not install unit where it would routinely be splashed with water.

H. Install a line size shutoff valve in cold water inlet close to each heater.

I. Flush water supply line to remove all air, scale and dirt prior to connecting heater.

J. Take precautions to prevent heat generated by soldering procedures from being transmitted to heater components.

K. Verify and insure that flow control outlets on faucets being served by water heater correspond with the flow requirements of the installed heater.

L. Coordinate with Electrical Contractor for power and wiring required. Verify that electrical power is connected to a properly grounded dedicated branch circuit of proper voltage rating and equipped with ground fault interrupter. Each heater shall be provided with an independent circuit. Insure that the correct wire and circuit breaker sizes are provided.

M. When all plumbing installation is completed, check for leaks and take corrective action before proceeding. Flow hot water until temperature has stabilized. Verify and insure that the water meets scheduled temperature at all outlets. Clean heater water inlet line strainer prior to final inspection of installation.

END OF SECTION 223313

SECTION 224000 – PLUMBING FIXTURES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Conditions and Division 01 Specification Sections, apply to this Section.

B. Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them.

1.02 SUMMARY

A. This section includes the furnishing of all labor and materials necessary for a complete installation of all plumbing fixtures indicated on the Drawings and specified herein.

1.03 REFERENCE STANDARDS

A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.

B. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this Project.

C. All materials, installation and workmanship shall comply with the applicable requirements and standards addressed within the following references:

1. 2012 Edition of the International Plumbing Code

2. Americans with Disabilities Act, 28 CFR Part 35 Nondiscrimination on the Basis of Disability in State and Local Government Services, Final Rule, as published in the Federal Register

3. ICC/ANSI A117.1, "Accessible and Usable Buildings and Facilities" relative to plumbing fixtures for people with disabilities

4. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water

5. ANSI/ASME A112, Plumbing Standards

1.04 PRODUCTS NOT FURNISHED BUT INSTALLED UNDER THIS SECTION

A. Rough-in for and make final connection to Owner furnished fixtures and equipment requiring plumbing services.

B. Rough-in for and make final connection to fixtures and equipment furnished under other divisions of these Contract Specifications requiring plumbing services.

1.05 QUALITY ASSURANCE

A. Fixtures, trim, accessories and carriers of any one type shall be by the same manufacturer throughout.

B. All fixtures and trim shall be new, institutional/commercial quality and free from mars, chips, scratches, blemishes or any defects.

1.06 SUBMITTALS

A. Product Data:

1. Provide manufacturer's data sheets indicating Code and Standards compliance, illustrations of fixtures, physical sizes, rough-in dimensions, utility sizes, trim and finishes.

B. Record Documents:

1. Provide full written description of manufacturer's warranty.

2. Manufacturer's installation instructions.

C. Operation and Maintenance Data:

1. Include installation instructions, exploded assembly views. servicing requirements, inspection data, installation instructions, spare parts lists, replacement part numbers and availability, location and contact numbers of service depot, for all plumbing specialties installed.

1.07 DELIVERY, STORAGE AND HANDLING

A. Accept fixtures on Site in factory packaging. Inspect for damage.

B. Protect all fixtures and trim before and after installation from exposure to rain, freezing temperatures and direct sunlight. EXCEPTION: Materials manufactured for installation within exterior environments.

C. Protect installed fixtures and trim from damage and/or entry of foreign materials by temporary covers during the construction phase of this project.

D. Do not allow use of installed fixtures and trim for any reason, other than testing, during the construction phase of this project.

1.08 EXTRA MATERIALS

A. Provide two service kits for each type of faucet, flush valve, shower/tub valve and all other trim/accessories having serviceable parts.

1.09 FIELD MEASUREMENTS

A. Verify that field measurements are either as indicated on Shop Drawings or as instructed by the manufacturer. Designate within submittals that measurements have been verified, and note which measurements are the basis for construction.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Stainless Steel Sinks:	Just, Elkay
B. Mop Sinks:	Crane/Fiat, Stern Williams
C. Drinking Fountains:	Oasis, Sunroc, Elkay, Halsey Taylor
D. Vitreous China Water Closets:	American Standard, Kohler, Crane, Eljer
E. Vitreous China Lavatories:	American Standard, Kohler, Crane, Eljer

F. Manual Lavatory/Sink Faucets: Chicago

G. Electronic Lavatory/Sink Faucets (DC Powered): Chicago “HyTronic”

H. Electronic Lavatory/Sink Faucets (AC Powered): Chicago “HyTronic”

I. Manual Flush Valves: Sloan “Royal” or Zurn “AquaVantage”

J. Manual Flush Valves with Bedpan Washer: Sloan “Royal” or Zurn “AquaVantage”

K. Fixture Stops & Supplies: Chicago

L. Fixture Traps: Chicago, McGuire

M. Toilet Seats: Church, Bemis, Olsonite

N. Fixture Carriers: Wade, Josam, Zurn, Smith

O. A.D.A. Insulation Kits: Mcguire, Truebro, Plumberex

2.02 GENERAL

A. All materials shall meet or exceed all applicable referenced standards, federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction.

B. Provide plumbing fixtures as indicated and scheduled on the Contract Drawings and as specified herein.

C. Fixtures, trim and accessories of any one type shall be by the same manufacturer.

D. All vitreous china fixtures shall be white in color unless noted otherwise on Drawings.

E. All plumbing fixture trim within public toilet rooms shall be furnished with vandal-proof trim.

F. All exposed brass fixture trim shall be heavily chrome plated.

G. Fittings and piping shall be brass and, wherever exposed, shall be polished chrome-plated. Provide tight fitting wall or floor escutcheons of chrome-plated brass or stainless steel wherever pipes pass through floors, walls or ceilings.

H. Fixture supplies shall be loose key angle stops with 1/2" I.P.S. female inlets and shall include wall flanges and brass risers. All components shall be chrome plated. In all cases, all piping, tubing, fittings and faucets shall be installed using mechanical non-slip connections, such as bull-nose, flanged, ferrule or threaded fittings. Fittings requiring a friction fit using slip-on or gasket connections are not acceptable. [EXCEPTION: Hose type riser supplies are acceptable when supplied and required by the fixture manufacturer]. Supply riser tubing for lavatories and sinks shall be minimum 3/8” O.D.

I. Provide A.D.A. compliant molded insulation on exposed water and drain piping beneath handicap accessible lavatories and sinks. Insulation shall be designed to allow removal and re-installation for pipe servicing.

J. Unless noted otherwise, install each lavatory, sink and drinking fountain with chrome-plated, 17 gauge trap with cleanout plug that is easily removable for servicing and cleaning. Slip joints shall be permitted only on the fixture trap inlet, within the trap seal and at outlet connection to the trap adapter.

K. Wall mounted water closets, lavatories, urinals and drinking fountains shall be supported with commercial carriers bolted to floor, model to suit installation. Provide concealed arm type carriers for lavatories.

L. Fixtures shall have flow control devices to limit the flow of water to a maximum rate in accordance with the following table:

FIXTURE	MAXIMUM WATER USAGE
Lavatory Faucet	0.5 GPM (at 60 psi)
Sink Faucet	2.2 GPM (at 60 psi)
Water Closet	1.6 Gallons Per Flush

M. Stainless Steel Sinks

1. Stainless steel sinks shall be 18 gauge, Type 304 stainless steel with insulation undercoating.

2. Provide stainless steel covers for all unused sink faucet/accessory holes. Covers shall be secured with stainless steel bolt and wing nut. Snap-in type covers are not acceptable. Covers shall provide a watertight seal by utilizing rubber gasket or plumbers putty.

3. Sink strainer shall be 316 stainless steel.

N. Housekeeping Mop Sinks

1. Provide mop sink having dimensions as scheduled on Contract Drawings

2. Receptor shall be precast terrazzo composed of marble chips and Portland cement, ground smooth, grouted and sealed to resist stains.

3. Stainless steel caps shall be cast integral on all curbs.

4. Shoulders shall not be less than 9-3/4" high inside (12” high outside) measurement, and not less than 1-1/4" wide. Drop front shoulders shall have 6” high outside measurement.

5. Tiling flanges shall be cast integral and extend 1" above shoulder on 1, 2 or 3 sides (as required per Project).

6. Drain shall be cast brass with stainless steel strainer cast integral and shall provide for a code compliant connection to a 3" pipe.

O. Water Closets

1. Water closets shall be vitreous china, wall-mounted elongated bowl having siphon jet flushing action design.

2. Water closet bowls installed within non-ambulatory patient toilet rooms shall be furnished with slotted rim for bedpan holding.

3. Water closet bowl gaskets shall be neoprene, felt gaskets and wax rings are not permitted.

4. Wall mounted water closets shall be supported with extra-heavy duty commercial carriers bolted to floor and rated for a 500 pound load. Carrier model shall be designed for the actual fixture being supported and provided with all options and accessories manufactured by the carrier manufacturer for a complete installation. Provide auxiliary foot support as recommended by the manufacture to prevent bending of fixture support stud bolts.

5. Water closet seats shall be commercial/institutional grade, white in color, have open front and stainless steel self-sustaining check hinges.

P. Faucets

1. Provide faucets with laminar flow outlets. Aerators shall not be acceptable. Faucet flow control devices shall be located at the spout outlet.

2. Provide vacuum breakers for all faucets that have threaded or serrated hose connection outlets (including laboratory pure water faucets).

3. Gooseneck spout outlets shall terminate five inches minimum and six & one half inches maximum above top rim of lavatory or sink. Horizontal dimension from spout inlet to spout outlet shall be a minimum five & one half inches.

4. Provide integral hot and cold water inlet check stops in all mixing type sink faucets that have hose connection outlets.

5. All electronic lavatory faucets located within public toilet rooms shall be designed and manufactured to allow continuous water flow during usage for a maximum duration of ten seconds after initial activation.

6. AC powered electronic faucets located within Patient Care areas and critical Research areas shall be connected to the emergency electrical system.

7. Lavatory Faucets:

a. Chicago – HyTronic Traditional with internal temperature control mixer, 2.2 GPM flow outlet, Model 116.211.AB.1 for DC power, and Model 116.111.AB.1 for AC power.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify that walls and floor finishes are prepared and ready for installation of fixtures.

B. Confirm that millwork is constructed with adequate provision for the installation of countertop lavatories, sinks, faucets and related trim and accessories.

C. Verify that electric power is available and of the correct characteristics.

3.02 PREPARATION

A. Rough-in fixture piping connections in accordance with minimum sizes required by code, as recommended by the manufacturer, and as indicated in Contract Drawings fixture rough-in schedule.

3.03 INSTALLATION

A. Installation shall meet or exceed all applicable federal, state and local requirements, referenced standards and conform to codes and ordinances of authorities having jurisdiction.

B. All installation shall be in accordance with manufacturer's published recommendations.

C. Furnish and install all labor, materials, equipment, tools and services and perform all operations required in connection with or properly incidental to the installation of complete plumbing fixtures, as indicated on Contract Drawings, reasonably implied therein or as specified herein, unless specifically excluded.

D. Each piece of trim shall be furnished whether specifically mentioned or not, in order to provide a complete first-class installation. Furnish and install all required water, waste, soil and vent connections to all plumbing fixtures, together with all fittings, supports, fastening devices, cocks, valves, traps, etc., leaving all in complete working order.

E. Provide accessible check valves in the individual cold and hot water fixture supply lines serving mixing valve type faucets or assemblies having hose connection outlets that are not equipped with integral check stops.

F. Coordinate mounting heights of plumbing fixtures with architectural details/elevations.

G. Install A.D.A. compliant water closet flush valve handles on wide side of toilet stalls.

H. Install fixtures and trim in accordance with manufacturer's instructions.

I. All exposed chrome plated, polished or enameled fixtures and trim shall be installed with special care, leaving no tool marks on finishes. Install flexible brass fixture supply risers using manufactured tube bending tools. Bending tubes only with the use of hands shall not be permitted.

J. Install each fixture trap, easily removable for servicing and cleaning.

K. Provide chrome-plated deep escutcheons where required to cover non-chrome-plated piping projecting through walls.

L. Thoroughly fill spaces between fixtures and walls, countertops and/or floors with waterproof, mold resistant, non-toxic, non-shrinkable white tile caulking.

M. Install components firmly fixed, level and plumb.

N. Install and secure all wall mounted fixtures in place with commercial carriers and bolts in accordance with manufacturer's instructions. Fixture weight shall not be transmitted to walls, partitions or service piping. Installation shall prevent any movement of fixture during use.

O. All non-monolithic shower floors shall be provided with drain pan attached to floor drain flange in accordance with the latest edition of the Uniform Plumbing Code. Refer to Architectural Contract Specifications and Drawings for pan materials and additional installation requirements.

3.04 INTERFACE WITH OTHER PRODUCTS AND TRADES

A. Review millwork Shop Drawings. Confirm location and size of fixtures and openings before rough-in and installation.

B. Provide templates for all fixtures to be mounted in millwork to General Contractor.

C. Coordinate with Electrical Contractor and insure proper power is provided for electric drinking fountains, sensor operated faucets and sensor operated flush valves

3.05 TESTING

A. Adjust stops or valves for intended water flow rate to fixtures without splashing, noise or overflow.

B. Adjust and set sensor faucet mixing valves to provide desired water temperature at spout outlet.

C. Insure that all traps are filled with water and maintain trap seal. Each fixture shall be filled and then drained. Traps and fixture connections shall be proven water tight by visual inspection.

D. After fixtures have been installed and water systems are pressurized, test each fixture and associated trim for proper operation and inspect for leaks. Replace malfunctioning fixtures and components, then retest. Repeat procedure until all components operate properly.

E. Test drain pans installed for non-monolithic shower floors prior to installation of finished flooring. Fill pan with water to within 1” of top. Pan must maintain test water level without leakage for at least eight hours

3.06 CLEANING

A. Thoroughly clean all plumbing fixtures and equipment furnished under this Contract prior to final acceptance.

B. Thoroughly flush and clean all faucet spout outlet screens and flow control devices.

3.07 PROTECTION OF FINISHED WORK

A. Do not permit use of fixtures until after Substantial Completion has been announced by Owner.

END OF SECTION 224000

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SECTION 230010 – BASIC MECHANICAL REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to this and the other sections of Division 23.

B. "Mechanical," as used in this specification, includes all work specified under Division 23. All requirements for "mechanical work" apply to all of Division 23, regardless of specific trade (i.e., HVAC).

1.2 SUMMARY

A. This section includes general administrative and procedural requirements for mechanical, fire protection and plumbing installations. The following administrative and procedural requirements are included in this section to expand the requirements specified in Division 1:

1. Submittals.

2. Record documents.

3. Maintenance manuals.

4. Delivery, storage and handling.

5. Warranty and service.

6. Rough-ins.

7. Mechanical, fire protection and plumbing installations.

8. Cutting and patching.

1.3 PERMITS, FEES, CODES, ORDINANCES AND REGULATIONS

A. Obtain and pay for all permits, inspections and connection fees required by governing bodies in connection with the work. Deliver Certificates of Inspection to the Architect.

B. All work shall comply with governing codes, ordinances and regulations of city, county and state having jurisdiction.

C. Other than the signed and sealed Contract Documents, the Contractor is responsible for any Professional Engineer's signature and seal required by authorities having jurisdiction.

1.4 SUBMITTALS

A. General: Follow the procedures specified in Division 1, Section 013300 – SUBMITTAL PROCEDURES.

1.5 RECORD DOCUMENTS

A. Prepare record documents in accordance with the requirements in Division 1, Section 017700 – CLOSEOUT PROCEDURES. In addition to the requirements specified in Division 1, indicate the following installed conditions:

1. Ductwork mains and branches, size and location, for both exterior and interior; locations of dampers and other control devices; filters, boxes, and terminal units requiring periodic maintenance or repair.

2. Mains and branches of piping systems, with valves and control devices located and numbered, concealed unions located, and with items requiring maintenance located (i.e., traps, strainers, expansion compensators, tanks, etc.). Valve location diagrams, complete with valve tag chart. Refer to Division 23, Section 230553 – IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT. Indicate actual inverts and horizontal locations of underground piping.

3. Equipment locations (exposed and concealed), dimensioned from prominent building lines.

4. Approved substitutions, contract modifications, and actual equipment and materials installed.

B. Engage the services of a Land Surveyor or Professional Engineer registered in the state in which the project is located as specified in Division 1, Section 017300 - EXECUTION to record the locations and invert elevations of underground installations.

C. Miscellaneous Record Submittals: Provide the following in accordance with Division 1, Section 017700 - CLOSEOUT PROCEDURES:

1. 2 copies of final approved Test and Balance Report.

2. 2 copies of control manufacturer's certification that controls have been checked for operation and calibration and that system is operating as intended.

3. 2 copies of potable water Sterilization Report.

4. 2 copies of acknowledgement of all required instructions by Owner.

1.6 MAINTENANCE MANUALS

A. Prepare maintenance manuals in accordance with Division 1, Section 017700 – CLOSEOUT PROCEDURES. In addition to the requirements specified in Division 1, include the following information for equipment items:

1. Description of function, normal operating characteristics and limitations, performance curves, engineering data (specified capacities, i.e., submittal data) and tests (including ASME Vessel test reports), and complete nomenclature and commercial numbers of replacement parts.

2. Manufacturer's printed operating procedures to include start-up, break-in, and routine and normal operating instructions; regulation, control, stopping, shutdown, and emergency instructions; and summer and winter operating instructions. Provide parts list for all equipment, fixtures, valves and accessories.

3. Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions.

4. Servicing instructions and lubrication charts and schedules.

5. Extended warranties for equipment.

B. Maintenance manuals shall be on site for use during the final inspection.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to the project properly identified with names, model numbers, types, grades, compliance labels, and other information needed for identification.

B. Protect materials, apparatus and equipment from damage, moisture, dirt, debris and work of other trades.

C. Use of paper, cardboard or other flimsy material for protection will not be permitted. Replace damaged protective materials immediately. Do not install damaged materials, apparatus and equipment; remove from site.

D. After equipment and gauges have been installed, cover with a protective material and keep covered until all painting and insulating work has been completed. The subject equipment shall not be operated while it has a protective covering. At final inspection, all equipment shall be free of stains, scratches and foreign debris. All equipment finishes that do not meet these requirements shall be sanded, primed and painted to match original paint finish.

1.8 WARRANTY AND SERVICE

A. Refer to GENERAL CONDITIONS and Division 1, Section 017700 – CLOSEOUT PROCEDURES.

B. Where extended warranties are called for herein, furnish three copies to be inserted in Operation and Maintenance Manuals.

C. All preventative maintenance and normal service will be performed by the Owner's maintenance personnel after final acceptance of the work. This shall not alter the Contractor's warranty of the work in any way.

PART 2 - PRODUCTS

2.1 GENERAL

A. All materials and equipment shall be new. Systems shall be provided complete, and each system as a whole, and in all its parts, shall function correctly up to the specified capacity. Should a system, or any part thereof fail to meet performance requirements, necessary replacements, alterations or repairs, as required by the Architect- Engineer, shall be made to bring performance up to specified requirements and all building construction and finishes damaged or marred by such replacements, alterations or repairs shall be restored to prior condition, at no additional cost to the Owner.

B. Where multiple items of equipment or materials are required they shall be the product of a single manufacturer.

C. Before ordering any equipment, the size of all equipment shall be checked to easily fit spaces allotted on the drawings.

D. Inserts, pipe sleeves, supports and anchorage of equipment shall be provided as specified herein. Where such items are to be set or embedded in concrete, masonry or similar work,

the items shall be furnished and layout made at the proper time for the setting or embedment thereof so as to cause no delay in the work.

E. The drawings are diagrammatic and may not detail all appurtenances required for the proper operation of all equipment. Provide such items for a complete and operable system.

2.2 MANUFACTURERS' NAMES AND CATALOG NUMBERS

A. Specific references have been made to one or more manufacturers' names and model or catalog numbers. This does not indicate that the material and equipment specified is necessarily an "off the shelf" item; requirements for specific finishes, materials or other modifications may introduce variances from manufacturers' standards. Contractor shall ascertain that such modifications are fully considered.

2.3 DIAGRAMS, NAMEPLATES AND LABELS

A. Nameplate: For each piece of power operated mechanical, fire protection and plumbing equipment, provide a permanent operational data nameplate indicating manufacturer, product name, model number, serial number, capacity, operating and power characteristics, labels of tested compliances and similar essential data. Nameplates shall be securely mounted in an accessible location. The nameplate of a distributing agent will not be accepted.

B. In all areas having equipment, valves and control devices, provide single line diagrams framed under glass and mounted on equipment room wall. Diagrams shall be black lines on white vellum. The diagrams shall give name, number designation, and location of each piece of equipment, valve, and control device.

C. All pieces of equipment, (i.e., valves, starters, disconnects, fans, Rtu,s, etc.) and electrical control instruments and apparatus shall be identified as specified in Division 23, Section 230553 – IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT.

PART 3 - EXECUTION

3.1 ROUGH-IN

A. Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected.

B. Refer to equipment specifications in Divisions 2 through 28 for rough-in requirements.

3.2 MECHANICAL INSTALLATIONS

A. General: Sequence, coordinate, and integrate the various elements of mechanical, fire protection and plumbing systems, materials, and equipment. Comply with the following requirements:

1. Coordinate mechanical, fire protection and plumbing systems, equipment, and materials installation with other building components.

2. Verify all dimensions by field measurements.

3. Arrange for chases, slots, and openings in other building components during progress of construction, to allow for mechanical, fire protection and plumbing installations.

4. Coordinate the installation of required supporting devices and sleeves to be set in poured-in-place concrete and other structural components, as they are constructed.

5. Sequence, coordinate, and integrate installations of materials and equipment for efficient flow of the work. Give particular attention to large equipment requiring positioning prior to closing in the building.

6. Where mounting heights are not detailed or dimensioned, install systems, materials, and equipment to provide the maximum headroom possible.

7. Coordinate connection of mechanical, fire protection and plumbing systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies. Provide required connection for each service.

8. Install systems, materials, and equipment to conform with approved submittal data to greatest extent possible. Conform to arrangements indicated by the Contract Documents, recognizing that portions of the work are shown only in diagrammatic form. Where coordination requirements conflict with individual system requirements, refer conflict to the Architect prior to installation.

9. Install systems, materials, and equipment level and plumb, parallel and perpendicular to other building systems and components. Piping shall be sloped as specified in individual sections.

10. Install mechanical, fire protection and plumbing equipment to facilitate servicing, maintenance, and repair or replacement of equipment components. As much as practical, connect equipment for ease of disconnecting, with minimum of interference with other installations. Extend grease fittings to an accessible location.

11. Install access panel or doors where access is required behind finished surfaces. Access panels and doors are specified in Division 23, Section 230050 - BASIC MECHANICAL MATERIALS AND METHODS.

12. Install systems, materials, and equipment giving right-of-way priority to systems required to be installed at a specified slope.

3.3 CUTTING AND PATCHING

A. General: Perform cutting and patching in accordance with Division 1, Section 017300 - EXECUTION. In addition to the requirements specified in Division 1, the following requirements apply:

1. Protection of Installed Work: During cutting and patching operations, protect adjacent installations.

B. Perform cutting, fitting, and patching of mechanical, fire protection and plumbing equipment and materials required to:

1. Uncover work to provide for installation of ill-timed work.

2. Remove and replace defective work.

3. Remove and replace work not conforming to requirements of the Contract Documents.

4. Remove samples of installed work as specified for testing.

5. Install equipment and materials in existing structures.
6. Upon written instructions from the Architect, uncover and restore work to provide for Architect observation of concealed work.

C. Protect the structure, furnishings, finishes, and adjacent materials not to be removed.

D. Provide and maintain temporary partitions or dust barriers adequate to prevent the spread of dust and dirt to adjacent areas.

1. Patch existing finished surfaces and building components using new materials matching existing materials by experienced installers. Installers' qualifications refer to the materials and methods required for the surface and building components being patched.

2. Patch finished surfaces and building components using new materials specified for the original installation by experienced installers. Installers' qualifications refer to the materials and methods required for the surface and building components being patched.

3.4 INSTRUCTION OF OWNER'S OPERATING PERSONNEL

A. The Contractor shall include the cost of the services of qualified instructor(s) to instruct the Owner's operating personnel in the operation, adjustment, care and maintenance of all equipment and systems.

B. Instruction shall be performed at a time approved by the Owner after all equipment and systems are installed, completed, adjusted and operating to specified requirements. Contractor shall notify the Architect when instructions will be given.

C. Qualification of instructor(s) shall be subject to approval of the Owner and equipment manufacturer.

D. Additional requirements concerning operation and maintenance of mechanical, fire protection and plumbing equipment and systems may be specified in other sections.

E. Two copies of acknowledgement of all required instructions to Owner's operating personnel, signed by the Owner or his authorized representative, shall be submitted to the Architect prior to submitting application for final payment. An additional copy of this acknowledgement is required in each copy of Operation and Maintenance Manuals required in Division 1, Section 017700 – CLOSEOUT PROCEDURES.

END OF SECTION 230010

SECTION 230050 - BASIC MECHANICAL MATERIALS AND METHODS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and the Supplementary Conditions and Division 1 Specification Sections, apply to this section.

1.2 SUMMARY

A. This section includes the following basic mechanical materials and methods to complement other Division 23 Sections.

1. Piping materials and installation instructions common to most piping systems.
2. Concrete equipment base construction requirements.
3. Equipment nameplate data requirements.
4. Labeling and identifying mechanical systems and equipment is specified in Division 23, Section 230553 – IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT.
5. Nonshrink grout for equipment installations.
6. Field-fabricated metal and wood equipment supports.
7. Installation requirements common to equipment specification sections.
8. Mechanical demolition.
9. Cutting and patching.
10. Touchup painting and finishing.

B. Requirements of the following Division 23 sections apply to this section:

1. Division 23, Section 230010 - BASIC MECHANICAL REQUIREMENTS.

C. Pipe and pipe fitting materials are specified in piping system sections.

1.3 DEFINITIONS

A. Pipe, pipe fittings, and piping include tube, tube fittings, and tubing.

B. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below the roof, spaces above ceilings, unexcavated spaces, crawl spaces, and tunnels.

C. Exposed Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

D. Exposed Exterior Installations: Exposed to view outdoors, or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

E. Concealed Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in duct shafts.

F. Concealed Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants, but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

1.4 SUBMITTALS

A. General: Submit the following according to the Conditions of the Contract and Division 1 Specification Sections.

B. Product data for following piping specialties:

1. Mechanical sleeve seals.

2. Identification materials and devices.

C. Samples of color, lettering style, and other graphic representation required for each identification material and device.

D. Shop drawings detailing fabrication and installation for metal and wood supports and anchorage for mechanical materials and equipment.

E. Coordination drawings for access panel and door locations.

F. Prepare coordination drawings according to Division 1, Section 013300 – SUBMITTAL PROCEDURES to a 1/4 inch equals 1 foot (1:48) scale or larger. Detail major elements, components, and systems of mechanical equipment and materials in relationship with other systems, installations, and building components. Show space requirements for installation and access. Show where sequence and coordination of installations are important to the efficient flow of the work. Include the following:

1. Proposed locations of piping, ductwork, equipment, and materials. Include the following:

a. Planned piping layout, including valve and specialty locations and valve stem movement.

b. Planned duct systems layout, including elbow radius and duct accessories.

c. Clearances for installing and maintaining insulation.

d. Clearances for servicing and maintaining equipment, including space for equipment disassembly required for periodic maintenance.

e. Equipment service connections and support details.

f. Exterior wall and foundation penetrations.

g. Fire-rated wall and floor penetrations.

h. Sizes and location of required concrete pads and bases.

2. Scheduling, sequencing, movement, and positioning of large equipment into the building during construction.

3. Floor plans, elevations, and details to indicate penetrations in floors, walls, and ceilings and their relationship to other penetrations and installations.

4. Reflected ceiling plans to coordinate and integrate installations, air outlets and inlets, light fixtures, communication systems components, sprinklers, and other ceiling-mounted items.

G. Welder certificates signed by Contractor certifying that welders comply with requirements specified under the "Quality Assurance" Article.

1.5 QUALITY ASSURANCE

A. Qualify welding processes and operators for structural steel according to AWS D1.1 "Structural Welding Code--Steel."

B. Qualify welding processes and operators for piping according to ASME "Boiler and Pressure Vessel Code," Section IX, "Welding and Brazing Qualifications."

1. Comply with provisions of ASME B31 Series "Code for Pressure Piping."

2. Certify that each welder has passed AWS qualification tests for the welding processes involved and that certification is current.

C. ASME A13.1 for lettering size, length of color field, colors, and viewing angles of identification devices.

D. Equipment Selection: Equipment of greater or larger power, dimensions, capacities, and ratings may be furnished provided such proposed equipment is approved in writing and connecting mechanical and electrical services, circuit breakers, conduit, motors, bases, and equipment spaces are increased. No additional costs will be approved for these increases, if larger equipment is approved. If minimum energy ratings or efficiencies of the equipment are specified, the equipment must meet the design requirements and commissioning requirements.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver pipes and tubes with factory-applied end-caps. Maintain end-caps through shipping, storage, and handling to prevent pipe-end damage and prevent entrance of dirt, debris, and moisture.

B. Protect stored pipes and tubes from moisture and dirt. Elevate above grade. When stored inside, do not exceed structural capacity of the floor.

C. Protect flanges, fittings, and piping specialties from moisture and dirt.

D. Protect stored plastic pipes from direct sunlight. Support to prevent sagging and bending.

1.7 SEQUENCING AND SCHEDULING

A. Coordinate mechanical equipment installation with other building components.

B. Arrange for chases, slots, and openings in building structure during progress of construction to allow for mechanical installations.

C. Coordinate the installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

D. Sequence, coordinate, and integrate installations of mechanical materials and equipment for efficient flow of the work. Coordinate installation of large equipment requiring positioning prior to closing in the building.

E. Coordinate connection of electrical services.

F. Coordinate connection of mechanical systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies.

G. Coordinate requirements for access panels and doors where mechanical items requiring access are concealed behind finished surfaces. Access panels and doors are specified in Division 8, Section 081113 – HOLLOW METAL DOORS AND FRAMES.

H. Coordinate installation of identifying devices after completing covering and painting where devices are applied to surfaces. Install identifying devices prior to installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 EQUIPMENT INSTALLATION--COMMON REQUIREMENTS

A. Install equipment to provide the maximum possible headroom where mounting heights are not indicated.

B. Install equipment according to approved submittal data. Portions of the work are shown only in diagrammatic form. Refer conflicts to the Architect.

C. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, except where otherwise indicated.

D. Install mechanical equipment to facilitate servicing, maintenance, and repair or replacement of equipment components. Connect equipment for ease of disconnecting, with minimum of interference with other installations. Extend grease fittings to an accessible location.

E. Install equipment giving right-of-way to piping systems installed at a required slope.

3.2 PAINTING AND FINISHING

A. Refer to Division 9, Section 099000 –PAINTING for field painting requirements.

B. Damage and Touch Up: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.3 ERECTION OF METAL SUPPORTS AND ANCHORAGE

A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor mechanical materials and equipment.

B. Field Welding: Comply with AWS D1.1 "Structural Welding Code--Steel."

3.4 ERECTION OF WOOD SUPPORTS AND ANCHORAGE

A. Cut, fit, and place wood grounds, nailers, blocking, and anchorage to support and anchor mechanical materials and equipment.

B. Select fastener sizes that will not penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood members.

C. Attach to substrates as required to support applied loads.

3.5 CUTTING AND PATCHING

A. Cut, channel, chase, and drill floors, walls, partitions, ceilings, and other surfaces necessary for mechanical installations. Perform cutting by skilled mechanics of the trades involved.

B. Repair cut surfaces to match adjacent surfaces.

3.6 GROUTING

A. Install nonmetallic nonshrink grout for mechanical equipment base bearing surfaces, pump and other equipment base plates, and anchors. Mix grout according to manufacturer's printed instructions.

B. Clean surfaces that will come into contact with grout.

C. Provide forms for placement of grout, as required.

D. Avoid air entrapment when placing grout.

E. Place grout to completely fill equipment bases.

F. Place grout on concrete bases to provide a smooth bearing surface for equipment.

G. Place grout around anchors.

H. Cure placed grout according to manufacturer's printed instructions.

END OF SECTION 230050

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SECTION 230513 - COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this section.

1.2 SUMMARY

A. This section includes basic requirements for motors. It includes motors that are factory-installed as part of equipment and appliances as well as field-installed motors.

1.3 QUALITY ASSURANCE

A. Comply with NFPA 70, "National Electrical Code."

B. NRTL Listing: Provide NRTL listed motors.

1. Term "Listed": As defined in "National Electrical Code," Article 100.

2. Listing Agency Qualifications: "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.7.

C. Comply with NEMA MG 1, "Motors and Generators."

D. Comply with UL 1004, "Motors, Electric."

PART 2 - PRODUCTS

2.1 MOTORS, GENERAL

A. General: Requirements below apply to motors covered by this section except as otherwise indicated.

B. Motors 1/2 HP and Larger: Premium energy-efficient polyphase.

C. Motors Smaller Than 1/2 HP: Single-phase.

D. Frequency Rating: 60 Hz.

E. Voltage Rating: Determined by voltage of circuit to which motor is connected for the following motor voltage ratings (utilization voltages):

1. 120 V Circuit: 115 V - motor rating.

2. 208 V Circuit: 200 V - motor rating.

3. 240 V Circuit: 230 V - motor rating.

4. 480 V Circuit: 460 V - motor rating.

F. Service factors indicated for motors are minimum values and apply at frequency and utilization voltage at which motor is connected. Provide motors which will not operate in service factor range when supply voltage is within 10 percent of motor voltage rating.

G. Capacity: Sufficient to start and operate connected loads at designated speeds in indicated environment, and with indicated operating sequence, without exceeding nameplate ratings. Provide motors rated for continuous duty at 100 percent of rated capacity.

H. Temperature Rise: Based on 40 degrees C ambient except as otherwise indicated.

I. Enclosure: Open dripproof or as indicated.

J. Service Factor: Minimum 1.15.

2.2 POLYPHASE MOTORS

A. General: Squirrel-cage induction-type conforming to the following requirements except as otherwise indicated.

B. NEMA Design Letter Designation: "B."

C. Multi-Speed Motors: Separate winding for each speed.

D. Energy Efficient Motors: Nominal efficiency equal to or greater than that stated in NEMA MG 1, table 12-6B for that type and rating of motor.

E. Energy Efficient Motors: Nominal efficiency equal to or greater than that stated in NEMA MG 1, table 12-6C for that type and rating of motor.

F. Variable Speed Motors for Use With Solid-State Drives: Energy efficient, squirrel-cage induction, design B units with ratings, characteristics, and features coordinated with and approved by drive manufacturer.

G. Internal Thermal Overload Protection For Motors: For motors so indicated, protection automatically opens control circuit arranged for external connection. Protection operates when winding temperature exceeds safe value calibrated to the temperature rating of the motor insulation.

H. Bearings: Double-shielded, prelubricated ball bearings suitable for radial and thrust loading of the application.

I. Rugged Duty Motors: Totally enclosed with 1.25 minimum service factor. Provide motors with regreasable bearings and equipped with capped relief vents. Insulate windings with nonhygroscopic material. External finish shall be chemical resistant paint over corrosion resistant primer. Provide integral condensate drains.

J. Motors for Reduced Inrush Starting: Coordinate with indicated reduced inrush controller type and with characteristics of driven equipment load. Provide required wiring leads in motor terminal box to suit control method.

2.3 SINGLE-PHASE MOTORS

A. General: Conform to the following requirements except as otherwise indicated.

B. Provide Energy Efficient Motors: One of the following types as selected to suit the starting torque and other requirements of the specific motor application.

1. Permanent Split Capacitor.

2. Split-Phase Start, Capacitor-Run.

3. Capacitor-Start, Capacitor-Run.

C. Shaded-Pole Motors: Use only for motors smaller than 1/20 hp.

D. Internal Thermal Overload Protection for Motors: For motors so indicated, protection automatically opens the power supply circuit to the motor, or a control circuit arranged for external connection. Protection operates when winding temperature exceeds a safe value calibrated to the temperature rating of the motor insulation. Provide device that automatically resets when motor temperature returns to normal range except as otherwise indicated.

E. Bearings, belt connected motors and other motors with high radial forces on motor shaft shall be ball bearing type. Sealed, prelubricated sleeve bearings may be used for other single phase motors.

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 230513

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SECTION 230519 – METERS AND GAUGES FOR HVAC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including the General and Supplementary Conditions and Division 1 Specification Sections, apply to this section.

B. Requirements of the following Division 23 Sections apply to this section:

1. Division 23, Section 230010 - BASIC MECHANICAL REQUIREMENTS.

2. Division 23, Section 230050 - BASIC MECHANICAL MATERIALS AND METHODS.

1.2 SUMMARY

A. This section includes meters and gauges used in mechanical systems.

B. Related Sections: Division 23 piping sections contain requirements that relate to this section.

1. Meters and gauges furnished as part of factory-fabricated equipment are specified as part of the equipment assembly in other Division 23 Sections.

1.3 SUBMITTALS

A. General: Submit the following according to the Conditions of the Contract and Division 1 Specification Sections.

B. Product data for each type of meter, gauge, and fitting specified. Include scale range, ratings, and calibrated performance curves, certified where indicated. Submit a meter and gauge schedule showing manufacturer's figure number, scale range, location, and accessories for each meter and gauge.

C. Product certificates signed by manufacturers of meters and gauges certifying accuracies under specified operating conditions and compliance with specified requirements.

D. Maintenance data to include in the "Operating and Maintenance Manuals" specified in Division 1, Section 017700 – CLOSEOUT PROCEDURES. Include data for the following:

1. Test plugs.

1.4 QUALITY ASSURANCE

A. Comply with applicable portions of American Society of Mechanical Engineers (ASME) and Instrument Society of America (ISA) standards pertaining to construction and installation of meters and gauges.

B. Design Criteria: The drawings indicate types, sizes, capacities, ranges, profiles, connections, and dimensional requirements of meters and gauges and are based on the specific manufacturer types and models indicated. Meters and gauges having equal performance characteristics by other manufacturers may be considered, provided that deviations do not change the design concept or intended performance as judged by the Architect. The burden of proof for equality of meters and gauges is on the proposer.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Liquid-in-Glass Thermometers:

a. Marsh Instrument Co.

b. Marshalltown Instruments, Inc.

c. H.O. Trerice Co.

d. Weiss Instruments, Inc.

e. Weksler Instruments Corp.

2. Direct-Mounting Filled-System Dial Thermometers:

a. Ashcroft Instrument Div. of Dresser Industries.

b. Marsh Instrument Co.

c. H.O. Trerice Co.

d. Weiss Instruments, Inc.

e. Weksler Instruments Corp.

PART 3 - EXECUTION

3.1 METER AND GAUGE APPLICATIONS

A. General: Where indicated, install meters and gauges of types, sizes, capacities, and with features indicated.

3.2 METER AND GAUGE INSTALLATION, GENERAL

A. Install meters, gauges, and accessories according to manufacturers' written instructions for applications where used.

3.3 THERMOMETER INSTALLATION

A. Install thermometers and adjust vertical and tilted positions.

END OF SECTION 230519

SECTION 230529 – HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawing and general provisions of the Contract, including the General and Supplementary Conditions and Division 1 Specification Sections, apply to this section.

1.2 SUMMARY

A. This section includes hangers and supports for mechanical equipment.

B. Related Sections: The following sections contain requirements that relate to this section:

1. Division 5, Section 055000 - METAL FABRICATIONS for materials for attaching hangers and supports to building structure.

2. Division 23, Section 230548.13 - VIBRATION CONTROL FOR HVAC for vibration-isolation hangers and supports.

3. Division 23, Section 233113 – METAL DUCTS for duct hangars and supports.

1.3 DEFINITIONS

A. Terminology used in this section is defined in MSS SP-90.

1.4 PERFORMANCE REQUIREMENTS

A. Design seismic restraint hangers and supports, for equipment.

B. Design and obtain approval from authority with jurisdiction over seismic restraint hangers and supports for equipment.

1.5 SUBMITTALS

A. General: Submit the following according to the Conditions of the Contract and Division 1 Specification Sections.

B. Product data for each type of hanger and support.

C. Shop drawings for each type of hanger and support, indicating dimensions, weights, required clearances, and methods of component assembly.

1.6 QUALITY ASSURANCE

A. Qualify welding processes and welding operators according to AWS D1.1 "Structural Welding Code--Steel."

1. Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.

B. Qualify welding processes and welding operators according to ASME "Boiler and Pressure Vessel Code," Section IX, "Welding and Brazing Qualifications."

C. NFPA Compliance: Comply with NFPA 13 for hangers and supports used as components of fire protection systems.

D. Listing and Labeling: Provide hangers and supports that are listed and labeled as defined in NFPA 70, Article 100.

1. UL and FM Compliance: Hangers, supports, and components include listing and labeling by UL and FM where used for fire protection piping systems.

2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.7.

E. Licensed Operators: Use operators that are licensed by powder-operated tool manufacturers to operate their tools and fasteners.

PART 2 - PRODUCTS

2.1 MISCELLANEOUS MATERIALS

A. Structural Steel: ASTM A36/A36M, steel plates, shapes, and bars, black and galvanized.

B. Bolts and Nuts: ASME B18.10 or ASTM A183, steel, hex-head, track bolts and nuts.

C. Washers: ASTM F844, steel, plain, flat washers.

D. Grout: ASTM C1107, Grade B, nonshrink, nonmetallic.

1. Characteristics include post-hardening, volume-adjusting, dry, hydraulic-cement-type grout that is nonstaining, noncorrosive, nongaseous and is recommended for both interior and exterior applications.

2. Design Mix: 5000-psi (34.5MPa), 28-day compressive strength.

3. Water: Potable.

4. Packaging: Premixed and factory-packaged.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT APPLICATIONS

A. Specific hanger requirements are specified in the section specifying the equipment and systems.

B. Comply with MSS SP-69 for pipe hanger selections and applications that are not specified in piping specification sections.

3.2 HANGER AND SUPPORT INSTALLATION

A. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.

B. Heavy-Duty Steel Trapezes: Field-fabricate from ASTM A36 steel shapes selected for loads being supported. Weld steel according to AWS D-1.1.

C. Support fire protection systems piping independent of other piping.

3.3 EQUIPMENT SUPPORTS

A. Fabricate structural steel stands to suspend equipment from structure above or support equipment above floor.

B. Grouting: Place grout under supports for equipment, and make a smooth bearing surface.

3.4 METAL FABRICATION

A. Cut, drill, and fit miscellaneous metal fabrications for pipe and equipment supports.

B. Fit exposed connections together to form hairline joints. Field-weld connections that cannot be shop-welded because of shipping size limitations.

C. Field Welding: Comply with AWS D1.1 procedures for manual shielded metal-arc welding, appearance and quality of welds, methods used in correcting welding work, and the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.

2. Obtain fusion without undercut or overlap.

3. Remove welding flux immediately.

4. Finish welds at exposed connections so that no roughness shows after finishing, and so that contours of welded surfaces match adjacent contours.

3.5 ADJUSTING

A. Hanger Adjustment: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

3.6 PAINTING

A. Touching Up: Clean field welds and abraded areas of shop paint and paint exposed areas immediately after erection of hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply by brush or spray to provide a minimum dry film thickness of 2.0 mils (0.05 mm).

B. Touching Up: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal is specified in Division 9, Section 099000 - PAINTING.

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A780.

3.7 FIELD QUALITY CONTROL

A. Licensed Engineer's Report: Prepare hanger and support installation report. Include seal and signature of Registered Engineer, licensed in jurisdiction where project is located, certifying compliance with specifications.

END OF SECTION 230529

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SECTION 230548.13 – VIBRATION CONTROLS FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work of this section.

1.2 SUMMARY

A. Extent of vibration control work required by this section is indicated on drawings and schedules, and/or specified in other Division 23 sections.

B. Types of vibration control products specified in this section include the following:

1. Fiberglass pads and shapes.

2. Neoprene pads.

3. Vibration isolation springs.

4. Neoprene mountings.

5. Spring isolators, freestanding.

6. Spring isolators, housed.

7. Isolation hangers.

8. Riser isolators.

9. Flexible pipe connectors.

1.3 QUALITY ASSURANCE

A. Except as otherwise indicated, obtain vibration control products from single manufacturer.

B. Engage manufacturer to provide technical supervision of installation of vibration control products.

1.4 SUBMITTALS

A. Vibration Isolation Mounts and Hangers: Provide catalog cuts, shop drawings and other documents as necessary to indicate equipment unit number, isolator type, supported weight, scheduled deflection, proposed deflection under operating load, spring free height, spring operating height, spring solid height (at coil bind), and spring diameter for each isolator. Submittals based upon rated deflection will be rejected. Indicate the weight and lowest rotational or reciprocal speed of each piece of isolated equipment. Indicate bridge bearing quality neoprene components where provided. Use the format below to summarize isolator characteristics for submittal review by the Engineer.

B. Elastomeric Pads: For pads supporting equipment (not piping), submit calculations showing supported weight, required deflection, pad support area, load per square inch, operating deflection, unloaded pad height (not including shims and top plate) and percent deflection. Indicate bridge bearing quality neoprene where provided.

C. SAMPLE SUBMITTAL FORMAT:

	MOUNT/HANGER	PAD
Supported Equipment	RTU-1	ELEVATOR UNIT
Isolator Type	Mason SLF-464	Mason SWM-40
Supported Weight	5200 LB	120 LB
Lowest Speed	800 RPM	-
Scheduled Deflection	2.5 inch	0.10 inch
Operating Deflection	2.6 inch	0.11 inch
Spring (Pad) Free Height	14.38 inch	0.75 inch
Operating Height	12.28 inch	0.64 inch
Solid Height	8.38 inch	-
Spring Diameter	10.5 inch	-
Pad Support Area	-	4 sq. in.
Percent Deflection	-	15%
Remarks		Bridge bearing quality neoprene, 40 durometer.

D. Shop Drawings: Submit shop drawings and manufacturer's installation instructions for thrust restraints and sway braces wherever they are required. Submit shop drawings for piping isolation details where Type A pads are used; see paragraph "Piping Isolation".

E. Reports: Provide inspection reports from the isolation materials manufacturer or representative indicating that the installations are complete and correct in every respect.

F. Samples: Submission of samples may be requested for each type of isolation device. After approval, samples will be returned for installation at the job. All costs associated with submission of samples shall be borne by the Contractor.

G. Written Certificate Required: Contractor & Manufacturer shall certify that products, materials and processes submitted do not contain asbestos or PCB.

1.5 DRAWINGS ARE SCHEMATIC ONLY

A. The size and number of mounts and hangers shall be chosen to meet these specifications. Brackets, rails, bases, braces, snubbers, etc. shall be provided as needed for a complete and correct installation.

1.6 STANDARDS

A. American Association of Safety and Highway Officials (AASHO), Highway Bridge Specification. See table B requirements for physical properties of bridge bearing quality neoprene.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Manufacturer: Subject to compliance with requirements, provide vibration control products of one of the following:

1. Amber/Booth Co.

2. Korfund Dynamics Corp.

3. Mason Industries, Inc.

4. Peabody Noise Control, Inc.

5. Kinetics Noise Control, Inc.

B. Since manufacturer's products vary, specific models listed in this specification may not be approved if they do not meet all requirements in this section. Model designations listed herein are intended only as a guide.

2.2 VIBRATION CONTROL MATERIALS

A. Spring Requirements:

1. Steel springs and neoprene elements shall have static deflections under operating load equal to or greater than deflections shown on the documents.

2. All steel springs as installed shall have a minimum additional travel to solid (coil bind) equal to 50 percent of the deflection under operating load.

3. Spring diameter shall be no less than 80 percent of the compressed height of the spring at operational load.

4. Steel springs shall not be welded to other elements of the isolator unless specifically noted in the submittal and approved by the Engineer.

5. Steel springs shall not take a permanent set when compressed to coil bind.

6. Steel springs shall be color coded to allow positive identification after installation.

B. Elastomer Requirements:

1. All elastomeric (neoprene) components shall be selected for maximum hardness of 40 durometer, shore A rating, where possible. In no case shall hardness exceed 50 durometer.

2. Bridge bearing quality neoprene meeting AASHO Highway Bridge Specifications shall be used in all elastomeric components where installed in irretrievable locations and as noted elsewhere in the documents.

C. Corrosion Resistance:

1. All isolators and associated hardware shall be designed or treated for resistance to corrosion. Steel components shall be PVC coated, or phosphated and painted with industrial grade enamel. All nuts, bolts and washers shall be zinc electroplated. Structural steel bases and exposed steel components of concrete inertia bases shall be cleaned of welding slag and primed with zinc-chromate or metal etching primer. A finish coat of industrial grade enamel shall be applied over the primer.

2. All isolators exposed to the weather shall have steel parts PVC coated, hot-dip galvanized or zinc-electroplated plus coating of neoprene or bitumastic paint. Aluminum components for outdoor installation shall be etched and painted with industrial grade enamel. Nuts, bolts, and washers may be zinc-electroplated.

2.3 VIBRATION ISOLATION EQUIPMENT

A. Type F - Elastomeric Hanger:

1. Neoprene-in-shear element mounted in a hanger box. The neoprene element shall be molded with a rod isolation bushing that prevents the rod from contacting the hanger box. Design for 0.25- to 0.35-inch minimum static deflection at rated load. Isolators shall be Mason model HD, WHD, Amber-Booth model BRD or Kinetics model RH.

B. Type G - Spring and Neoprene in Series Isolator Hangers:

1. Contain a steel spring and 0.3-inch deflection elastomeric element in series. Neoprene elements shall be molded with a rod isolation bushing that passes through the hanger box that prevents the rod from contacting the hanger box. The diameters of the spring and the hole in the mounting box shall allow for 15-degree misalignment from vertical before mechanical short circuit occurs. Isolators shall be Mason model 30N, Amber-Booth model BSRA or Kinetics model SRH.

C. Type H - Precompressed Spring and Neoprene in Series Hanger:

1. Equal to Type G including 15-degree misalignment capability. Isolator shall be precompressed to the rated deflection to allow installation at a fixed elevation. Hangers shall have a release mechanism to free the spring after installation and the hanger is subjected to its full load. Deflection shall be indicated by means of a scale. Isolators shall be Mason model PC30N or Amber-Booth model PBSRA.

2.4 WALL-MOUNT ISOLATORS

A. Type P - Captive Neoprene Wall Mount Isolators.

1. Mason model RBA, RCA or Peabody model RQ.

2.5 FLEXIBLE CONDUIT

A. UL-listed liquidtight flexible conduit. Manufactured flexible conduit connector for sizes greater than 2 inches diameter shall be Crouse-Hinds type XD expansion/deflection coupling, or approved equal.

2.6 ELASTOMERIC GROMMETS

A. Combination of neoprene washer and bushing, Mason models HLIW and HLIB or E.A.R. (Indianapolis, Indiana) Isodamp, C-1000, ring bushing and washer combination.

B. Elastomer shall be 56 durometer maximum. Grommets shall be formed to prevent bolts from directly contacting the secured item.

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine areas and conditions under which vibration control units are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to installer.

3.2 GENERAL

A. All mechanical equipment, ductwork, piping and other equipment shall be resiliently mounted on or suspended from approved foundations and supports, with isolation pads, mounts and hangers as specified herein and as shown on drawings. Seismic restraints shall be installed in strict conformance with the certified shop drawings. Location of all isolation equipment shall be selected for ease of inspection and adjustment as well as for proper operation.

B. Mounts and Hangers:

1. All vibration isolators shall be aligned squarely above or below mounting points of the supported equipment.

2. Isolators for equipment with bases shall be located on the sides of the base which are parallel to the equipment shaft.

3. If a housekeeping pad is provided, isolator base plates shall rest entirely on the pad.

4. Hangers for vibration isolators shall be connected to structural beams or joists, not from the floor slab between beams and joists. Provide intermediate support members as necessary.

5. Vibration isolation hangers shall be positioned as high as possible in the hanger rod assembly, <u>but not in contact with the building structure.</u> Provide 1/2-inch minimum clearance between hanger housing and structure above. Provide side clearance for hanger housings to allow a full 360-degree rotation about the rod axis without contacting any object.

6. Parallel pipes may be hung together on a trapeze which is isolated from the structure. Isolator deflections must equal the greatest deflection for those pipes if isolated individually.

a. Do not mix isolated and non-isolated pipes on the same trapeze.

7. Limit stops shall be out of contact during normal operation.

8. Adjust all leveling bolts and hanger rod bolts so that the isolated equipment is level and in proper alignment with connecting ducts or pipes.

9. Contractor may elect to use Type H instead of Type G, to simplify installation.

C. All concrete inertia bases and required steel reinforcing shall be furnished and installed under this section. Dense aggregate concrete shall be poured within structural frames under the supervision of the contractor responsible for the work of this section.

D. Deflections:

1. Vibration isolation systems shall be designed to have deflections equal or greater than indicated on drawings and specifications; or as recommended by ASHRAE for the application. Where multiple deflection requirements apply to a single isolator, the greater deflection shall prevail.

2. Isolators supporting equipment with center of gravity that is asymmetrical in plan shall be selected for nearly equal deflection under actual load.

3. Number and size of mountings shall be determined by vibration isolation manufacturer. Install isolators in accordance with manufacturer's instructions.

E. Isolated Systems Shall be Independent:

1. Piping, ductwork, conduit or mechanical equipment shall not be hung from or supported on other equipment, pipes or ductwork installed on vibration isolators. Maintain 2 inches clearance between isolated equipment and walls, ceilings and other equipment.

2. Drain piping connected to vibration isolated equipment shall not contact the building structure or other non-isolated systems unless it is resiliently mounted.

F. Stabilize All Isolated Equipment:

1. Provide resilient sway bracing to solid anchor points to stabilize all equipment with center of gravity sufficiently above the plane of isolation mounts (such as vertical air handlers) to cause the top of the equipment to move more than 1/2 inch.

G. Treat All Isolation Systems for Corrosion Resistance:

1. Coatings damaged during installation shall be repaired.

3.3 CEILING SUPPORTED FANS

A. Hang with spring and neoprene in series hangers Type G.

B. If equipment to be mounted is not furnished with integral structural frames and external mounting lugs of suitable strength and rigidity, provide structural sub-base to support equipment and to which hangers shall be attached.

C. Thrust restraints shall be provided as required to limit motion to 1/4 inch maximum under fan operating, start-up and shut-down conditions.

D. Minimum deflection one inch.

3.4 DUCTWORK ISOLATION

A. Flexible duct connections as specified in Division 23, Section 233300 – AIR DUCT ACCESSORIES shall be provided at all fan inlets and outlets between the fan and the first duct hanger or support.

B. Provide resilient support for all ductwork in mechanical equipment rooms. Ducts shall be resiliently supported by elastomeric hangers Type F, with a static deflection of 0.25 to 0.35 inch, except as noted below.

C. Supply ducts below RC 20 spaces with velocities over 1000 FPM shall be supported on spring and neoprene in series hangers Type G.

D. All ductwork with air velocities in excess of 1,500 feet per minute shall be supported by elastomeric hangers Type F with a static deflection of 0.25 to 0.35 inch.

3.5 CENTRIFUGAL FANS (not including smoke evacuation or emergency stair pressurization fans):

A. Fans and bases shall be supported on open-spring, floor-mount isolators Type D. Minimu deflection 1-1/2 inch.

3.6 TRANSFORMERS, MOTOR CONTROL CENTERS, MOTOR STARTERS, DIMMER CABINETS

A. All electrical coil devices, including entire transformers (core and housing), shall be placed on neoprene-in-shear, floor-mount isolators Type B of bridge bearing quality neoprene, or captive neoprene, wall-mount isolators Type P. Connect with flexible conduit as described below.

END OF SECTION 230548.13

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SECTION 230553 – IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work of this section.

1.2 SUMMARY

A. Types of identification devices specified in this section include the following:

1. Painted identification materials.

2. Plastic pipe markers.

3. Plastic tape.

4. Plastic duct markers.

5. Valve tags.

6. Valve schedule frames.

7. Engraved plastic-laminate signs.

8. Plastic equipment markers.

9. Plasticized tags.

B. Requirements of the following Division 23 sections apply to this section:

1. Division 23, Section 230010 - BASIC MECHANICAL REQUIREMENTS.

2. Division 23, Section 230050 - BASIC MECHANICAL MATERIALS AND METHODS.

1.3 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacturer of identification devices of types and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Codes and Standards:

1. ANSI Standards: Comply with ANSI A13.1 for lettering size, length of color field, colors, and viewing angles of identification devices.

1.4 SUBMITTALS

A. General: Submit the following:

B. Product Data: Submit manufacturer's technical product data and installation instructions for each identification material and device required.

C. Schedules: Submit valve schedule for each piping system, typewritten and reproduced on 8-1/2 x 11 inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on tag), location of valve (room or space), and variations for identification (if any).

Mark valves which are intended for emergency shut-off and similar special uses, by special "flags," in margin of schedule. In addition to mounted copies, furnish extra copies for Operating and Maintenance Manuals.

D. Maintenance Data: Include product data and schedules in Operating and Maintenance Manuals.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, provide mechanical identification materials of one of the following:

1. Allen Systems, Inc.

2. Brady (W.H.) Co.; Signmark Div.

3. Industrial Safety Supply Co., Inc.

4. Seton Name Plate Corp.

2.2 MECHANICAL IDENTIFICATION MATERIALS

A. General: Provide manufacturer's standard products of categories and types required for each application. Where more than single type is specified for application, selection is installer's option, but provide single selection for each product category.

2.3 PAINTED IDENTIFICATION MATERIALS

A. Stencils: Standard fiberboard stencils, prepared for required applications with letter sizes generally complying with recommendations of ANSI A13.1 for piping and similar applications, but not less than 1-1/4-inch high letters for ductwork and not less than 3/4-inch high letters for access door signs and similar operational instructions.

B. Stencil Paint: Standard exterior type stenciling enamel; black, except as otherwise indicated; either brushing grade or pressurized spray-can form and grade.

C. Identification Paint: Standard identification enamel of colors indicated or, if not otherwise indicated for piping systems, comply with ANSI A13.1 for colors.

2.4 PLASTIC DUCT MARKERS

A. General: Provide manufacturer's standard laminated plastic, color coded duct markers. Conform to the following color code:

1. Green: Cold air.

2. Yellow: Hot air.

3. Yellow/Green: Supply air.

4. Blue: Exhaust, outside, return, and mixed air.

5. For hazardous exhausts, use colors and designs recommended by ANSI A13.1.

B. Nomenclature: Include the following:

1. Direction of air flow.

2. Duct service (supply, return, exhaust, etc.).

3. Duct origin (from).

4. Duct destination (to).

5. Design cfm.

2.5 PLASTIC TAPE

A. General: Provide manufacturer's standard color-coded pressure-sensitive (self-adhesive) vinyl tape, not less than 3 mils thick.

B. Width: Provide 1-1/2-inch wide tape markers on pipes with outside diameters (including insulation, if any) of less than 6 inches, 2-1/2-inch wide tape for larger pipes.

C. Color: Comply with ANSI A13.1, except where another color selection is indicated.

2.6 ENGRAVED PLASTIC-LAMINATE SIGNS

A. General: Provide engraving stock melamine plastic laminate, complying with FS L-P-387, in the sizes and thicknesses indicated, engraved with engraver's standard letter style of the sizes and wording indicated, black with white core (letter color) except as otherwise indicated, punched for mechanical fastening except where adhesive mounting is necessary because of substrate.

B. Thickness: 1/16 inch for units up to 20 square inches or 8-inch length; 1/8 inch for larger units.

C. Fasteners: Self-tapping stainless steel screws, except contact-type permanent adhesive where screws cannot or should not penetrate the substrate.

2.7 PLASTIC EQUIPMENT MARKERS

A. General: Provide manufacturer's standard laminated plastic, color coded equipment markers. Conform to the following color code:

1. Green: Cooling equipment and components.

2. Yellow: Heating equipment and components.

3. Yellow/Green: Combination cooling and heating equipment and components.

4. Brown: Energy reclamation equipment and components.

5. Blue: Equipment and components that do not meet any of the above criteria.

6. For hazardous equipment, use colors and designs recommended by ANSI A13.1.

B. Nomenclature: Include the following, matching terminology on schedules as closely as possible:

1. Name and plan number.

2. Equipment service.

3. Design capacity.

4. Other design parameters such as pressure drop, entering and leaving conditions, rpm, etc.

C. Size: Provide approximate 2-1/2 x 4 inch markers for control devices, dampers, and valves; and 4-1/2 x 6 inches for equipment.

2.8 LETTERING AND GRAPHICS

A. General: Coordinate names, abbreviations and other designations used in mechanical identification work, with corresponding designations shown, specified or scheduled. Provide numbers, lettering and wording as indicated or, if not otherwise indicated, as recommended by manufacturers or as required for proper identification and operation/maintenance of mechanical, fire protection and plumbing systems and equipment.

1. Multiple Systems: Where multiple systems of same generic name are shown and specified, provide identification which indicates individual system number as well as service (as examples; Boiler No. 3, Air Supply No. 1H, Standpipe F12).

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

A. Coordination: Where identification is to be applied to surfaces which require insulation, painting or other covering or finish, including valve tags in finished mechanical spaces, install identification after completion of covering and painting. Install identification prior to installation of acoustical ceilings and similar removable concealment.

3.2 DUCTWORK IDENTIFICATION

A. General: Identify air supply, return, exhaust, intake and relief ductwork with duct markers; or provide stenciled signs and arrows, showing specified information, in black or white (whichever provides most contrast with ductwork color).

B. Location: In each space where ductwork is exposed, or concealed only by removable ceiling system, locate signs near points where ductwork originates or continues into concealed enclosures (shaft, underground or similar concealment), and at 50-foot spacings along exposed runs.

C. Access Doors: Provide duct markers or stenciled signs on each access door in ductwork and housings, indicating purpose of access (to what equipment) and other maintenance and operating instructions, and appropriate safety and procedural information.

3.3 EQUIPMENT IDENTIFICATION

A. General: Install engraved plastic laminate sign or plastic equipment marker on or near each major item of equipment and each operational device, as specified herein if not otherwise specified for each item or device. Provide signs for the following general categories of equipment and operational devices:

1. Main control and operating valves, including safety devices and hazardous units such as gas outlets.

2. Meters, gauges, thermometers and similar units.

3. Water heaters.
4. Motor-driven units.

5. Coils and similar equipment.

6. Fans, blowers, primary balancing dampers and mixing boxes.

7. Packaged HVAC central-station or zone-type units.

B. Optional Sign Types: Where lettering larger than 1-inch height is needed for proper identification, because of distance from normal location of required identification, stenciled signs may be provided in lieu of engraved plastic, at installer's option.

C. Lettering Size: Minimum 1/4-inch high lettering for name of unit where viewing distance is less than 2 feet, 0 inches, 1/2-inch high for distances up to 6 feet, 0 inches, and proportionately larger lettering for greater distances. Provide secondary lettering of 2/3 to 3/4 of size of the principal lettering.

D. Text of Signs: In addition to name of identified unit, provide lettering to distinguish between multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations.

3.4 ADJUSTING AND CLEANING

A. Adjusting: Relocate any mechanical identification device which has become visually blocked by work of this division or other divisions.

B. Cleaning: Clean face of identification devices, and glass frames of valve charts.

END OF SECTION 230553

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SECTION 230593 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work of this section.

1.2 SUMMARY

A. This section specifies the requirements and procedures total mechanical systems testing, adjusting, and balancing. Requirements include measurement and establishment of the fluid quantities of the mechanical systems as required to meet design specifications, and recording and reporting the results.

B. Related Sections:

1. General requirements for testing agencies are specified in the Division 1, Section 014000 - QUALITY REQUIREMENTS.

2. Division 23, Section 230010 - BASIC MECHANICAL REQUIREMENTS.

3. Division 23, Section 230050 - BASIC MECHANICAL MATERIALS AND METHODS.

4. Division 23, Section 238126 - SPLIT-SYSTEM AIR-CONDITIONERS.

5. Division 23, Section 238113.11 - PACKAGED TERMINAL AIR CONDITIONERS, THROUGH-WALL UNITS.

6. Division 23, Section 237413 - PACKAGED, OUTDOOR, CENTRAL-STATION AIR HANDLING UNITS

7. Division 23, Section 233423 - HVAC POWER VENTILATORS.

8. Division 23, Section 238239.19 – WALL AND CEILING UNIT HEATERS.

9. Division 23, Section 233113 - METAL DUCTS.

10. Division 23, Section 233713.13 - AIR DIFFUSERS.

11. Division 23, Section 233713.23 - REGISTERS AND GRILLES.

C. Test, adjust, and balance the following mechanical systems:

1. Supply air systems, all pressure ranges

2. Return air systems.

3. Exhaust air systems.

4. Verify temperature control system operation.

D. Test systems for proper sound and vibration levels.

E. This section does not include:

1. Specifications for materials for patching mechanical systems;

2. Specifications for materials and installation of adjusting and balancing devices. If devices must be added to achieve proper adjusting and balancing, refer to the respective system sections for materials and installation requirements.

3. Requirements and procedures for piping and ductwork systems leakage tests.

1.3 DEFINITIONS

A. Systems testing, adjusting, and balancing is the process of checking and adjusting all the building environmental systems to produce the design objectives. It includes:

1. The balance of air distribution;

2. Adjustment of total system to provide design quantities;

3. Electrical measurement;

4. Verification of performance of all equipment and automatic controls;

5. Sound and vibration measurement.

B. Test: To determine quantitative performance of equipment.

C. Adjust: To regulate the specified fluid flow rate and air patterns at the terminal equipment (e.g., reduce fan speed, throttling).

D. Balance: To proportion flows within the distribution system (submains, branches, and terminals) according to specified design quantities.

E. Procedure: Standardized approach and execution of sequence of work operations to yield reproducible results.

F. Report forms: Test data sheets arranged for collecting test data in logical order for submission and review. These data should also form the permanent record to be used as the basis for required future testing, adjusting, and balancing.

G. Terminal: The point where the controlled fluid enters or leaves the distribution system. These are supply inlets on water terminals, supply outlets on air terminals, return outlets on water terminals, and exhaust or return inlets on air terminals such as grilles, diffusers, louvers, and hoods.

H. Main: Duct or pipe containing the system's major or entire fluid flow.

I. Submain: Duct or pipe containing part of the systems' capacity and serving two or more branch mains.

J. Branch main: Duct or pipe serving two or more terminals.

K. Branch: Duct or pipe serving a single terminal.

1.4 SUBMITTALS

A. Agency Data:

1. Submit proof that the proposed testing, adjusting, and balancing agency meets the qualifications specified below.

B. Engineer and Technicians Data:

1. Submit proof that the Test and Balance Engineer assigned to supervise the procedures, and the technicians proposed to perform the procedures meet the qualifications specified below.

C. Procedures and Agenda: Submit a synopsis of the testing, adjusting, and balancing procedures and agenda proposed to be used for this project.

D. Maintenance Data: Submit maintenance and operating data that include how to test, adjust, and balance the building systems. Include this information in maintenance data specified in Division 1 and Division 23, Section 230010 - BASIC MECHANICAL REQUIREMENTS.

1. Provide written warranty similar to AABC National Performance Guarantee.

E. Sample Forms: Submit sample forms, if other than those standard forms prepared by the AABC or NEBB are proposed.

F. Certified Reports: Submit testing, adjusting, and balancing reports bearing the seal and signature of the Test and Balance Engineer. The reports shall be certified proof that the systems have been tested, adjusted, and balanced in accordance with the referenced standards; are an accurate representation of how the systems have been installed; are a true representation of how the systems are operating at the completion of the testing, adjusting, and balancing procedures; and are an accurate record of all final quantities measured, to establish normal operating values of the systems. Follow the procedures and format specified below:

1. Draft reports: Upon completion of testing, adjusting, and balancing procedures, prepare draft reports on the approved forms. Draft reports may be hand written, but must be complete, factual, accurate, and legible. Organize and format draft reports in the same manner specified for the final reports. Submit 2 complete sets of draft reports. Only 1 complete set of draft reports will be returned.

2. Final Report: Upon verification and approval of draft reports, prepare final reports, type written, and organized and formatted as specified below. Submit 2 complete sets of final reports.

3. Report Format: Report forms shall be those standard forms prepared by the referenced standard for each respective item and system to be tested, adjusted, and balanced. Bind report forms complete with schematic systems diagrams and other data in reinforced, vinyl, three-ring binders. Provide

binding edge labels with the project identification and a title descriptive of the contents. Divide the contents of the binder into the below listed divisions, separated by divider tabs:

a. General Information and Summary

b. Air Systems

c. Temperature Control Systems

d. Special Systems

e. Sound and Vibration Systems

4. Report Contents: Provide the following minimum information, forms and data:

a. General Information and Summary: Inside cover sheet to identify testing, adjusting, and balancing agency, Contractor, Owner, Architect, Engineer, and Project. Include addresses, and contact names and telephone numbers. Also include a certification sheet containing the seal and name address, telephone number, and signature of the Certified Test and Balance Engineer. Include in this division a listing of the instrumentations used for the procedures along with the proof of calibration.

b. The remainder of the report shall contain the appropriate forms containing as a minimum, the information indicated on the standard report forms prepared by the AABC and NEBB, for each respective item and system. Prepare a schematic diagram for each item of equipment and system to accompany each respective report form. Include pump and fan curves plotted to actual operating point for each pump or fan.

G. Calibration Reports: Submit proof that all required instrumentation has been calibrated to tolerances specified in the referenced standards, within a period of six months prior to starting the project.

1.5 QUALITY ASSURANCE

A. Agency Qualifications:

1. Employ the services of an independent testing, adjusting, and balancing agency meeting the qualifications specified below, to be the single source of responsibility to test, adjust, and balance the building mechanical systems identified above, to produce the design objectives. Services shall include checking installations for conformity to design, measurement and establishment of the fluid quantities of the mechanical systems as required to meet design specifications, and recording and reporting the results.

2. An independent testing, adjusting, and balancing agency certified by the National Environmental Balancing Bureau (NEBB) or the Associated Air Balance Council (AABC) in those testing and balancing disciplines required for this project, and having at least one Professional Engineer registered in the State in which the services are to be performed, certified by NEBB or AABC as a Test and Balance Engineer.

B. Codes and Standards:

1. NEBB: "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems."

2. AABC: "National Standards For Total System Balance".

3. ASHRAE: ASHRAE Handbook, 2011 Applications Volume, Chapter 38, Testing, Adjusting, and Balancing.

C. Pre-Balancing Conference: Prior to beginning of the testing, adjusting, and balancing procedures, schedule and conduct a conference with the representatives of installers of the mechanical systems. The objective of the conference is final coordination and verification of system operation and readiness for testing, adjusting, and balancing.

1.6 PROJECT CONDITIONS

A. Systems Operation: Systems shall be fully operational prior to beginning procedures.

1.7 SEQUENCING AND SCHEDULING

A. Test, adjust, and balance the air systems before hydronic, steam, and refrigerant systems.

B. Test, adjust and balance air conditioning systems during summer season and heating systems during winter season, including at least a period of operation at outside conditions within 5 degrees F wet bulb temperature of maximum summer design condition, and within 10 degrees F dry bulb temperature of minimum winter design condition. Take final temperature readings during seasonal operation.

1.8 WARRANTY

A. Provide extended warranty of 90 days, after completion of test and balance work, during which time Owner may at his discretion, request recheck or resetting or equipment or system which is not performing satisfactorily. Provide technicians to assist as required in making such tests.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 PRELIMINARY PROCEDURES FOR AIR SYSTEM BALANCING

A. Before operating the system, perform these steps:

1. Obtain design drawings and specifications and become thoroughly acquainted with the design intent.

2. Obtain copies of approved shop drawings of all air handling equipment, outlets (supply, return, and exhaust) and temperature control diagrams.

3. Compare design to installed equipment and field installations.

4. Walk the system from the system air handling equipment to terminal units to determine variations of installation from design.

5. Check filters for cleanliness.

6. Check dampers (both volume and fire) for correct and locked position, and temperature control for completeness of installation before starting fans.

7. Prepare report test sheets for both fans and outlets. Obtain manufacturer's outlet factors and recommended procedures for testing. Prepare a summation of required outlet volumes to permit a crosscheck with required fan volumes.

8. Determine best locations in main and branch ductwork for most accurate duct traverses.

9. Place outlet dampers in the full open position.

10. Prepare schematic diagrams of system "as-built" ductwork and piping layouts to facilitate reporting.

11. Lubricate all motors and bearings.

12. Check fan belt tension.

13. Check fan rotation.

3.2 MEASUREMENTS

A. Provide all required instrumentation to obtain proper measurements, calibrated to the tolerances specified in the referenced standards. Instruments shall be properly maintained and protected against damage.

B. Provide instruments meeting the specifications of the referenced standards.

C. Use only those instruments which have the maximum field measuring accuracy and are best suited to the function being measured.

D. Apply instrument as recommended by the manufacturer.

E. Use instruments with minimum scale and maximum subdivisions and with scale ranges proper for the value being measured.

F. When averaging values, take a sufficient quantity of readings which will result in a repeatability error of less than 5 percent. When measuring a single point, repeat readings until 2 consecutive identical values are obtained.

G. Take all reading with the eye at the level of the indicated value to prevent parallax.

H. Use pulsation dampeners where necessary to eliminate error involved in estimating average of rapidly fluctuation readings.

I. Take measurements in the system where best suited to the task.

3.3 PERFORMING TESTING, ADJUSTING, AND BALANCING

A. Perform testing and balancing procedures on each system identified, as listed below and in accordance with the detailed procedures outlined in the referenced standards.

B. Cut insulation, ductwork, and piping for installation of test probes to the minimum extent necessary to allow adequate performance of procedures.

C. Patch insulation, ductwork, and housings, using materials identical to those removed.

D. Seal ducts and piping, and test for and repair leaks.

E. Seal insulation to re-establish integrity of the vapor barrier.

F. Mark equipment settings, including damper control positions, valve indicators, fan speed control levers, and similar controls and devices, to show final settings. Mark with paint or other suitable, permanent identification materials.

G. Retest, adjust, and balance systems subsequent to significant system modifications, and resubmit test results.

3.4 AIR BALANCING METHODS

A. Balance each air system that is served by air filters, using artificial static loading of system, to demonstrate, test and obtain system design pressure drop data.

1. Provide dirty filter pressure drop conditions on system.

2. Do not use high-efficiency filters (65 percent and above) in testing and balancing.

3. Static pressure losses may be simulated by using wood or sheet steel blanking plates in high-efficiency filter racks and housings.

4. Do not install blanking plates within 2 feet of low-efficiency filter unit or rack.

3.5 AIR BALANCE TESTING PROCEDURE

A. Test and adjust equipment capacity to design requirements and record RPM.

B. Test motor load amperes and fan rotations.

C. Make pitot tube traverse of main supply ducts and obtain design CFM at fans. Provide fan curves and plots.

D. Test system static pressures, suction and discharge.

E. Test and adjust system for design CFM outside and return air:

1. Maximum outside air setting.

2. Minimum outside air setting.

F. Test and adjust system for design CFM outside air.

G. Test coil entering air temperatures:

1. Dry bulb degrees F heating and cooling.

2. Wet bulb degrees F cooling.

H. Test leaving air temperatures:

1. Dry bulb degrees F heating and cooling.

2. Wet bulb degrees F cooling.

I. Adjust main supply and return air ducts to proper design CFM.

J. Adjust zones to proper design CFM, supply and return.

K. Test and adjust each diffuser and grille to within 10 percent of design requirements.

1. Identify location and area of each grille and diffuser.

2. Identify and list size, type and manufacture of diffusers and grilles.

3. Use manufacturer's ratings on equipment to make required calculations.

4. Readings and tests of diffusers and grilles shall include required FPM velocity and test resultant velocity, required CFM and test resultant CFM after adjustments.

5. Adjust diffusers and grilles to minimize drafts.

L. In cooperation with control manufacturer's representative, set automatically operated dampers to operate as indicated.

1. Check controls for proper calibration and list controls requiring adjustment by control installers.

M. Balance supply, return and exhaust air to provide designed pressure relationships to adjacent areas.

N. Make changes in pulleys, belts and dampers to achieve capacity.

O. Check fire dampers and smoke dampers for correct operation and damper position.

P. Adjust special equipment fans to CFM requirements as indicated.

Q. List mechanical nameplate and specification of fans.

3.6 TESTING FOR SOUND AND VIBRATION

A. Test and adjust mechanical systems for sound and vibration in accordance with the detailed instructions of the referenced standards.

3.7 RECORD AND REPORT DATA

A. Record all data obtained during testing, adjusting, and balancing in accordance with, and on the forms recommended by the referenced standards, and as approved on the sample report forms.

B. Prepare report of recommendations for correcting unsatisfactory mechanical performances when system cannot be successfully balanced.

3.8 OPERATING TEST

A. After systems are balanced, conduct operating test of not less than 8 hours duration each for heating and cooling systems to demonstrate to satisfaction of Owner that systems comply with requirements of plans and specifications and that equipment and controls are functioning properly.

3.9 DEMONSTRATION

A. Training:

1. Train the Owner's maintenance personnel on troubleshooting procedures and testing, adjusting, and balancing procedures. Review with the Owner's personnel, the information contained in the Operating and Maintenance Data specified in Division 1 and Division 23, Section 230010 - BASIC MECHANICAL REQUIREMENTS.

2. Schedule training with Owner through the Architect with at least 7 days prior notice.

END OF SECTION 230593

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SECTION 230713 – DUCT INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work of this section.

1.2 SUMMARY

A. Types of mechanical insulation specified in this section include the following:

1. Ductwork System Insulation:

a. Fiberglass.

B. Requirements of the following Division 23 sections apply to this section.

1. Division 23, Section 230010 - BASIC MECHANICAL REQUIREMENTS.

2. Division 23, Section 230050 - BASIC MECHANICAL MATERIALS AND METHODS.

3. Division 23, Section 230719 - HVAC PIPING INSULATION.

4. Division 23, Section 233113 - METAL DUCTS for duct liners.

1.3 QUALITY ASSURANCE

A. Labeling: Insulation shall be labeled by the manufacturer. The label shall include the insulating valve, flame spread and smoke developed rating.

B. Flame/Smoke Ratings: Provide composite mechanical insulation (insulation, jackets, coverings, sealers, mastics and adhesives) with flame-spread index of 25 or less, and smoke-developed index of 50 or less, as tested by ASTM E84 (NFPA 255) method.

C. Hot Surface Performance: Insulation coverings, jackets and linings shall not flame, glow, smolder or smoke when tested at their rated temperature in accordance with ASTM C411. Test temperature shall be 250 degrees F or greater.

D. Testing: All testing shall be by UL or other testing or inspecting organization acceptable to the authority having jurisdiction.

1.4 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data and installation instructions for each type of mechanical insulation. Submit schedule showing manufacturer's product number, k-value, density, thickness, and furnished accessories for each mechanical system requiring insulation.

B. Maintenance Data: Submit maintenance data and replacement material lists for each type of mechanical insulation. Include this data and product data in Operating and Maintenance Manual.

C. Test Reports: Submit material test reports prepared by a qualified independent testing laboratory. Certify insulation meets specified requirements.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver insulation, coverings, cements, adhesives, and coatings to site in containers with manufacturer's stamp or label, affixed showing fire hazard indexes of products.

B. Protect insulation against dirt, water, and chemical and mechanical damage. Do not install damaged or wet insulation; remove from project site.

C. Remove and replace any damaged or wet insulation with new materials. Remove damaged material from project site.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products which may be incorporated in the work include, but are not limited to, the following:

B. Manufacturer: Subject to compliance with requirements, provide products of one of the following:

1. Fiberglass:

a. Certainteed Corp.

b. Knauf Fiberglass GmbH.
c. Schuller International.

d. Owens-Corning Fiberglass Corp.

2. Flexible Unicellular:

a. Armstrong World Industries, Inc.

b. Rubatex Corp.

c. Imoca.

3. Adhesives, Mastics, Sealers and Cements:

a. Armstrong World Industries, Inc.

b. Certainteed Corp.

c. Foster Products Corp.

d. Knauf Fiberglass GmbH.

e. Schuller International.

f. Owens-Corning Fiberglass Corp.

g. Pittsburgh Corning Corp.

h. Rubatex Corp.

i. King Co.

2.2 DUCTWORK INSULATION MATERIALS

A. Fiberglass Blanket Insulation: Flexible, blanket duct insulation with jacket.

1. Insulation shall comply with requirements of ASTM C553, Type I, Class B-2 for service up to 250 degrees F.

2. Thermal conductivity (k) at 75 degrees F mean temperature shall be 0.27 maximum at labeled thickness and 0.25 maximum with material compressed 25 percent when tested in accordance with ASTM C177 or ASTM C518.

3. Density shall be 1 lb/cu ft.

4. Fiberglass blanket duct insulation installed indoors shall be jacketed with foil-scrim-kraft (FSK) facing.

a. Jacket shall be factory applied.
b. Water vapor permeance shall be 0.02 permeance inch maximum when tested in accordance with ASTM E96, Procedure A.

c. Beach puncture shall be 40 oz in/in tear minimum when tested in accordance with ASTM D781.

B. Fiberglass Board Insulation: Rigid board duct insulation with jacket.

1. Insulation shall comply with requirements of ASTM C612, Class 2 for service up to 450 degrees F.

2. Thermal conductivity (k) at 75 degrees F mean temperature shall be 0.22 maximum when tested in accordance with ASTM C177 or ASTM C518.

3. Density shall be 3 lbs/cu ft.

4. Fiberglass board duct insulation installed indoors shall be jacketed with FSK facing.

a. Jacket shall be factory applied.

b. Water vapor permeance shall 0.02 permeance inch maximum when tested in accordance with ASTM E96, Procedure A.

c. Beach puncture shall be 40 oz in/in tear minimum when tested in accordance with ASTM D781.

2.3 ADHESIVES

A. Flexible Elastomeric Cellular Insulation Adhesive: Solvent-based, contact adhesive recommended by insulation manufacturer.

B. Lagging Adhesive: MIL-A-3316C, nonflammable adhesive in the following classes and grades:

1. Class 1, Grade A for bonding glass cloth and tape to unfaced glass fiber insulation, sealing edges of glass fiber insulation, and bonding lagging cloth to unfaced glass fiber insulation.

2. Class 2, Grade A for bonding glass fiber insulation to metal surfaces.

2.4 ACCESSORIES AND ATTACHMENTS

A. Glass Cloth and Tape: Woven glass fiber fabrics, plain weave, presized a minimum of 8 ounces per sq. yd.

1. Tape Width: 4 inches.

2. Cloth Standard: MIL-C-20079H, Type I.

B. Bands: 3/4-inch wide, in one of the following materials compatible with jacket:

1. Stainless Steel: Type 304, 0.020 inch thick.

C. Corner Angles: 28-gauge, 1-inch by 1-inch aluminum, adhered to 2-inch by 2-inch kraft paper.

D. Anchor Pins: Capable of supporting 20 pounds each. Provide anchor pins and speed washers of sizes and diameters as recommended by the manufacturer for insulation type and thickness.

2.5 SEALING COMPOUNDS

A. Vapor Barrier Compound: Water-based, fire-resistive composition.

1. Water Vapor Permeance: 0.08 perm maximum.

2. Temperature Range: Minus 20 to 180 degrees F.

B. Weatherproof Sealant: Flexible-elastomer-based, vapor-barrier sealant designed to seal metal joints.

1. Water Vapor Permeance: 0.02 perm maximum.

2. Temperature Range: Minus 50 to 250 degrees F.

3. Color: Aluminum.

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine areas and conditions under which mechanical insulation is to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to installer.

B. Do not insulate ductwork until leak tests have been completed and approved by Architect.

3.2 DUCTWORK SYSTEM INSULATION

A. Application Requirements: Insulate all ductwork, fan and terminal unit collars, duct-mounted coils, diffuser and grille backs and plenums.

1. Exhaust ducts within return air ceiling plenums or in conditioned spaces do not require insulation.

2. Internally lined ductwork return air and transfer ductwork within return air ceiling plenums or in conditioned spaces do not require insulation.

B. Mechanical Rooms: Ductwork within mechanical rooms shall have insulation thicknesses 1 thickness greater than that specified in the following paragraphs.

C. Insulate each ductwork system specified above with one of the following types and thicknesses of insulation:

1. Rigid Fiberglass: 2-inch thick for outdoor air duct exposed indoors.

2. Flexible Fiberglass: 1-1/2-inch thick.

3. Kitchen Hood Exhaust Duct: Calcium silicate, 2 inches thick.

3.3 INSTALLATION OF DUCTWORK INSULATION

A. General: Install insulation products in accordance with manufacturer's written instructions, and in accordance with recognized industry practices to ensure that insulation serves its intended purpose.

B. Install insulation materials with smooth and even surfaces.

C. Clean and dry ductwork prior to insulating. Butt insulation joints firmly together to ensure complete and tight fit over surfaces to be covered.

D. Maintain integrity of vapor-barrier jacket on ductwork insulation, and protect it to prevent puncture and other damage. Seal all tears, punctures and other penetrations in insulation jacket.

E. Rigid Fiberglass Insulation: Install using mechanical fasteners (weld pins or stick clips) located not less than 3 inches from edge or corner of insulation board. Pin spacing along duct shall be no greater than 12 inches on centers. Duct insulation board shall be impaled over pins and fasteners with self-locking washers. All joints shall be tight, with insulation lengths tightly butted against each other. Where lengths are cut, they shall be smooth and square without breakage of end surfaces. Where insulation terminates, the ends shall be neatly tapered and effectively sealed and finished. Longitudinal seams of exposed insulation shall be directed away from normal view. Apply a matching pressure-sensitive vapor seal patch over each pin and washer. All insulation edges and butt joints are to be sealed with pressure-sensitive joint sealing tape to match the jacket. Tape shall comply with UL 181A-P requirements. Use 3-inch wide tape on flat surfaces, or where edges are shiplapped and stapled. Five-inch wide tape can be used in lieu of shiplapping. Contours on exposed work shall be smooth and continuous. Cemented laps, flaps, bands and tapes shall be smoothly and securely pasted down.

F. Flexible Fiberglass: Install insulation over a 50-percent coverage coat of UL-approved adhesive, applied to duct in 6-inch brush strokes, on 12-inch centers. Ducts 24 inches and larger in width or height shall have insulation additionally secured with mechanical fasteners (weld pins or stick clips) spaced on 18-inch centers (maximum) to prevent sagging of insulation. Insulation jacket shall be overlapped a minimum of 2 inches at all joints and

seams then stapled 6 inches on center with outward clinching staples. All joints, seams and breaks in the vapor barrier shall be sealed with UL-approved mastic and 4-inch wide glass fabric.

G. Extend ductwork insulation without interruption through walls, floors and similar ductwork penetrations, except where fire dampers are installed.

H. Ductwork Exposed to Weather: Protect outdoor insulation from weather by outdoor jacketing.

I. Corner Angles: Provide corner angles on external corners of insulation on ductwork in exposed finished spaces before covering with jacketing.

3.4 PROTECTION AND REPLACEMENT

A. Replace damaged insulation which cannot be repaired satisfactorily, including units with vapor barrier damage and moisture saturated units.

B. Protection: Insulation installer shall advise Contractor of required protection for insulation work during remainder of construction period, to avoid damage and deterioration.

END OF SECTION 230713

SECTION 230719 – HVAC PIPING INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work of this section.

1.2 SUMMARY

A. Types of mechanical insulation specified in this section include the following:

1. Pipe Insulation:

a. Flexible Unicellular.

B. Requirements of the following Division 23 sections apply to this section.

1. Division 23, Section 230010 - BASIC MECHANICAL REQUIREMENTS.

2. Division 23, Section 230050 - BASIC MECHANICAL MATERIALS AND METHODS.

3. Division 23, Section 230713 – DUCT INSULATION.

1.3 QUALITY ASSURANCE

A. Labeling: Insulation shall be labeled by the manufacturer. The label shall include the insulating valve, flame spread and smoke developed rating.

B. Flame/Smoke Ratings: Provide composite mechanical insulation (insulation, jackets, coverings, sealers, mastics and adhesives) with flame-spread index of 25 or less, and smoke-developed index of 50 or less, as tested by ASTM E84 (NFPA 255) method.

C. Hot Surface Performance: Insulation coverings, jackets and linings shall not flame, glow, smolder or smoke when tested at their rated temperature in accordance with ASTM C411. Test temperature shall be 250 degrees F or greater.

D. Testing: All testing shall be by UL or other testing or inspecting organization acceptable to the authority having jurisdiction.

1.4 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data and installation instructions for each type of mechanical insulation. Submit schedule showing manufacturer's product number, k-value, density, thickness, and furnished accessories for each mechanical system requiring insulation.

B. Maintenance Data: Submit maintenance data and replacement material lists for each type of mechanical insulation. Include this data and product data in Operating and Maintenance Manual.

C. Test Reports: Submit material test reports prepared by a qualified independent testing laboratory. Certify insulation meets specified requirements.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver insulation, coverings, cements, adhesives, and coatings to site in containers with manufacturer's stamp or label, affixed showing fire hazard indexes of products.

B. Protect insulation against dirt, water, and chemical and mechanical damage. Do not install damaged or wet insulation; remove from project site.

C. Remove and replace any damaged or wet insulation with new materials. Remove damaged material from project site.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products which may be incorporated in the work include, but are not limited to, the following:

B. Manufacturer: Subject to compliance with requirements, provide products of one of the following:

1. Flexible Unicellular:

a. Armstrong World Industries, Inc.

b. Rubatex Corp.

c. Imoca.

2. Adhesives and Sealers:

a. Armstrong World Industries, Inc.

b. Certainteed Corp.

c. Foster Products Corp.

d. Schuller International.

e. King Co.

2.2 PIPE INSULATION MATERIALS

A. Flexible Unicellular Insulation:

1. Insulation shall comply with requirements of ASTM C534, Type II for service up to 220 degrees F.

2. Thermal conductivity (k) at 75 degrees F mean temperature shall be 0.28 maximum when tested in accordance with ASTM C177 or ASTM C518.

2.3 ADHESIVES

A. Flexible Elastomeric Cellular Insulation Adhesive: Solvent-based, contact adhesive recommended by insulation manufacturer.

2.4 SEALING COMPOUNDS

A. Vapor Barrier Compound: Water-based, fire-resistive composition.

1. Water Vapor Permeance: 0.08 perm maximum.

2. Temperature Range: Minus 20 to 180 degrees F.

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine areas and conditions under which mechanical insulation is to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to installer.

B. Do not insulate pipes until pressure and leak tests have been completed and approved by Architect.

3.2 INSTALLATION OF PIPE INSULATION

A. General: Install thermal insulation products in accordance with manufacturer's written instructions, and in compliance with recognized industry practices to ensure that insulation serves intended purpose.

B. Install insulation materials with smooth and even surfaces and on clean and dry surfaces. Redo poorly fitted joints. Do not use mastic or joint sealer as filler for gapping joints and excessive voids resulting from poor workmanship.

C. Maintain integrity of vapor-barrier jacket on insulation and protect it to prevent puncture and other damage. Seal all tears, punctures and other penetrations in insulation jacket.

3.3 PROTECTION AND REPLACEMENT

A. Replace damaged insulation which cannot be repaired satisfactorily, including units with vapor barrier damage and moisture saturated units.

B. Protection: Insulation installer shall advise Contractor of required protection for insulation work during remainder of construction period, to avoid damage and deterioration.

END OF SECTION 230719

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SECTION 233113 – METAL DUCTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this section.

1.2 SUMMARY

A. This section includes rectangular, round, and flat-oval metal ducts and plenums for heating, ventilating, and air conditioning systems in pressure classes from minus 2 inches to plus 10 inches water gauge.

B. Related Sections: The following sections contain requirements that relate to this section:

1. Division 23, Section 230010 - BASIC MECHANICAL REQUIREMENTS.

2. Division 23, Section 230050 - BASIC MECHANICAL MATERIALS AND METHODS.

3. Division 23, Section 230713 - DUCT INSULATION for exterior duct and plenum insulation.

4. Division 23, Section 233300 - AIR DUCT ACCESSORIES for flexible duct materials, dampers, duct-mounted access panels and doors, and turning vanes.

5. Division 23, Section 233713.13 - AIR DIFFUSERS.

6. Division 23, Section 233713.23 - REGISTERS AND GRILLES.

7. Division 23, Section 230593 - TESTING, ADJUSTING, AND BALANCING FOR HVAC.

1.3 DEFINITIONS

A. Sealing Requirements Definitions: For the purposes of duct systems sealing requirements specified in this section, the following definitions apply:

1. Seams: A seam is defined as joining of two longitudinally (in the direction of airflow) oriented edges of duct surface material occurring between two joints. All other duct surface connections made on the perimeter are deemed to be joints.

2. Joints: Joints include girth joints; branch and subbranch intersections; so-called duct collar tap-ins; fitting subsections; louver and air terminal connections to ducts; access door and access panel frames and jambs; duct, plenum, and casing abutments to building structures.

1.4 SYSTEM PERFORMANCE REQUIREMENTS

A. The duct system design, as indicated, has been used to select and size air moving and distribution equipment and other components of the air system. Changes or alterations to the layout or configuration of the duct system must be specifically approved in writing. Accompany requests for layout modifications with calculations showing that the proposed layout will provide the original design results without increasing the system total pressure.

1.5 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.

B. Product data including details of construction relative to materials, dimensions of individual components, profiles, and finishes for the following items:

1. Duct Liner.

2. Sealing Materials.

3. Firestopping Materials.

4. Round duct and fittings.

C. Shop drawings from duct fabrication shop, drawn to a scale not smaller than 1/4 inch equals 1 foot, on drawing sheets same size as the Contract Drawings, detailing:

1. Fabrication, assembly, and installation details, including plans, elevations, sections, details of components, and attachments to other work.

2. Duct layout, indicating pressure classifications and sizes in plan view. For exhaust ducts systems, indicate the classification of the materials handled as defined in this section.

3. Fittings.

4. Reinforcing details and spacing.

5. Seam and joint construction details.

6. Penetrations through fire-rated and other partitions.

7. Hangers and supports, including methods for building attachment, vibration isolation, and duct attachment.

D. Coordination drawings for ductwork installation in accordance with Division 23, Section 230010 - BASIC MECHANICAL REQUIREMENTS. In addition to the requirements specified in Section 230010 - BASIC MECHANICAL REQUIREMENTS, show the following:

1. Coordination with ceiling suspension members.

2. Spatial coordination with other systems installed in the same space with the duct systems.

3. Coordination of ceiling- and wall-mounted access doors and panels required to provide access to dampers and other operating devices.

4. Coordination with ceiling-mounted lighting fixtures and air outlets and inlets.

E. Welding certificates including welding procedures specifications, welding procedures qualifications test records, and welders' qualifications test records complying with requirements specified in "Quality Assurance" below.

F. Record drawings including duct systems routing, fittings details, reinforcing, support, and installed accessories and devices, in accordance with Division 23, Section 230010 - BASIC MECHANICAL REQUIREMENTS and Division 1.

1.6 QUALITY ASSURANCE

A. NFPA Compliance: Comply with the following NFPA Standards:

1. NFPA 90A, "Standard for the Installation of Air Conditioning and Ventilating Systems," except as indicated otherwise.

B. Construct all ductwork and accessories in accordance with SMACNA "HVAC Duct Construction Standards - Metal and Flexible" 2nd Edition, 1995.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver sealant and fire-stopping materials to site in original unopened containers or bundles with labels informing about manufacturer, product name and designation, color, expiration period for use, pot life, curing time, and mixing instructions for multi-component materials. Maintain copies of MSDS on site.

B. Store and handle sealant fire-stopping materials in compliance with manufacturers' recommendations to prevent their deterioration or damage due to moisture, high or low temperatures, contaminants, or other causes.

C. Deliver and store stainless steel sheets with mill-applied adhesive protective paper, maintained through fabrication and installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturer: Subject to compliance with requirements, provide products of one of the following:

1. Ductwork, Round:

a. United McGill Corp.

b. Semco.

c. Sheet Metal Products Co.

d. Lindab.

2. Duct Sealers and Coatings:

a. Durkee-Atwood.

b. Hardcast, Inc.

c. United McGill Corp.

d. Foster Products Division, H.B. Fuller, Co.

e. King Co.

f. Porter Paint.

3. Duct Sealing Tape:

a. Durkee-Atwood.

b. Hardcast, Inc.

c. United McGill Corp.

4. Acoustical Duct Liners:

a. Knauf.

b. Certainteed Corp.

c. Owens-Corning.

d. Manville-Schuller.

5. Duct Liner, Adhesive:

a. Foster Products Division, H.B. Fuller, Co.

b. Manville-Schuller.

c. King Co.

6. Duct Liner, Mastic:

a. Foster Products Division, H.B. Fuller, Co.

b. Manville-Schuller.

c. King Co.

2.2 SHEET METAL MATERIALS

A. Sheet Metal, General: Provide sheet metal in thicknesses indicated, packaged and marked as specified in ASTM A700.

B. Galvanized Sheet Steel: Lock-forming quality, ASTM A527, Coating Designation G 90. Provide mill phosphatized finish for exposed surfaces of ducts exposed to view.

C. Reinforcement Shapes and Plates: Unless otherwise indicated, provide galvanized steel reinforcing where installed on galvanized sheet metal ducts. For aluminum and stainless steel ducts provide reinforcing of compatible materials.

D. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for 36-inch length or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.3 DUCT LINER

A. General: Comply with NFPA Standard 90A and TIMA Standard AHC-101.

B. Materials: ASTM C1071, Type II, with coated surface exposed to airstream to prevent erosion of glass fibers.

1. Thickness: 1 inch.

2. Density: 1-1/2 pounds.

3. Thermal Performance: "K-Factor" equal to 0.28 or better, at a mean temperature of 75 degrees F.

4. Fire Hazard Classification: Flame spread rating of not more than 25 without evidence of continued progressive combustion and a smoke developed rating of no higher than 50, when tested in accordance with ASTM C411.

5. Liner Adhesive: Comply with NFPA Standard 90A and ASTM C916.

6. Mechanical Fasteners: Galvanized steel, suitable for adhesive attachment, mechanical attachment, or welding attachment to duct. Provide fasteners that do not damage the liner when applied as recommended by the manufacturer, that do not cause leakage in the duct, and will indefinitely sustain a 50-pound tensile dead load test perpendicular to the duct wall.

a. Fastener Pin Length: As required for thickness of insulation, and without projecting more than 1/8 inch into the airstream.

b. Adhesive For Attachment of Mechanical Fasteners: Comply with the "Fire Hazard Classification" of duct liner system.

7. Coating: Acrylic cleanable coating factory formulated with an EPA registered antimicrobial growth-resistant agent in accordance with ASTM G21 and G22 test.

2.4 SEALING MATERIALS

A. Joint and Seam Sealants, General: The term sealant used here is not limited to materials of adhesive or mastic nature, but also includes tapes and combinations of open weave fabric strips and mastics.

1. Duct Sealers: NFPA rating of "Non-Combustible."

a. Flame Spread Rating: 25 or lower, in dry condition.

b. Smoke Developed Rating: 50 or lower, in dry condition.

c. Resistant to water and water vapors.

d. Pressure Rupture Rating: 16-inch water gauge, minimum.

2. Duct Sealing Tapes: NFPA rating of "Non-Combustible."

a. Flame Spread Rating: 25 or lower, in dry condition.

b. Smoke Developed Rating: 50 or lower, in dry condition.

c. Adhesive: Specifically compounded for maximum adhesion to galvanized and stainless steel.

B. Joint and Seam Tape: 2 inches wide, glass-fiber-fabric reinforced.

C. Tape Sealing System: Woven-fiber tape impregnated with a gypsum mineral compound and a modified acrylic/silicone activator to react exothermically with the tape to form a hard, durable, airtight seal.

D. Joint and Seam Sealant: One-part, nonsag, solvent-release-curing, polymerized butyl sealant complying with FS TT-S-001657, Type I; formulated with a minimum of 75 percent solids.

E. Flanged Joint Mastics: One-part, acid-curing, silicone elastomeric joint sealants, complying with ASTM C920, Type S, Grade NS, Class 25, Use O.

2.5 FIRESTOPPING

A. Fire-Resistant Sealant: Provide two-part, foamed-in-place, fire-stopping silicone sealant formulated for use in a through-penetration fire-stop system for filling openings around duct penetrations through walls and floors, having fire-resistance ratings indicated as established by testing identical assemblies per ASTM E814 by Underwriters Laboratory, Inc. or other testing and inspecting agency acceptable to authorities having jurisdiction.

B. Fire-Resistant Sealant: Provide one-part elastomeric sealant formulated for use in a through-penetration fire-stop system for filling openings around duct penetrations through walls and floors, having fire-resistance ratings indicated as established by testing identical assemblies per ASTM E814 by Underwriters Laboratory, Inc. or other testing and inspecting agency acceptable to authorities having jurisdiction.

C. Products: Subject to compliance with requirements, provide one of the following:

1. "Dow Corning Fire Stop Foam"; Dow Corning Corp.

2. "Pensil 851"; General Electric Co.

3. "Dow Corning Fire Stop Sealant"; Dow Corning Corp.

4. "3M Fire Barrier Caulk CP-25"; Electrical Products Div./3M.

5. "RTV 7403"; General Electric Co.

6. "Fyre Putty"; Standard Oil Engineered Materials Co.

2.6 HANGERS AND SUPPORTS

A. Building Attachments: Concrete inserts, powder actuated fasteners, or structural steel fasteners appropriate for building materials. Do not use powder actuated concrete fasteners for lightweight aggregate concretes or for slabs less than 4 inches thick.

B. Hangers: Galvanized sheet steel, or round, uncoated steel, threaded rod.

1. Hangers Installed In Corrosive Atmospheres: Electro-galvanized, all-thread rod or hot-dipped-galvanized rods with threads painted after installation.

2. Straps and Rod Sizes: Conform with Table 4-1 in SMACNA HVAC Duct Construction Standards, for sheet steel width and gauge and steel rod diameters.

C. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

D. Trapeze and Riser Supports: Steel shapes conforming to ASTM A36.

1. Where galvanized steel ducts are installed, provide hot-dipped-galvanized steel shapes and plates.

2. For stainless steel ducts, provide stainless steel support materials.

3. For aluminum ducts, provide aluminum support materials, except where materials are electrolytically separated from ductwork.

2.7 RECTANGULAR DUCT FABRICATION

A. General: Except as otherwise indicated, fabricate rectangular ducts with galvanized sheet steel, in accordance with SMACNA "HVAC Duct Construction Standards," Tables 1-6 through 1-20, including their associated details. Conform to the requirements in the referenced standard for metal thickness, reinforcing types and intervals, tie rod applications, and joint types and intervals.

1. Fabricate rectangular ducts in lengths appropriate to reinforcement and rigidity class required for pressure classification.

2. Provide materials that are free from visual imperfections such as pitting, seam marks, roller marks, stains, and discolorations.

B. Static Pressure Classifications: Except where otherwise indicated, construct duct systems to the following pressure classifications:

1. Supply Ducts: 3 inches water gauge.

2. Return Ducts: 3 inches water gauge, negative pressure.

3. Exhaust Ducts: 3 inches water gauge, negative pressure.

C. Crossbreaking or Cross Beading: Crossbreak or bead duct sides that are 19 inches and larger and are 20 gauge or less, with more than 10 sq. ft. of unbraced panel area, as indicated in SMACNA "HVAC Duct Construction Standard," Figure 1-8, unless they are lined or are externally insulated.

D. Button punch or snaplock seams not acceptable.

2.8 RECTANGULAR DUCT FITTINGS

A. Fabricate elbows, transitions, offsets, branch connections, and other duct construction in accordance with SMACNA "HVAC Metal Duct Construction Standard," Figures 2-1 through 2-11.

B. Provide turning vanes as specified in Section 233300 – AIR DUCT ACCESSORIES in all rectangular nonradius elbows.

2.9 SHOP APPLICATION OF LINER IN RECTANGULAR DUCTS

A. Adhere a single layer of indicated thickness of duct liner with 90 percent coverage of adhesive at liner contact surface area. Multiple layers of insulation to achieve indicated thickness is prohibited.

B. Apply a coat of adhesive to liner facing in direction of airflow not receiving metal nosing.

C. Butt transverse joints without gaps and coat joint with adhesive.

D. Fold and compress liner in corners of rectangular ducts or cut and fit to assure butted edge overlapping.

E. Longitudinal joints in rectangular ducts shall not occur except at corners of ducts, unless the size of the duct and standard liner product dimensions make longitudinal joints necessary.

1. Apply an adhesive coating on longitudinal seams in ducts exceeding 2,500 FPM air velocity.

F. Secure liner with mechanical fasteners 4 inches from corners and at intervals not exceeding 12 inches transversely around perimeter; at 3 inches from transverse joints and at intervals not exceeding 18 inches longitudinally.

G. Secure transversely oriented liner edges facing the airstream with metal nosings that are either channel or "Z" profile or are integrally formed from the duct wall at the following locations:

1. Fan discharge.

2. Intervals of lined duct preceding unlined duct.

3. Upstream edges of transverse joints in ducts.

H. Secure insulation liner with perforated sheet metal liner of the same gauge specified for the duct, secured to ducts with mechanical fasteners that maintain metal liner distance from duct without compressing insulation. Provide 3/32-inch-diameter perforations, with an overall open area of 23 percent.

I. Terminate liner with duct buildouts installed in ducts to attach dampers, turning vane assemblies, and other devices. Fabricated buildouts (metal hat sections) or other buildout means are optional; when used, secure buildouts to the duct wall with bolts, screws, rivets, or welds. Terminate liner at fire dampers at connection to fire damper sleeve through fire separation.

2.10 ROUND DUCT FABRICATION

A. General: "Basic Round Diameter" as used in this article is the diameter of the size of round duct that has a circumference equal to the perimeter of a given sized of flat oval duct. Except where interrupted by fittings, provide round and flat oval ducts in lengths not less than 12 feet.

B. Round Ducts: Fabricate round supply ducts with spiral lockseam construction, except where diameters exceed 72 inches. Fabricate ducts having diameters greater than 72 inches with longitudinal butt-welded seams. Comply with SMACNA "HVAC Duct Construction Standards," Table 3-2 for galvanized steel gauges.

C. Round Ducts: Fabricate round supply ducts using seam types identified in SMACNA "HVAC Duct Construction Standards," 1985 Edition, Figure 3-1, RL-1, RL-4, or RL-5. Seams Types

RL-2 or RL-3 may be used if spot-welded on 1-inch intervals. Comply with SMACNA "HVAC Duct Construction Standards," Table 3-2 for galvanized steel gauges.

2.11 ROUND SUPPLY AND EXHAUST FITTINGS FABRICATION

A. 90-Degree Tees, Laterals and Conical Tees: Fabricate to conform to SMACNA "HVAC Duct Construction Standards," Figures 3-4 and 3-5 and with metal thicknesses specified for longitudinal seam straight duct.

B. Diverging-Flow Fittings: Fabricate with a reduced entrance to branch taps with no excess material projecting from the body onto branch tap entrance.

C. Elbows: Fabricate in die-formed, gored, pleated, or mitered construction. Fabricate the bend radius of die-formed, gored, and pleated elbows 1.5 times the elbow diameter. Unless elbow construction type is indicated, provide elbows meeting the following requirements:

1. Mitered Elbows: Fabricate mitered elbows with continuously welded construction in gauges specified below.

a. Mitered Elbows Radius and Number of Pieces: Unless otherwise indicated, construct elbow to comply with SMACNA "HVAC Duct Construction Standards," Table 3-1.

b. Flat Oval Mitered Elbows: Solid welded and with the same metal thickness as longitudinal seam flat oval duct.

c. 90-Degree, 2-Piece, Mitered Elbows: Use only for supply systems, or exhaust systems for material handling classes A and B; and only where space restrictions do not permit the use of 1.5 bend radius elbows. Fabricate with a single-thickness turning vanes.

2. Round Elbows - 8 Inches and Smaller: Die-formed elbows for 45- and 90-degrees elbows and pleated elbows for 30, 45, 60, and 90 degrees only. Fabricate nonstandard bend angle configurations or 1/2-inch-diameter (e.g. 3-1/2- and 4-1/2-inch) elbows with gored construction.

3. Round Elbows - 9 Through 14 Inches: Gored or pleated elbows for 30, 45, 60, and 90 degrees, except where space restrictions require a mitered elbow. Fabricate nonstandard bend angle configurations or 1/2-inch-diameter (e.g. 9-1/2- and 10-1/2-inch) elbows with gored construction.

4. Round Elbows - Larger Than 14 Inches and All Flat Oval Elbows: Gored elbows, except where space restrictions require a mitered elbow.

5. Die-Formed Elbows for Sizes Through 8 Inches and All Pressures: 20 gauge with 2-piece welded construction.

PART 3 - EXECUTION

3.1 DUCT INSTALLATION, GENERAL

A. Duct System Pressure Class: Construct and install each duct system for 2-inch water guage classification.

B. Install ducts with the fewest possible joints.

C. Use fabricated fittings for all changes in directions, changes in size and shape, and connections.

D. Install couplings tight to duct wall surface with projections into duct at connections kept to a minimum.

E. Locate ducts, except as otherwise indicated, vertically and horizontally, parallel and perpendicular to building lines; avoid diagonal runs. Install duct systems in shortest route that does not obstruct useable space or block access for servicing building and its equipment.

F. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.

G. Provide clearance of 1 inch where furring is shown for enclosure or concealment of ducts, plus allowance for insulation thickness, if any.

H. Install insulated ducts with 1-inch clearance outside of insulation.

I. Conceal ducts from view in finished and occupied spaces by locating in mechanical shafts, hollow wall construction, or above suspended ceilings. Do not encase horizontal runs in solid partitions, except as specifically shown.

J. Coordinate layout with suspended ceiling and lighting layouts and similar finished work.

K. Electrical Equipment Spaces: Route ductwork to avoid passing through transformer vaults and electrical equipment spaces and enclosures.

L. Non-Fire-Rated Partition Penetrations: Where ducts pass interior partitions and exterior walls, and are exposed to view, conceal space between construction opening and duct or duct insulation with sheet metal flanges of same gauge as duct. Overlap opening on 4 sides by at least 1-1/2 inches.

3.2 SEAM AND JOINT SEALING

A. General: Seal duct seams and joints as follows:

B. Pressure Classifications Greater Than 3 Inches Water Gauge: All transverse joints, longitudinal seams, and duct penetrations (SMACNA Class A).

C. Pressure Classification equal to or less than 3 Inches Water Gauge: All transverse joints and longitudinal seams, and duct penetrations (SMACNA Class A).

D. Seal externally insulated ducts prior to insulation installation.

3.3 HANGING AND SUPPORTING

A. Install rigid round and rectangular metal duct with support systems indicated in SMACNA "HVAC Duct Construction Standards," Tables 4-1 through 4-3 and Figures 4-1 through 4-9.

B. Support horizontal ducts within 2 feet of each elbow and within 4 feet of each branch intersection.

C. Support vertical ducts at a maximum interval of 16 feet and at each floor.

D. Upper attachments to structures shall have an allowable load not exceeding 1/4 of the failure (proof test) load but are not limited to the specific methods indicated.

E. Install concrete insert prior to placing concrete.

F. Install powder actuated concrete fasteners after concrete is placed and completely cured.

3.4 CONNECTIONS

A. Equipment Connections: Connect equipment with flexible connectors in accordance with Division 23, Section 233300 – AIR DUCT ACCESSORIES.

B. Branch Connections: Comply with SMACNA "HVAC Duct Construction Standards," Figures 2-5 and 2-6, using only 45-degree or conical taps.

C. Outlet and Inlet Connections: Comply with SMACNA "HVAC Duct Construction Standards," Figures 2-14 through 2-16.

D. Terminal Units Connections: Comply with SMACNA "HVAC Duct Construction Standards," Figure 2-19.

3.5 FIELD QUALITY CONTROL

A. Remake leaking joints as required and apply sealants to achieve specified maximum allowable leakage.

3.6 ADJUSTING AND CLEANING

A. Adjust volume control devices as required by the testing and balancing procedures to achieve required air flow. Refer to Division 23, Section 230593 - TESTING, ADJUSTING, AND BALANCING FOR HVAC for requirements and procedures for adjusting and balancing air systems.

B. Vacuum ducts systems prior to final acceptance to remove dust and debris.

END OF SECTION 233113

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SECTION 233300 – AIR DUCT ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this section.

1.2 SUMMARY

A. This section includes the following:

1. Backdraft dampers.

2. Manual volume control dampers.

3. Actuators.

4. Turning vanes.

5. Duct-mounted access doors and panels.

6. Flexible connectors.

7. Flexible ducts.

8. Accessories hardware.

B. Related Sections: The following sections contain requirements that relate to this section:

1. Division 08, Section 089100 – LOUVERS for louvers installed in walls, connected to duct systems.

2. Division 23, Section 230010 - BASIC MECHANICAL REQUIREMENTS.

3. Division 23, Section 230050 - BASIC MECHANICAL MATERIALS AND METHODS.

4. Division 23, Section 233713.13 – AIR DIFFUSERS for diffusers.

5. Division 23, Section 233713.23 – REGISTERS AND GRILLES for registers and grilles.

1.3 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.

B. Product data including details for materials, dimensions of individual components, profiles, and finishes for the following items:

1. Backdraft dampers.

2. Manual volume control dampers.

3. Duct-mounted access panels and doors.

4. Flexible ducts.

C. Shop drawings from manufacturer detailing assemblies. Include dimensions, weights, loadings, required clearances, method of field assembly, components, and location and size of each field connection. Detail the following:

1. Special fittings and volume control damper installation (both manual and automatic) details.

2. Fire and smoke damper installations, including sleeves and duct-mounted access door and panel installations.

D. Product Certification: Submit certified test data on dynamic insertion loss; self-noise power levels; and airflow performance data, static pressure loss, and dimensions and weights.

1.4 QUALITY ASSURANCE

A. NFPA Compliance: Comply with the following NFPA Standards:

1. NFPA 90A, "Standard for the Installation of Air Conditioning and Ventilating Systems."

2. NFPA 90B, "Standard for the Installation of Warm Air Heating and Air Conditioning Systems."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturer: Subject to compliance with requirements, provide duct accessories of one of the following:

1. Backdraft Dampers:

a. Ruskin Manufacturing Co.
b. Air Balance, Inc.
c. American Warming & Ventilating Co.
d. Carnes.
e. Cesco.
f. Penn Ventilator Co.
g. Prefco Products, Inc.
h. Safe-Air, Inc.

2. Manual Dampers:

a. Ruskin Manufacturing Co.
b. Air Balance, Inc.
c. American Warming & Ventilating Co.
d. Carnes.
e. Krueger.
f. Penn Ventilator Co.
g. Prefco Products, Inc.
h. Safe-Air, Inc.
i. Vent Products, Co.

3. Turning Vanes:

   a. Aero-Dyne.
   b. Airsan.
   c. Tuttle and Bailey.
   d. Titus.
   e. Vent Products Co.

4. Access Doors:

   a. Air Balance, Inc.
   b. American Warming & Ventilating Co.
   c. Nailor-Hart Industries, Inc.
   d. Prefco Products, Inc.
   e. Ruskin.
   f. United McGill Corp.

5. Flexible Fan Connections:

   a. Duro-Dyne.
   b. Elgin.
   c. Ventfabrics.

6. Flexible Duct:

   a. Acme Manufacturing Co.
   b. CertainTeed Corp.
   c. Clevepak Corp., Clevaflex Division.
   d. General Flex Corp.
   e. Goodman Manufacturing Corp.
   f. Flexible Technologies, Automation Industries, Inc.
   g. H.K. Porter Co., Inc., Thermoid Division.
   h. The Wiremold Co., Flexible Systems Group.

7. Barometric Relief Damper (Adjustable)

   a. Ruskin.
   b. Breeheck.

2.2 BACKDRAFT DAMPERS

A. Description: Suitable for horizontal or vertical installation.

B. Frame: 0.063-inch-thick 6063T extruded aluminum, with mounting flange.

C. Blades: 0.025-inch-thick roll-formed aluminum.

D. Blade Seals: Neoprene.

E. Blade Axles: Nonferrous.

F. Tie Bars and Brackets: Aluminum.

G. Tie Bars and Brackets: Galvanized steel.

H. Return Spring: Adjustable tension.

I. Chain Operator: 15-foot-long galvanized-steel sash chain and pulley.

J. Wing-Nut Operator: Galvanized steel, with 1/4-inch galvanized-steel rod.

2.3 MANUAL VOLUME CONTROL DAMPERS

A. General: Provide factory-fabricated volume-control dampers, complete with required hardware and accessories. Stiffen damper blades to provide stability under operating conditions. Provide locking device to hold single-blade dampers in a fixed position without vibration. Close duct penetrations for damper components to seal duct consistent with pressure class. Provide end bearings or other seals for ducts with pressure classifications of 3 inches or higher. Extend axles full length of damper blades. Provide bearings at both ends of operating shaft.

B. Standard Volume Control Dampers: Multiple- or single-blade, parallel- or opposed-blade design as indicated, standard leakage rating, and suitable for horizontal or vertical applications.

1. Aluminum Frames: Hat-shaped, 0.063-inch-thick, 6063T extruded aluminum channels. Provide frames with flanges where indicated for attaching to walls. Provide flangeless frames where indicated for installation in ducts.

2. Roll-Formed Aluminum Blades: 0.025-inch-thick roll-formed aluminum.

3. Blade Axles: Nonferrous.

4. Tie Bars and Brackets: Aluminum.

5. Provide Type C housing for installation in round ductwork.

6. Round Dampers: Butterfly type with 20-gauge circular blade mounted to 3/8-inch square axle, with self-lubricating nylon bearings in a 20-gauge galvanized steel sleeve.

a. Use only where indicated.

b. Shop or field assembled dampers not acceptable.

c. Ruskin MDRS-25.

C. Low-Leakage Volume Control Dampers: Multiple- or single-blade, parallel- or opposed-blade design as indicated, low-leakage rating, and suitable for horizontal or vertical applications.

1. Aluminum Frames: Hat-shaped, 0.063-inch-thick, 6063T extruded aluminum channels. Provide frames with flanges where indicated for attaching to walls. Provide flangeless frames where indicated for installation in ducts.

2. Roll-Formed Steel Blades: 16-gauge galvanized steel.

3. Roll-Formed Aluminum Blades: 0.025-inch-thick roll-formed aluminum.

4. Blade Seals: Neoprene.

5. Blade Axles: Nonferrous.

6. Tie Bars and Brackets: Aluminum.

D. Jackshaft: 1-inch-diameter, galvanized-steel pipe rotating within a pipe bearing assembly mounted on supports at each mullion and at each end of multiple damper assemblies. Provide appropriate length and number of mounting to connect linkage of each damper of a multiple damper assembly.

E. Damper Control Hardware: Zinc-plated, die-cast core with a heavy-gauge dial and handle made of 3/32-inch-thick zinc-plated steel, and a 3/4-inch hexagon locking nut. Provide center hole to suit damper operating rod size. Provide elevated platform for insulated duct mounting.

2.4 ACTUATORS

A. Damper Motors: Provide motors for smooth modulating or 2-position action.

1. Permanent-Split-Capacitor or Shaded-Pole Motors: Provide with oil-immersed and sealed gear trains.

2. Spring-Return Motors: Equip with an integral spiral-spring mechanism where indicated. Enclose entire spring mechanism in a removable housing designed for service or adjustments. Size for running torque rating of 150 inch-pounds and breakaway torque rating of 150 inch-pounds.

3. Outdoor Motors and Motors in Outside Air Intakes: Equip with O-ring gaskets designed to make motors weatherproof. Equip motors with internal heaters to permit normal operation at minus 40 degrees F (minus 40 degrees C).

4. Non-Spring Return Motors: For dampers larger than 25 square feet, size motor for running torque rating of 150 inch-pounds and breakaway torque rating of 300 inch-pounds.

5. 2-Position Motor: 115 V, single phase, 60 Hz.

6. Modulating, Spring Return Motor: 115 V, single phase, 60 Hz.

2.5 TURNING VANES

A. Fabricate turning vanes according to SMACNA HVAC Duct Construction Standards, Figures 2-2 through 2-7.

B. Manufactured Turning Vanes: Fabricate of 1-1/2-inch-wide, curved blades set at 3/4 inch on center, support with bars perpendicular to blades set at 2 inches on center, and set into side strips suitable for mounting in ducts.

1. Provide turning vanes in all nonradius elbows, supply, exhaust or return.

C. Acoustic Turning Vanes: Fabricate of airfoil-shaped aluminum extrusions with perforated faces and fiber glass fill.

2.6 DUCT-MOUNTED ACCESS DOORS AND PANELS

A. General: Refer to the Access Door Materials Schedule at the end of this section for frame and door thickness, number of hinges and locks, and location of locks. Provide construction and airtightness suitable for duct pressure class.

B. Frame: Galvanized sheet steel. Provide with bend-over tabs and foam gaskets.

C. Door: Double-wall, galvanized sheet metal construction with insulation fill and thickness, number of hinges and locks as indicated for duct pressure class. Provide vision panel where indicated. Provide 1-inch by 1-inch butt hinge or piano hinge and "Ventlock" lever handles.

1. Sash or cam locks not acceptable.

D. Seal around frame attachment to duct and door to frame with neoprene or foam rubber seals.

E. Insulation: 1-inch thick fiber glass or polystyrene foam board.

2.7 FLEXIBLE CONNECTORS

A. General: Flame-retarded or noncombustible fabrics, coatings, and adhesives complying with UL Standard 181, Class 1.

1. Provide at all air moving device duct-to-unit connections, all building expansion joints and where indicated.

B. Standard Metal-Edged Connectors: Factory-fabricated with a strip of fabric 3-1/2 inches wide attached to 2 strips of 2-3/4-inch-wide, 24-gauge, galvanized sheet steel or 0.032-gauge aluminum sheets. Select metal compatible with connected duct system. Fold and crimp metal edge strips onto fabric as illustrated in SMACNA HVAC Duct Standard, 1st Edition, Figure 2-19.

C. Conventional, Indoor System Flexible Connectors Fabric: Glass fabric double coated with polychloroprene.

1. Minimum Weight: 26 oz. per sq yd.

2. Tensile Strength: 480 lb per inch in the warp and 360 lb per inch in the filling.

D. Conventional, Outdoor System Flexible Connectors Fabric: Glass fabric double coated with Du Pont's HYPALON or other synthetic-rubber weatherproof coating resistant to the sun's ultraviolet rays and ozone environment.

1. Minimum Weight: 26 oz. per sq yd.

2. Tensile Strength: 530 lb per inch in the warp and 440 lb per inch in the filling.

3. High-Temperature System Flexible Connectors: Glass fabric coated with silicone rubber and having a minimum weight of 16 oz. per sq yd and tensile strength of 285 lb per inch in the warp, and 185 lb per inch in the filling.

4. High-Corrosive-Environment System Flexible Connectors: Glass fabric coated with a chemical-resistant coating.

5. Minimum Weight: 14 oz. per sq yd.

6. Tensile Strength: 450 lb per inch in the warp and 340 lb per inch in the filling.

2.8 FLEXIBLE DUCTS

A. General: Comply with UL 181, Class 1.

1. Flame spread of 25 or less, smoke developed not to exceed 50.

2. Rated Working Pressure: Positive 8-inch WG, negative 1-1/2-inch WG.

B. Flexible Ducts - Insulated: Factory-fabricated, insulated, round duct, with an outer jacket enclosing 1-1/2-inch-thick, glass fiber insulation around a continuous inner liner.

1. Reinforcement: Steel-wire helix encapsulated in the inner liner.

2. Outer Jacket: Glass-reinforced, silver mylar with a continuous hanging tab, integral fiber glass tape, and nylon hanging cord.

3. Outer Jacket: Polyethylene film.

4. Inner Liner: Polyethylene film.

5. Thermal Conductance (C): 0.023.

C. Connections: Secure flexible duct to collar or sleeve with duct sealer and 1/2-inch clamps. Secure insulation cover with 2 wraps of duct tape.

D. Maximum Length: Air outlets 6 feet, 0 inches; terminal unit inlets 2 feet, 0 inches.

2.9 ACCESSORIES HARDWARE

A. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket and a flat mounting gasket. Size to allow insertion of pitot tube and other testing instruments and provide in length to suit duct insulation thickness.

B. Splitter Damper Accessories: Zinc-plated damper blade bracket, 1/4-inch, zinc-plated operating rod, and a duct-mounted, ball-joint bracket with flat rubber gasket and square-head set screw.

C. Flexible Duct Clamps: Stainless steel band with cadmium-plated hex screw to tighten band with a worm-gear action. Provide in sizes from 3 to 18 inches to suit duct size.

D. Duct Sealer and Adhesives: As specified in Division 23, Section 233113 - METAL DUCTS.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of duct accessories. Do not proceed with installation until unsatisfactory conditions are corrected.

3.2 INSTALLATION

A. Install duct accessories according to manufacturer's installation instructions and applicable portions of details of construction as shown in SMACNA standards.

B. Install volume control dampers in lined duct with methods to avoid damage to liner and to avoid erosion of duct liner.

C. Provide test holes at fan inlet and outlet and elsewhere as indicated.

D. Label access doors according to Division 23, Section 230553 – IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT.

E. Install flexible duct with turn radius not less than R/D equal to 1.0. Provide supports per Figures 3-9 and 3-10, SMACNA HVAC Duct Construction Standards.

1. Maximum Length: Air outlets 6 feet, 0 inches; terminal unit inlets 2 feet, 0 inches.

F. Install access doors at each duct mounted controller and other items requiring access and service.

G. Install manufactured turning vanes in each nonradius elbow.

3.3 ADJUSTING

A. Adjust duct accessories for proper settings.

B. Final positioning of manual dampers is specified in Division 23, Section 230593 - TESTING, ADJUSTING, AND BALANCING.

ACCESS DOOR MATERIALS SCHEDULE

DUCT PRESSURE CLASS	DOOR SIZE INCHES	NUMBER OF HINGES	NUMBER OF LOCKS	METAL GAGE FRAME	METAL GAGE DOOR BACK
2 INCHES & LESS	12X12	2	1-S	24	26
	16x20	2	2-S	22	24
	24X24	3	2-S	22	22
3 INCHES	12X12	2	1-S	22	22
	16X20	2	1-S,1-T,1-B	20	20
	24X24	3	2-S,1-T,1-B	20	20
4 TO 10 INCHES	12X12	2	1-S,1-T,1-B	20	20
	16X20	3	2-S,1-T,1-B	20	18
	24X24	3	2-S,2-T,2-B	18	18

S: SIDE
T: TOP
B: BOTTOM

END OF SECTION 233300

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SECTION 233423 – HVAC POWER VENTILATORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this section.

1.2 SUMMARY

A. This section includes the following:

1. Ceiling-mounted ventilators.

2. In-line centrifugal fans.

B. Related Sections: The following sections contain requirements that relate to this section:

1. Division 23, Section 230010 - BASIC MECHANICAL REQUIREMENTS.

2. Division 23, Section 230050 - BASIC MECHANICAL MATERIALS AND METHODS.

3. Division 23, Section 230548.13 - VIBRATION CONTROLS FOR HVAC for vibration hangers and supports.

1.3 PERFORMANCE REQUIREMENTS

A. Project Altitude: Base air ratings on sea-level conditions.

B. Operating Limits: Classify according to AMCA 99.

C. Fan Unit Schedule: The following information is described in an equipment schedule on the Drawings.

1. Fan performance data including capacities, outlet velocities, static pressures, sound power characteristics, motor requirements, and electrical characteristics.
2. Fan arrangement including wheel configuration, inlet and discharge configurations, and required accessories.

1.4 SUBMITTALS

A. General: Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections.

B. Product Data including rated capacities of each unit, weights (shipping, installed, and operating), furnished specialties, accessories, and the following:

1. Certified fan performance curves with system operating conditions indicated.

2. Certified fan sound power ratings.

3. Motor ratings and electrical characteristics plus motor and electrical

accessories.

4. Material gauges and finishes, including color charts.

5. Dampers, including housings, linkages, and operators.

6. Accessories such as curbs, speed controllers, disconnects, etc.

C. Shop Drawings from manufacturer detailing equipment assemblies and indicating dimensions, weights, loadings, required clearances, method of field assembly, components, and location and size of each field connection.

D. Coordination Drawings, according to Division 23, Section 230010 - BASIC MECHANICAL REQUIREMENTS, for roof penetration requirements and for reflected ceiling plans drawn accurately to scale and coordinating penetrations and units mounted above ceiling. Show the following:

1. Roof framing and support members relative to duct penetrations.

2. Ceiling suspension assembly members.

3. Size and location of initial access modules for acoustical tile.

4. Ceiling-mounted items including light fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.

E. Wiring diagrams detailing wiring for power and control systems and differentiating clearly between manufacturer-installed and field-installed wiring.

F. Maintenance data for power ventilators to include in the operation and maintenance manual specified in Division 1 and in Division 23, Section 230010 - BASIC MECHANICAL REQUIREMENTS.

1.5 QUALITY ASSURANCE

A. Electrical Component Standard: Provide components that comply with NFPA 70 and that are listed and labeled by UL where available.

B. Listing and Labeling: Provide electrically operated fixtures specified in this section that are listed and labeled.

1. The Terms "Listed" and "Labeled": As defined in the National Electrical Code, Article 100.

2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.7.

C. AMCA Compliance: Provide products that meet performance requirements and are licensed to use the AMCA Seal.

D. NEMA Compliance: Provide components required as part of fans that comply with applicable NEMA standards.

E. UL Standard: Provide power ventilators that comply with UL 705.

1.6 PROJECT CONDITIONS

A. Field Measurements: Verify dimensions by field measurements. Verify clearances.

B. Do not operate fans until ductwork is clean, filters are in place, bearings are lubricated, and fans have been commissioned.

1.7 COORDINATION AND SCHEDULING

A. Coordinate the size and location of structural steel support members.

B. Coordinate the installation of roof curbs, equipment supports, and roof penetrations. Roof specialties are specified in Division 7 sections.

1.8 EXTRA MATERIALS

A. Furnish one set of belts for each belt-driven fan that match products installed, are packaged with protective covering for storage, and are identified with labels clearly describing contents.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Ceiling-Mounted Ventilators:

a. Broan Mfg. Co., Inc.

b. Cook (Loren) Co.

c. Greenheck Fan Corp.

d. Breidert

e. Twin City Fan Co.

f. ACME Fan Co.

2. In-Line Centrifugal Fans:

a. Cook (Loren) Co.

b. Greenheck Fan Corp.

c. Breidert.

d. Twin City Fan Co.

e. ACME Fan Co.

2.2 CEILING-MOUNTED VENTILATORS

A. Description: Centrifugal fans designed for installing in ceiling or wall, or for concealed in-line applications.

B. Housing: Galvanized steel lined with acoustical insulation.

C. Fan Wheel: Centrifugal wheels directly mounted on motor shaft. Fan shrouds, motor, and fan wheel shall be removable for service.

D. Grille: Aluminum, louvered grille with flange on intake and thumbscrew attachment to fan housing.

E. Electrical Requirements: Junction box for electrical connection on housing and receptacle for motor plug-in.

F. Variable-Speed Controller: Solid-state control to reduce speed from 100 percent to less than 50 percent.

2.3 IN-LINE CENTRIFUGAL FANS

A. Description: In-line, belt-driven centrifugal fans consisting of housing, wheel, outlet guide vanes, fan shaft, bearings, drive assembly, motor and disconnect switch, mounting brackets, and accessories.

B. Housing: Split, spun-aluminum housing, with aluminum straightening vanes; inlet and outlet flanges; and support bracket adaptable to floor, side wall, or ceiling mounting.

C. Direct-Drive Units: Motor encased in housing out of air stream, factory wired to disconnect located on outside of fan housing.

D. Belt-Driven Units: Motor mounted on adjustable base, with adjustable sheaves, enclosure around belts within fan housing, and lubricating tubes from fan bearings extended to outside of fan housing.

E. Fan Wheels: Aluminum, airfoil blades welded to aluminum hub.

F. Accessories: The following accessories are required as indicated:

1 Companion Flanges: For inlet and outlet duct connections.

2 Fan Guards: Expanded metal in removable frame. Provide belt guards for units not connected to ductwork.

2.4 MOTORS

A. Refer to Division 23, Section 230513 – COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT for general requirements for factory-installed motors.

B. Motor Construction: NEMA MG 1, general purpose, continuous duty, Design B.

C. Enclosure Type: The following features are required as indicated:

1 Open dripproof motors where satisfactorily housed or remotely located during operation.

2 Guarded dripproof motors where exposed to contact by employees or building occupants.

2.5 FACTORY FINISHES

A. Sheet Metal Parts: Prime coat before final assembly.

B. Exterior Surfaces: Baked-enamel finish coat after assembly.

C. Aluminum Parts: No finish required.

2.6 SOURCE QUALITY CONTROL

A. Testing Requirements: The following factory tests are required as indicated:

1 Sound Power Level Ratings: Comply with AMCA 301, "Methods for Calculating Fan Sound Ratings From Laboratory Test Data." Test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Label fans with the AMCA Seal.

2 Fan Performance Ratings: Establish flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests and ratings according to AMCA 210, "Laboratory Methods of Testing Fans for Rating."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions for compliance with requirements of installation tolerances and other conditions affecting performance of the power ventilators. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install power ventilators according to manufacturer's written instructions.

B. Support units using the vibration-control devices indicated. Vibration-control devices are specified in Division 23, Section 230548.13 - VIBRATION CONTROL FOR HVAC.

1. Suspend units from structural steel support frame using threaded steel rods and vibration isolation springs.

2. Ceiling Units: Suspend units from structure using steel wire or metal straps.

C. Install units with clearances for service and maintenance.

D. Label units according to requirements specified in Division 23, Section 230553 – IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT.

3.3 CONNECTIONS

A. Duct installation and connection requirements are specified in other Division 23 sections. Drawings indicate the general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors.

B. Electrical: Conform to applicable requirements in Division 26 sections.

C. Grounding: Ground equipment. Tighten electrical connectors and terminals, including grounding connections, according to manufacturer's published torque-tightening values. Where manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.4 ADJUSTING

A. Adjust damper linkages for proper damper operation.

B. Adjust belt tension.

C. Lubricate bearings.

END OF SECTION 233423

SECTION 233713.13 – AIR DIFFUSERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work of this section.

1.2 SUMMARY

A. Extent of air diffusers work is indicated by drawings and schedules, and by requirements of this section.

B. Types of air diffusers required for project include the following:

1. Ceiling air diffusers.

C. Related Sections: The following sections contain requirements that relate to this section.

1. Division 23, Section 230010 - BASIC MECHANICAL REQUIREMENTS.

2. Division 23, Section 230050 - BASIC MECHANICAL MATERIALS AND METHODS.

3. Division 23, Section 233713.23 – REGISTERS AND GRILLES.

4. Division 23, Section 233300 – AIR DUCT ACCESSORIES.

5. Division 23, Section 230593 - TESTING, ADJUSTING AND BALANCING.

1.3 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of air diffusers of types and capacities required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Codes and Standards:

1. ARI Compliance: Test and rate air diffusers in accordance with ARI 650 "Standard for Air Outlets and Inlets".

2. ASHRAE Compliance: Test and rate air outlets and inlets in accordance with ASHRAE 70 "Method of Testing for Rating the Air Flow Performance of Outlets and Inlets".

2. AMCA Seal: Provide louvers bearing AMCA Certified Rating Seal.

3. NFPA Compliance: Install air diffusers in accordance with NFPA 90A "Standard for the Installation of Air Conditioning and Ventilating Systems".

1.4 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data for air diffusers including the following:

1. Schedule of air diffusers indicating drawing designation, room location, number furnished, model number, size, and accessories furnished.

2. Data sheet for each type of air diffuser, and accessory furnished; indicating construction, finish, and mounting details.

3. Performance data for each type of air diffuser furnished, including aspiration ability, temperature and velocity traverses; throw and drop; and noise criteria ratings. Indicate selections on data.

B. Maintenance Data: Submit maintenance data, including cleaning instructions for finishes, and spare parts lists. Include this data, product data, and shop drawings in maintenance manuals; in accordance with requirements of Division 1.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Deliver air diffusers wrapped in factory-fabricated fiberboard type containers. Identify on outside of container type of diffuser and location to be installed. Avoid crushing or bending and prevent dirt and debris from entering and settling in devices.

B. Store air diffusers in original cartons and protect from weather and construction work traffic. Where possible, store indoors; when necessary to store outdoors, store above grade and enclose with waterproof wrapping.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturer: Subject to compliance with requirements, provide diffusers of one of the following:

1. Diffusers:

a. Price
b. Titus
c. Nailor.
d. Metal Aire.

2.2 AIR DIFFUSERS - GENERAL

A. General: Except as otherwise indicated, provide manufacturer's standard ceiling air diffusers where shown; of size, shape, capacity and type indicated; constructed of materials and components as indicated, and as required for complete installation.

B. Performance: Provide ceiling air diffusers that have, as minimum, temperature and velocity traverses, throw and drop, and noise criteria ratings for each size device as listed in manufacturer's current data.

C. Ceiling/Wall Compatibility: Provide diffusers with border styles that are compatible with adjacent ceiling and wall systems, and that are specifically manufactured to fit into ceiling module or wall construction with accurate fit and adequate support. Refer to general construction drawings and specifications for types of ceiling and wall systems which will contain each type of ceiling air diffuser.

2.3 CEILING AIR DIFFUSERS

A. Provide ceiling diffusers of type, capacity, and with accessories and finishes as listed on diffuser schedule. The following requirements shall apply to nomenclature indicated on schedule.

1. Diffuser Faces:
   a. Round: Round housing, core of concentric rings, round duct connection.

   b. Half-Round: Semi-circular housing, core of concentric half-rings, rectangular duct connection.

   c. Square: Square housing, core of square concentric louvers, square or round duct connection.

   d. Rectangular: Rectangular housing, core of rectangular concentric louvers, square or round duct connection.

   e. Panel: Square or rectangular housing extended to form a panel to fit in ceiling system module, core of square or rectangular concentric louvers, square or round duct connection.

   f. Perforated: Round, square, or rectangular housing covered with removable perforated panel in frame. Conceal air pattern devices above panel.

2. Diffuser Mountings:

   a. Stepped-Down: Diffuser housing below ceiling with perimeter flange and gasket to seal against ceiling construction.

   b. Flush: Diffuser housing above ceiling surface with flush perimeter flange and gasket to seal against ceiling.

   c. Lay-In: Diffuser housing sized to fit between ceiling exposed suspension tee bars and rest on top surface of tee bar.

   d. Snap-In: Diffuser housing sized to fit between ceiling concealed suspension runners, and snap into runners.

3. Diffuser Patterns:

   a. Fixed: Fixed position core with concentric rings or louvers for radial air flow around entire perimeter of diffuser.

   b. 2 Position: Manual 2-position core with concentric rings or louvers, upper position for horizontal air flow, lower position for vertical air flow.

   c. Adjustable: Manual adjustable core with concentric rings or louvers, fully adjustable for horizontal to vertical air flow.

   d. 1 Way: Fixed louver face for 1-direction air flow, direction indicated on drawings.

   e. 2 Way: Fixed louver face for 2-direction air flow, directions indicated on drawings.

f. 3 Way: Fixed louver face for 3-direction air flow, directions indicated on drawings.

g. 4 Way: Fixed louver face for 4-direction air flow, directions indicated on drawings.

4. Diffuser Accessories:

a. Operating Keys: Tools designed to fit through diffuser face and operate pattern adjustment.

5. Diffuser Finishes:

a. Aluminum Enamel: Air-dried aluminum enamel prime finish.

b. White Enamel: Semi-gloss white enamel prime finish.

c. Aluminum Anodize: Aluminum etched and anodized, covered with clear lacquer finish.

d. Paint inside of perforated face air devices black.

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine areas and conditions under which air diffusers are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Install air diffusers in accordance with manufacturer's written instructions and in accordance with recognized industry practices to insure that products serve intended function.

B. Coordinate with other work, including ductwork and duct accessories, as necessary to interface installation of air diffusers with other work.

C. Locate ceiling air diffusers, as indicated on general construction "Reflected Ceiling Plans". Unless otherwise indicated, locate units in center of acoustical ceiling module.

3.3 SPARE PARTS

A. Furnish to Owner, with receipt, 3 operating keys for each type of air diffuser that requires them.

END OF SECTION 233713.13

SECTION 233713.23 – REGISTERS AND GRILLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work of this section.

1.2 SUMMARY

A. Extent of registers and grilles work is indicated by drawings and schedules, and by requirements of this section.

B. Types of registers and grilles required for project include the following:

1. Ceiling grilles.

C. Related Sections: The following sections contain requirements that relate to this section.

1. Division 23, Section 230010 - BASIC MECHANICAL REQUIREMENTS.

2. Division 23, Section 230050 - BASIC MECHANICAL MATERIALS AND METHODS.

3. Division 23, Section 233300 - AIR DUCT ACCESSORIES.

4. Division 23, Section 230593 - TESTING, ADJUSTING, AND BALANCING FOR HVAC.

1.3 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of registers and grilles of types and capacities required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Codes and Standards:

1. ARI Compliance: Test and rate registers and grilles in accordance with ARI 650 "Standard for Air registers and grilles".

2. ASHRAE Compliance: Test and rate registers and grilles in accordance with ASHRAE 70 "Method of Testing for Rating the Air Flow Performance of Outlets and Inlets".

3. AMCA Seal: Provide louvers bearing AMCA Certified Rating Seal.

4. NFPA Compliance: Install registers and grilles in accordance with NFPA 90A "Standard for the Installation of Air Conditioning and Ventilating Systems".

1.4 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data for registers and grilles including the following:

1. Schedule of registers and grilles indicating drawing designation, room location, number furnished, model number, size, and accessories furnished.

2. Data sheet for each type of register and grille, and accessory furnished; indicating construction, finish, and mounting details.

B. Maintenance Data: Submit maintenance data, including cleaning instructions for finishes, and spare parts lists. Include this data, product data, and shop drawings in maintenance manuals; in accordance with requirements of Division 1.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Deliver registers and grilles wrapped in factory-fabricated fiberboard type containers. Identify on outside of container type of grille and location to be installed. Avoid crushing or bending and prevent dirt and debris from entering and settling in devices.

B. Store registers and grilles in original cartons and protect from weather and construction work traffic. Where possible, store indoors; when necessary to store outdoors, store above grade and enclose with waterproof wrapping.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturer: Subject to compliance with requirements, provide grilles of one of the following:

1. Grilles:

a. Price

b. Titus

c. Nailor.

d. Metal Aire.

2.2 REGISTERS AND GRILLES - GENERAL

A. General: Except as otherwise indicated, provide manufacturer's standard ceiling grilles where shown; of size, shape, capacity and type indicated; constructed of materials and components as indicated, and as required for complete installation.

B. Performance: Provide ceiling grilles that have, as minimum, temperature and velocity traverses, throw and drop, and noise criteria ratings for each size device as listed in manufacturer's current data.

C. Ceiling/Wall Compatibility: Provide grilles with border styles that are compatible with adjacent ceiling and wall systems, and that are specifically manufactured to fit into ceiling module or wall construction with accurate fit and adequate support. Refer to general construction drawings and specifications for types of ceiling and wall systems which will contain each type of ceiling grille.

2.3 CEILING GRILLES

A. Provide ceiling grilles of type, capacity, and with accessories and finishes as listed on grille schedule. The following requirements shall apply to nomenclature indicated on schedule:

1. Grille Materials:

a. Steel Construction: Manufacturer's standard stamped sheet steel frame and adjustable blades.

b. Aluminum Construction: Manufacturer's standard extruded aluminum frame and adjustable blades.

2. Grille Finishes:

a. Aluminum Enamel: Air-dried aluminum enamel prime finish.

b. White Enamel: Semi-gloss white enamel prime finish.

c. Aluminum Anodize: Aluminum etched and anodized, covered with clear lacquer finish.

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine areas and conditions under which registers and grilles are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Install registers and grilles in accordance with manufacturer's written instructions and in accordance with recognized industry practices to insure that products serve intended function.

B. Coordinate with other work, including ductwork and duct accessories, as necessary to interface installation of registers and grilles with other work.

C. Locate ceiling grilles, as indicated on general construction "Reflected Ceiling Plans". Unless otherwise indicated, locate units in center of acoustical ceiling module.

END OF SECTION 233713.23

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SECTION 234100 – PARTICULATE AIR FILTRATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this section.

1.2 SUMMARY

A. This section includes the following types of air filters and accessories:

1. Replaceable (throwaway) panel filters.

2. Extended-surface, disposable-panel filters.

3. Filter frames.

4. Filter gauges.

B. Related Sections: The following sections contain requirements that relate to this section:

1. Division 23, Section 230010 - BASIC MECHANICAL REQUIREMENTS.

2. Division 23, Section 230050 - BASIC MECHANICAL MATERIALS AND METHODS.

1.3 SUBMITTALS

A. General: Submit the following according to the Conditions of the Contract and Division 1 Specification Sections.

B. Product data including dimensions, weights, required clearances and access, flow capacity including initial and final pressure drop at rated air flow, efficiency and test method, and fire classification.

1.4 QUALITY ASSURANCE

A. NFPA Compliance: Comply with applicable portions of NFPA 90A and 90B pertaining to installing air filters.

B. ASHRAE Compliance: Comply with provisions of ASHRAE Standard 52 for method of testing and rating air filter units.

C. ARI Compliance: Comply with provisions of ARI Standard 850 pertaining to testing and performance of air filter units.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Lift and support factory-assembled units only at designated lifting or supporting points, as indicated on shop drawings. Deliver with protective crating and covering.

1.6 EXTRA MATERIALS

A. Furnish extra materials packaged with protective covering for storage and identified with labels clearly describing contents. Deliver extra materials to Owner.

1. Provide one complete extra set of filters for each filter bank.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Air Filters:

a. American Air Filter Co.

b. Purolator Products, Inc.

c. Camfarr, Inc.

d. Continental Air Filters.

e. Flanders Filters Inc.

2. Filter Gauges:

a. Cambridge Filter Corp.

b. Dwyer Instruments, Inc.

2.2 REPLACEABLE (THROWAWAY) PANEL FILTERS

A. Description: Factory-fabricated, viscous-coated, flat-panel type, replaceable air filters with holding frames in sizes and having performance characteristics as indicated.

B. Media: Throwaway media of interlaced glass fibers, sprayed with nonflammable adhesive.

C. Frame: Cardboard frame with perforated metal retainer.

D. Frame: 20-gauge (0.9 mm) minimum galvanized steel with expanded metal grid on outlet side and steel rod grid on inlet side, hinged with pull and retaining handles.

E. Duct Holding Frames: 20-gauge (0.9 mm) galvanized steel capable of holding media and media frame in place, with gaskets to prevent unfiltered air bypass.

2.3 EXTENDED-SURFACE, DISPOSABLE, PANEL FILTERS

A. Description: Medium-efficiency, factory-fabricated, dry, extended-surface filters with holding frames in sizes and having performance characteristics as indicated.

B. Media: Heavy duty, nonwoven cotton fabric filtering material formed into deep V-shaped pleats and held by 96 percent open self-supporting welded wire grid bonded to media. 4.6 sq. ft. of media per 1 sq. ft. of face area.

C. Frame: Rigid, heavy duty beverage board, with bonded periphery, suitable fasteners and gaskets to hold media and media frame and to prevent unfiltered air from passing between media frames and holding devices.

D. Frame: Galvanized steel, with suitable fasteners and gaskets to hold media and media frame and to prevent unfiltered air from passing between media frames and holding devices.

E. Frame: Fire-retardant, 3/4-inch (19 mm) particle board, with suitable fasteners and gaskets to hold media and media frame and to prevent unfiltered air from passing between media frames and holding devices.

F. Duct Holding Frames: Suitable for bolting together into built-up filter banks.

2.4 FILTER GAUGES

A. Diaphragm type with dial and pointer in metal case, vent valves, black figures on white background, and front recalibration adjustment.

1. Diameter: 3-1/2 inches (90 mm).

2. Diameter: 2 inches (50 mm).

3. Range: 0 - 0.5 inch wg (0 - 125 Pa).

4. Range: 0 - 1.0 inch wg (0 - 250 Pa).

5. Range: 0 - 2.0 inches wg (0 - 500 Pa).

6. Range: 0 - 3.0 inches wg (0 - 750 Pa).

7. Range: 0 - 4.0 inches wg (0 - 1000 Pa).

B. Manometer-Type Filter Gauge: Molded plastic with epoxy-coated aluminum scale, logarithmic-curve tube gauge with integral leveling gauge, graduated to read from 0 to 3 inches wg (750 Pa), accurate within 3 percent of full-scale range.

C. Accessories: Static-pressure tips, tubing, gauge connections, and mounting bracket.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install air filters and holding devices of types indicated and where shown following air filter manufacturer's written instructions and with recognized industry practices to ensure that filters comply with requirements and serve intended purposes.

B. Install filters in position to prevent passage of unfiltered air.

C. Install filter gauge for each filter bank.

1. Install filter gauge static-pressure tips upstream and downstream of filters to indicate air pressure drop through filter. Mount filter gauges on outside of filter housing or filter plenum in an accessible position. Adjust and level inclined gauges.

D. Install all filters rated 60 percent and higher with 2-inch prefilter.

3.2 CONNECTIONS

A. Coordinate filter installations with duct and air-handling unit installations.

3.3 CLEANING

A. After testing, adjusting, and balancing air-handling and air-distribution systems, install new filter media.

END OF SECTION 234100

SECTION 237413 PACKAGED, OUTDOOR, CENTRAL-STATION AIR HANDLING UNITS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Package roof top unit.

B. Heat exchanger.

C. Refrigeration components.

D. Unit operating controls.

E. Roof curb.

F. Electrical power connections.

G. Operation and maintenance service.

1.2 RELATED SECTIONS

A. Section 230513 – Common Motor Requirements for HVAC Equipment.

B. Section 230548.13 - Vibration Controls for HVAC.

C. Section 234100 - Particulate Air Filtration.

1.3 REFERENCES

A. NFPA 90 A & B - Installation of Air Conditioning and Ventilation Systems and Installation of Warm Air Heating and Air Conditioning Systems. (all)

B. ANSI/ASHRAE 15 - Safety Code for Mechanical Refrigeration. (all)

C. ARI 360 - Commercial and Industrial Unitary Air Conditioning Equipment testing and rating standard. (g/e, c/e above 135,000 btuh)

E. ANSI/ASHRAE 37 - Testing Unitary Air Conditioning and Heat Pump Equipment. (all)

F. ANSI/ASHRAE/IESNA 90.1-2010 - Energy Standard for New Buildings Except Low-Rise Residential Buildings.

G. ANSI Z21.47/UL1995 - Unitary Air Conditioning Standard for safety requirements.

H. California Energy Commission Administrative Code - Title 20/24 - Establishes the minimum efficiency requirements for HVAC equipment installed in new buildings in the State of California. (all)

I. ARI 210/240 - Unitary Air-Conditioning Equipment and Air- Source Heat Pump Equipment. (all under 135,000 btuh)

J. ARI 270 - Sound Rating of Outdoor Unitary Equipment. (all below 135,000)

K. ARI 370 - Sound Rating of Large Outdoor Refrigerating and Air Conditioning Equipment.(all above 135,000 Btuh)

L. ANSI/NFPA 70-1995 - National Electric Code. (all)

1.4 SUBMITTALS

A. Submit unit performance data including: capacity, nominal and operating performance.

B. Submit Mechanical Specifications for unit and accessories describing construction, components and options.

C. Submit shop drawings indicating overall dimensions as well as installation, operation and services clearances. Indicate lift points and recommendations and center of gravity. Indicate unit shipping, installation and operating weights including dimensions.

D. Submit data on electrical requirements and connection points. Include recommended wire and fuse sizes or MCA, sequence of operation, safety and start-up instructions.

E. Shop drawings submitted for approval shall be accompanied by a copy of the purchase agreement between the Contractor and an authorized service representative of the manufacturer for check, test and start up and first year service.

1.5 DELIVERY, STORAGE and HANDLING

A. Comply with manufacturer's installation instructions for rigging, unloading, and transporting units.
B. Protect units from physical damage. Leave factory-shipping covers in place until installation.

1.6 WARRANTY

A. Provide parts warranty (excluding refrigerant) for one year from start-up or 18 months from shipment, whichever occurs first.

B. Provide five-year extended warranty for compressors.

C. Provide five-year heat exchanger limited warranty.

1.7 MAINTENANCE SERVICE

A. Furnish complete parts and labor service and maintenance of packaged roof top units for one year from Date of Substantial Completion by contractor.

B. Provide maintenance service with a two-month interval as maximum time period between calls. Provide 24 hour emergency service on breakdowns and malfunctions.

C. Include maintenance items as outlined in manufacturer's operating and maintenance data.

D. Submit copies of service call work order or report and include description of work performed.

1.8 REGULATORY REQUIREMENTS

A. Unit shall conform to ANSI Z21.47/UL1995 for construction of packaged air conditioner.

1. In the event the unit is not UL approved, the manufacturer must, at his expense, provide for a field inspection by a UL representative to verify conformance to UL standards. If necessary, contractor shall perform modifications to the unit to comply with UL, as directed by the UL representative, at no additional expense to the Owner.

B. Conform to Canadian Standards Association (CAN/CSA-2.3/CAN/CSA C22.2 #236) for construction of packaged air conditioner.

1. In the event the unit is not CSA approved, the manufacturer must, at his expense, provide for a field inspection by a CSA representative to verify conformance to CSA standards. If necessary, contractor shall perform modifications to the unit to comply with CSA, as directed by the CSA representative, at no additional expense to the Owner.

1.9 EXTRA MATERIALS

A. Provide one set of filters.

B. Furnish a complete set of fan motor drive belts.

PART 2 - PRODUCTS

2.1 SUMMARY

A. The contractor shall furnish and install package rooftop unit(s) as shown and scheduled on the contract documents. The unit(s) shall be installed in accordance with this specification and perform at the specified conditions as scheduled.

B. APPROVED MANUFACTURERS

1. AAON, Inc.

2. Trane/American Standard.

3. Carrier.

4. York.

5. Lennox.

6. McQuay.

C.. Substitutions: 10 working days prior approval required as indicated under the general and/or supplemental conditions of these specifications. Mechanical contractor shall be responsible for electrical and mechanical changes to the structure when using a product other than the specified product. As built drawing changes are the responsibility of the mechanical contractor.

2.2 GENERAL UNIT DESCRIPTION

A. Unit(s) furnished and installed shall be cooling only packaged rooftop (s) as scheduled on contract documents and these specifications. Cooling capacity ratings shall be based on ARI Standard 210. Unit(s) shall consist of insulated weather-tight casing with

compressor(s), air-cooled condenser coil, condenser fans, evaporator coil, return-air filters, supply motors and unit controls and drives.

B. Unit(s) shall be 100% factory run tested and fully charged with refrigerant.

C. Unit(s) shall have labels, decals, and/or tags to aid in the service of the unit and indicate caution areas.

D. Units shall be convertible airflow design as manufactured.

E. Wiring internal to the unit shall be colored and numbered for identification.

2.3 UNIT CASING

A. Cabinet: Galvanized steel, phosphatized, and finished with an air-dry paint coating with removable access panels. Structural members shall be 18 gauge with access doors and removable panels of minimum 20 gauge.

B. Units cabinet surface shall be tested 1000 hours in salt spray test in compliance with ASTM B117.

C. Cabinet construction shall allow for all service/ maintenance from one side of the unit.

D. Cabinet top cover shall be one piece construction or where seams exits, it shall be double-hemmed and gasket-sealed.

E. Access Panels: Water- and air-tight panels with handles shall provide access to filters, heating section, return air fan section, supply air fan section, evaporator coil section, and unit control section.

F. Units base pan shall have a raised 1 1/8 inch high lip around the supply and return openings for water integrity.

G. Insulation: Provide 1/2 inch thick fiberglass insulation with foil face on all exterior panels in contact with the return and conditioned air stream. All edges must be captured so that there is no insulation exposed in the air stream.

H. Provide 115-volt convenience outlet, factory-installed and unpowered, per NEC requirements.

I. Provide openings either on side of unit or through the base for power, control, condensate, and gas connections.

J. The base of the unit shall have 3 sides for forklift provisions. The base of the units shall have rigging/lifting holes for crane maneuvering.

2.4 AIR FILTERS

A. Air Filters: Factory installed filters shall mount integral within the unit and shall be accessible through access panels. One-inch thick glass fiber disposable media filters shall be provided with the provisions within the unit for 2 inch thick filters to be field-provided and installed.

2.5 FANS AND MOTORS

A. Provide evaporator fan section with forward curved, double width, double inlet, centrifugal type fan.

B. Provide self-aligning, grease lubricated, ball or sleeve bearings with permanent lubrication fittings.

C. Provide units 5 tons and below with direct drive, multiple speed, dynamically balanced supply fans.

D. Provide units 3-5 Tons with belt driven supply fans with adjustable motor sheaves.

E. Provide units 6 tons and above with belt driven, supply fans with adjustable motor sheaves.

F. Outdoor and Indoor Fan motors shall be permanently lubricated and have internal thermal overload protection.

G. Outdoor fans shall be direct drive, statically and dynamically balanced, draw through in the vertical discharge position.

H. Provide shafts constructed of solid hot rolled steel, ground and polished, with key-way, and protectively coated with lubricating oil.

2.6 GAS HEATING SECTION

A. Description: Factory assembled, piped, and wired; complying with ANSI Z21.47 and NFPA 54.

B. Burners: Stainless steel.

1. Fuel: Propane gas.

2. Ignition: Electronically controlled electric spark or hot-surface igniter with flame sensor.

C. Heat-Exchanger and Drain Pan: Stainless steel.

D. Venting: Gravity vented.

E. Safety Controls:

1. Gas Control Valve: Single stage.
2. Gas Train: Single-body, regulated, redundant, 24-V ac gas valve assembly containing pilot solenoid valve, pilot filter, pressure regulator, pilot shutoff, and manual shutoff.

2.7 EVAPORATOR COIL

A. Provide configured aluminum fin surface mechanically bonded to copper tubing coil.

B. Provide an independent expansion device for each refrigeration circuit. Factory pressure tested at 450 psig and leak tested at 200 psig.

C. Provide factory installed thermal expansion valve (TXV) for each refrigerant circuit.

Factory pressure tested at 450 psig and leak tested at 200 psig.

D. Provide a removable, reversible, cleanable double sloped drain pan for base of evaporator coil constructed of PVC.

2.8 CONDENSER SECTION

A. Provide internally finned seamless copper tube mechanically bonded to configured aluminum fins. Factory pressure test to 450 psig. Provide black epoxy coils with thermoset vinyl coating that is bonded to the aluminum fin stock prior to the fin-stamping process. Field applied coil coatings are not acceptable.

B. Provide vertical discharge, direct drive fans with aluminum blades. Fans shall be statically balanced. Motors shall be permanently lubricated, with integral thermal overload protection in a weather tight casing.

2.9 REFRIGERATION SYSTEM

A. Compressor(s): Provide scroll compressor with direct drive operating at 3600 rpm. Provide integral centrifugal oil pump. Provide suction gas cooled motor with winding temperature limits and compressor overloads.

B. Units shall have cooling capabilities down to 0 degree F as standard. For field-installed low ambient accessory, the manufacturer shall provide a factory-authorized service technician that will assure proper installation and operation.

C. Provide each unit with one refrigerant circuit(s) factory-supplied completely piped with liquid line filter-drier, suction and liquid line pressure ports.

D. For heat pump units, provide reversing valve, discharge muffler, flow control check valve, and electronic adaptive demand defrost control on all units.

2.11 OPERATING CONTROLS

A. Provide factory-wired roof top units with 24-volt electro-mechanical control circuit with control transformers, contactors pressure lugs or terminal block for power wiring. Contractor to provide DISCONNECT DEVICE. Units shall have single point power connection as standard. Field wiring of zone controls to be NEC Class II.

B. Provide factory-installed indoor evaporator defrost control to prevent compressor slugging by interrupting compressor operation.

C. Provide an anti-cycle timing and minimum on/off between stages timing in the microprocessor.

2.12 STAGING CONTROLS

A. Provide NEC Class II, electronic, adjustable zone control to maintain zone temperature setting.

B. Provide programmable electronic thermostat zone control.

1. Thermostat control shall incorporate:

a. Set-up for at least 2 - sets of separate heating and cooling temperatures

per day.

b. Instant override of setpoint for continuous or timed period from one hour to 31 days.

c. Switch selection features including Fahrenheit display, 12 or 24-hour clock, keyboard disable, remote sensor, fan on-auto.

d. Smart Fan Operation: Allows the unit fan operation to default to the Auto Mode during unoccupied periods, regardless of the Fan switch position.

2. Zone thermostat shall display shall be capable of:

a. Time of day.

b. Actual room temperature.

c. Programmed temperature.

d. Programmed time.

e. Duration of timed override.

f. Day of week.

g. System mode indication: heating, cooling, low battery, and fan on.

2.15 ROOF CURB

A. Contractor shall provide factory supplied min 14 inch tall roof curb, 16 gauge perimeter made of zinc coated steel with supply and return air gasketing and wood nailer strips. Ship knocked down and provided with instructions for easy assembly.

B. Curb shall be manufactured in accordance with the National Roofing Contractors Association guidelines.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Contractor shall verify that roof is ready to receive work and opening dimensions are as indicated on shop drawings.

B. Contractor shall verify that proper power supply is available.

3.2 INSTALLATION

A. Contractor shall install in accordance with manufacturer's instructions.

B. Mount units on factory built roof mounting frame providing watertight enclosure to protect ductwork and utility services. Install roof mounting curb level.

3.3 MANUFACTURER'S FIELD SERVICES

A. The manufacturer shall furnish an alternative price for:

1. Extended compressor warranty for one years.

2. Extended heat exchanger warranty for five years.

3. Extended parts and labor by manufacturer to be provided to the owner for a period of one years.

B. The contractor shall furnish manufacturer complete submittal wiring diagrams of the package unit as applicable for field maintenance and service.

PART 4 - SEQUENCE OF OPERATIONS

4.1 PACKAGED ROOFTOP UNITS (RTU)

A. Microprocessor controller - Each RTU shall be controlled by a stand-alone microprocessor based controller with resident control logic. The controller will interface with the BAS and the inputs and outputs in the points list to accomplish the following temperature control and energy conservation strategies.

1. Occupied Mode - All unit functions will be enabled for normal heating and cooling operation. Unit defaults to default temperature setpoints in the unit thermostat.

2. Occupied Space Temperature Control - When in occupied mode as described above, the dedicated unit control shall operate stages of heating and cooling to maintain space temperature setpoint. Setpoints may be set by one of the following methods:

a. Locally through the thermostat by the occupant;

B. Optimal Start Mode - When the unit is turned on, heating or cooling is provided as required. The outside air dampers, if provided, remains closed, in heating mode or mechanical cooling mode, until occupied time.

C. Coastdown Mode - When the unit is turned "OFF", the supply fan remains "ON/AUTO", the outside air damper remains in minimum position for ventilation, and utilizes the unoccupied setpoints.

D. Demand Limit Mode - Through the thermostat a user defined Demand Limit Mode shall be available. User defines maximum off time and temperature to ensure occupant comfort.

E. In unoccupied mode, the unit shall be controlled to maintain user defined unoccupied heating and cooling setpoints. Adjustable start and stop temperature differentials will prevent short cycling. The outdoor air damper remains closed during heating night setback operation, if provided.

F. Low Ambient Compressor Lockout - Compressor operation shall be disabled below a user defined outdoor air temperature.

G. Timed Override - When a timed override is initiated by the user, the unit will return to its user defined normal occupied mode for the user determined period of time.

H. Fire Shutdown - The unit will shut down in response to a customer supplied contact closure to the thermostat indicating the presence of a fire or other emergency condition.

I. Unit status report - For each RTU unit, the thermostat shall provide an operating status summary of all sensed values (zone temperature, discharge temperature, etc.) setpoints and modes.

J. Alternating Lead/Lag - (Dual Compressors Models Only), During periods of part load operation, each compressor cycles alternatively as circuit number one in order to equalize wear and run time.

END OF SECTION 237413

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SECTION 238113.11 – PACKAGED TERMINAL AIR CONDITIONERS, THROUGH-WALL UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes packaged terminal air conditioners and their accessories and controls, in the following configurations:

1. Through-the-wall heat pumps.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, furnished specialties, electrical characteristics, and accessories.

B. Shop Drawings: For packaged terminal air conditioners. Include plans, elevations, sections, details for wall penetrations and attachments to other work.

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

2. Wiring Diagrams: For power, signal, and control wiring.

C. Color Samples: For unit cabinet, discharge grille, and exterior louver, and for each color and texture specified.

D. Product Test Reports: Based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified testing agency, for packaged terminal air conditioners.

E. Field quality-control reports.

F. Operation and Maintenance Data: For packaged terminal air conditioners to include in emergency, operation, and maintenance manuals.

G. Warranty: Sample of special warranty.

1.4 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1-2010, Section 4 - "Outdoor Air Quality," Section 5 - "Systems and Equipment," Section 6 - "Ventilation Rate Procedures," and Section 7 - "Construction and Startup."

C. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1-2004.

1.5 COORDINATION

A. Coordinate layout and installation of packaged terminal air conditioners and wall construction with other construction that penetrates walls or is supported by them.

1.6 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of packaged terminal air conditioners that fail in materials or workmanship within specified warranty period.

1. Warranty Period for Sealed Refrigeration System: Manufacturer's standard, but not less than five years from date of Substantial Completion, including components and labor.

2. Warranty Period for Nonsealed System Parts: Manufacturer's standard, but not less than five years from date of Substantial Completion, including only components and excluding labor.

3. Warranty Period for Heat Exchangers: Manufacturer's standard, but not less than five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. Amana

2. Carrier Corporation; a United Technologies company.

3. ClimateMaster, Inc.

4. Friedrich Air Conditioning Co.

5. General Electric Company; GE Consumer & Industrial - Appliances.

6. McQuay International.

7. Trane; a business of American Standard Companies.

2.2 MANUFACTURED UNITS

A. Description: Factory-assembled and -tested, self-contained, packaged terminal air conditioner with room cabinet, electric refrigeration system, heating, and temperature controls; fully charged with refrigerant and filled with oil; with hardwired chassis.

2.3 CHASSIS

A. Cabinet: 0.052-inch- thick steel with removable front panel with concealed latches.

1. Mounting: Wall with wall sleeve.

2. Discharge Grille: Punched-louver discharge grille allowing four-way discharge-air pattern.

3. Louvers: Extruded aluminum with enamel finish; white color.

4. Finish: Epoxy coating.

5. Access Door: Hinged door in top of cabinet for access to controls.

6. Cabinet Extension: Matching cabinet in construction and finish, allowing diversion of airflow to adjoining room; with grille.

7. Wall Sleeves: Galvanized steel with polyester finish.

B. Refrigeration System: Direct-expansion indoor coil with capillary restrictor; and hermetically sealed scroll compressor with vibration isolation and overload protection.

1. Indoor and Outdoor Coils: Seamless copper tubes mechanically expanded into aluminum fins with capillary tube distributor on indoor coil. Provide black epoxy outdoor coils with thermoset vinyl coating that is bonded to the aluminum fin stock prior to the fin-stamping process. Field applied coil coatings are not acceptable.

2. Accumulator.

3. Constant-pressure expansion valve.

4. Reversing valve.

5. Charge: R-410a.

C. Indoor Fan: Forward curved, centrifugal; with motor and positive-pressure ventilation damper with concealed manual operator.

D. Outdoor Fan: Forward curved, centrifugal motor.

1. Indoor and Outdoor Fan Motors: Two speed; comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Division 23 Section "Common Motor Requirements for HVAC Equipment."

a. Fan Motors: Permanently lubricated split capacitor.

b. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.

c. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Division 26 Sections.

2.4 ELECTRIC HEATING

A. Electric-Resistance Heating Coil: Nickel-chromium-wire, electric-resistance heating elements with contactor and high-temperature-limit switch.

2.5 CONTROLS

A. Control Module: Unit-mounted digital panel with touchpad temperature control and with touchpad for heating, cooling, and fan operation. Include the following features:

1. Low Ambient Lockout Control: Prevents cooling-cycle operation below 40 deg F (5 deg C) outdoor air temperature.

2. Temperature-Limit Control: Prevents occupant from exceeding preset setback or setup temperature.

3. Building Automation System Interface: Allows remote on-off control with setback temperature control.

4. Reverse-Cycle Defrost: Solid-state sensor monitors frost buildup on outdoor coil and reverses unit to melt frost.

B. Remote Control: Standard unit-mounted controls with remote-mounted, low-voltage adjustable thermostat with heat anticipator, heat-off-cool-auto switch, and on-auto fan switch.

C. Outdoor Air: Manual intake damper. Open intake when unit indoor air fan runs.

2.6 SOURCE QUALITY CONTROL

A. Sound-Power Level Ratings: Factory test to comply with ARI 300, "Sound Rating and Sound Transmission Loss of Packaged Terminal Equipment."

B. Unit Performance Ratings: Factory test to comply with ARI 310/380/CSA C744, "Packaged Terminal Air-Conditioners and Heat Pumps."

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install units level and plumb, maintaining manufacturer's recommended clearances and tolerances.

B. Install wall sleeves in finished wall assembly; seal and weatherproof. Joint-sealant materials and applications are specified in Division 7 Section "Joint Sealants."

3.2 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

B. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

C. Tests and Inspections:

1. Inspect for and remove shipping bolts, blocks, and tie-down straps.

2. After installing packaged terminal air conditioners and after electrical circuitry has been energized, test for compliance with requirements.

3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.

4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Packaged terminal air conditioners will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports.

3.3 STARTUP SERVICE

A. Perform startup service.

B. After installation, verify the following:

1. Unit is level on base and is flashed in exterior wall.

2. Unit casing has no visible damage.

3. Compressor, air-cooled condenser coil, and fans have no visible damage.

4. Labels are clearly visible.

5. Controls are connected and operable.

6. Shipping bolts, blocks, and tie-down straps are removed.

7. Filters are installed and clean.

8. Drain pan and drain line are installed correctly.

9. Electrical wiring installation complies with manufacturer's submittal and installation requirements in Division 26 Sections.

10. Installation. Perform startup checks according to manufacturer's written instructions, including the following:

a. Lubricate bearings on fan.

b. Check fan-wheel rotation for correct direction without vibration and binding.

C. After startup service and performance test, change filters.

3.4 ADJUSTING

A. Adjust initial temperature set points.

B. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

3.5 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain packaged terminal air conditioners.

END OF SECTION 238113.11

SECTION 238126 – SPLIT-SYSTEM AIR-CONDITIONERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to this section.

1.2 SUMMARY

A. This section contains requirements for commercial split system air conditioners and heat pumps and their related accessories and controls.

B. Related Sections: The following sections contain requirements that relate to this section.

1. Division 23, Section 230010 - BASIC MECHANICAL REQUIREMENTS.

2. Division 23, Section 230050 - BASIC MECHANICAL MATERIALS AND METHODS.

1.3 QUALITY ASSURANCE

A. Factory test all units.

B. All units CSA and/or UL approved.

C. Standard for air conditioners: ARI 210.

D. Standard for heat pumps: ARI 240.

1.4 SUBMITTALS

A. General: Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification sections.

B. Product data including rated capacities of each unit, weights (shipping, installed, and operating), furnished specialties, accessories, and the following:

1. Certified fan performance with system operating conditions indicated.

2. Motor ratings and electrical characteristics plus motor and electrical accessories.

3. Material gauges and finishes, including color charts.

C. Shop drawings from manufacturer detailing equipment assemblies and indicating dimensions, weights, loadings, required clearances, method of field assembly, components, and location and size of each field connection.

D. Wiring diagrams detailing wiring for power and control systems and differentiating clearly between manufacturer-installed and field-installed wiring.

E. Maintenance data for split systems to include in the operation and maintenance manual specified in Division 1 and in Division 23, Section 230010 - BASIC MECHANICAL REQUIREMENTS.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Ductless split system air conditioners and heat pumps:

a. Sanyo.

b. Daiken.

c. Mitsubishi.

d. Carrier.

2.2 SPLIT SYSTEMS, GENERAL

A. Ductless split system air conditioner; unitary, split type, cooling, with outdoor condensing unit and indoor evaporator blower unit.

B. Air conditioner: Unitary, split type, cooling and heating unit with outdoor condensing unit an indoor blower unit with evaporator.

C. Capacities as scheduled.

2.3 CONDENSING UNIT

A. Condensing Unit: Air-cooled condensing unit, factory assembled, consisting of compressor, condenser coil and fan, and casing.

1. Operating Range: 40-120 degrees F outdoor ambient.

2. Factory installed filter dryer.

B. Compressor: Hermatic, welded shell-type.

1. Motor: Wide operating range, dual voltage.

2. Internal spring isolation and two-stage sound isolation.

3. Winding thermostat and current overload device coupled with pressure limiting valve.

4. Internal protection devices for:

a. Motor overload.

b. Locked rotor.
c. Extreme voltage supply.

d. Excessive winding temperatures.

e. Extreme pressures.

f. Loss of refrigerant charge.

g. Compressor cycling.

5. Off cycle crankcase heater.

C. Coil, Condenser: Seamless aluminum tubes, 3/8 inch OD with aluminum fins mechanically bonded. Provide black epoxy coils with thermoset vinyl coating that is bonded to the aluminum fin stock prior to the fin-stamping process. Field applied coil coatings are not acceptable.

1. Two row.

2. Factory pressure and leak tested at 600 psi.

3. Provide heavy duty protective grille on all sides.

D. Fan, Condenser: Aluminum, aerodynamically designed, statically balanced.

1. Motor: Two-speed, single-phase, direct drive, heavy duty, permanently lubricated, with built-in thermal overload protection.

2. Mount fan and motor support to cabinet top.

3. Provide grille to protect fan.

E. Casing, Condensing Unit: 18 gauge galvanized steel.

1. Finish: Phosphatized; epoxy resin primer; acrylic finish coat.

2. Removable end panel for access to all components and connections.

3. Standard base size.

4. Mounting Rails: Die formed; integral with base.

5. Drain holes in base pan.

6. Electrical and refrigeration connections in same location on all units.

2.4 DUCTLESS EVAPORATOR UNIT

A. Evaporator Unit: slim line cooling unit, factory assembled consisting of fan, filters, evaporator coil, controls and casing.

B. Fan, Evaporator: Centrifugal, direct drive.

1. Motor: Three-speed, permanent split capacitor, with built-in thermal overload protection and run capacitor.

C. Filter, Evaporator: Washable type, slide-in/slide-out.

D. Casing, Evaporator Unit: 20 gauge steel.

1. Finish: Baked enamel.

2. Lined with 1/2-inch thick, 1/2 PCF density neoprene coated insulation.

3. Removable access panels with quarter-turn fasteners.

E. Coil, Evaporator: Seamless copper tubes with aluminum fins mechanically bonded.

1. Quick-connect male couplers.

2. Expansion valve expansion device.

3. Operating charge of R-410A.

2.5 REFRIGERANT PIPING

A. Piping, refrigerant for quick-connect installations: Precharged, factory assembled, in standard lengths.

1. Female couplings.

2. Suction Line: Foam plastic insulated.

3. Provide gauge ports at condenser.

2.6 TEMPERATURE CONTROLS

A. Control Devices:

1. Devices integral with ductless evaporator unit:

a. Unit mounted, packaged, prewired microprocessor controller/thermostat.

b. Terminal strip for wiring to outdoor condensing unit.

c. 6 foot power cord and plug.

B. Sequence of Operation: For ductless units.

1. Unit microprocessor cycle on demand for cooling or heating.

2. Condensing unit energized upon demand for cooling or heating.

a. Cycled with packaged controls.

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine areas and conditions under which split systems are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.2 INSTALLATION OF SPLIT SYSTEM UNITS

A. General: Install split systems as indicated, and in accordance with manufacturer's installation instructions.

B. Locate split system evaporator and condensing units as indicated, coordinate with other trades to assure correct recess size for recessed units.

C. Install refrigeration and condensate drain piping as indicated.

D. Protect units with protective covers during balance of construction.

E. Mount condensing units on prefabricated concrete slab or roof supports as indicated.

3.3 ELECTRICAL WIRING

A. General: Install electrical devices furnished by manufacturer but not specified to be factory-mounted. Furnish copy of manufacturer's wiring diagram submittal to Electric Installer.

1. Verify that electrical wiring installation is in accordance with manufacturer's submittal and installation requirements of Division 26 sections. Do not proceed with equipment startup until wiring installation is acceptable to equipment installer.

3.4 ADJUSTING AND CLEANING

A. General: After construction is completed, including painting, clean unit exposed surfaces, vacuum clean coils and inside of cabinets.

B. Retouch any marred or scratched surfaces of factory-finished cabinets, using finish materials furnished by manufacturer.

C. Install new filter units for terminals requiring same, or clean washable filter units.

END OF SECTION 238126

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SECTION 238239.19 –WALL AND CEILING UNIT HEATERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work of this section.

1.2 SUMMARY

A. Extent of terminal unit work is indicated by drawings and schedules, and by requirements of this section.

B. Types of unit heaters required for project include the following:

1. Unit heaters.

C. Related Sections:

1. Division 23, Section 230010 - BASIC MECHANICAL REQUIREMENTS.

2. Division 23, Section 230050 - BASIC MECHANICAL MATERIALS AND METHODS section apply to work of this section.

3. Refer to other Division 23 sections for piping; ductwork; and testing, adjusting and balancing of unit heaters.

1.3 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of unit heaters, of types and sizes required, whose products have been in satisfactory use in similar service for not less than 3 years.

B. Codes and Standards:

1. I=B=R Compliance: Test and rate baseboard and finned tube radiation in accordance with I=B=R, provide published ratings bearing emblem of I=B=R.

2. ARI Compliance: Provide coil ratings in accordance with ARI Standard 410 "Forced-Circulation Air-Cooling and Air-Heating Coils".

3. ASHRAE Compliance: Test coils in accordance with ASHRAE Standard 33 "Methods of Testing Forced Circulation Air Cooling and Heating Coils".

4. UL Compliance: Provide electrical components for unit heaters which have been listed and labeled by UL.

1.4 SUBMITTALS

A. Product Data: Submit manufacturer's specifications for unit heaters showing dimensions, capacities, ratings, performance characteristics, gages and finishes of materials, and installation instructions.

B. Shop Drawings: Submit assembly-type shop drawings showing unit dimensions, construction details, and field connection details.

C. Wiring Diagrams: Submit manufacturer's electrical requirements for power supply wiring to unit heaters. Submit manufacturer's ladder-type wiring diagrams for interlock and control wiring. Clearly differentiate between portions of wiring that are factory-installed and portions to be field-installed.

D. Maintenance Data: Submit maintenance instructions, including lubrication instructions, filter replacement, motor and drive replacement, and spare parts lists. Include this data, product data, shop drawings in maintenance manuals; in accordance with requirements of Division 1.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Handle unit heaters and components carefully to prevent damage, breaking, denting and scoring. Do not install damaged units or components; replace with new.

B. Store unit heaters and components in clean dry place. Protect from weather, dirt, fumes, water, construction debris, and physical damage.

C. Comply with Manufacturer's rigging and installation instructions for unloading unit heaters, and moving them to final location.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturer: Subject to compliance with requirements, provide one of the following:

1. Unit Heaters:

a. Airtherm Mfg. Co.

b. Q-Mark.

c. McQuay Inc.

d. Modine Mfg. Co.

e. Trane (The) Co.

f. Young Radiator Co.

g. Reznor.

h. Sterling.

2.2 ELECTRIC UNIT HEATERS

A. Description: Cabinet mounting with air inlet and air outlet grille locations as scheduled.

B. Electric-Resistance Heating Elements: Nickel-chromium heating wire, free from expansion noise and 60-Hz hum, embedded in magnesium oxide refractory and sealed in steel or corrosion-resistant metallic sheath with fins no closer than 0.16 inch (4 mm). Element ends shall be enclosed in terminal box. Fin surface temperature shall not exceed 550 deg F (288 deg C) at any point during normal operation.

1. Circuit Protection: One-time fuses in terminal box for overcurrent protection and limit controls for high-temperature protection of heaters.

2. Wiring Terminations: Stainless-steel or corrosion-resistant material.

C. Fan and Motor: Direct-drive propeller fan and manufacturer's standard motor. Motors sized 1 hp and less include motor overload protection.

D. Wiring Terminations: Match conductor materials and sizes indicated.

E. Unit Configuration: Recessed, horizontal discharge with horizontal, adjustable louvers.

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine areas and conditions under which unit heaters are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.2 INSTALLATION OF UNIT HEATERS

A. General: Install unit heaters as indicated, and in accordance with manufacturer's installation instructions.

B. Uncrate units and inspect for damage. Verify that nameplate data corresponds with unit designation.

C. Hang units from building substrate, not from piping. Mount as high as possible to maintain greatest headroom possible unless otherwise indicated.

D. Support units with rod-type hangers anchored to building substrate.

E. Protect units with protective covers during balance of construction.

3.3 ELECTRICAL WIRING

A. General: Install electrical devices furnished by manufacturer but not specified to be factory-mounted. Furnish copy of manufacturer's wiring diagram submittal to Electric Installer.

1. Verify that electrical wiring installation is in accordance with manufacturer's submittal and installation requirements of Division 26 sections. Do not proceed with equipment start-up until wiring installation is acceptable to equipment installer.

3.4 ADJUSTING AND CLEANING

A. General: After construction is completed, including painting, clean unit exposed surfaces, vacuum clean terminal coils and inside of cabinets.

B. Retouch any marred or scratched surfaces of factory-finished cabinets, using finish materials furnished by manufacturer.

C. Install new filter units for terminals requiring same.

END OF SECTION 238239.19

260510 – BASIC ELECTRICAL REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this section.

1.2 SUMMARY

A. Division 26 of the specifications covers all electrical work for the project. Work shall include labor, including time necessary to investigate existing conditions, material, tools, temporary wiring, accessories, etc. required to accomplish the work as specified and shown on the drawings.

B. The drawings and specifications shall support each other to the extent that materials and labor indicated, called for, or implied by either shall be furnished and installed as if required by both. If the drawings and the specifications contradict each other or different drawings or specifications contradict each other, then the more expensive requirement of the two shall be bid, furnished and installed.

1.3 CODES, PERMITS AND INSPECTIONS

A. Installation shall comply with all laws applying to electrical installation in effect; with the regulations of the NEC, National Electrical Safety Code, other applicable publications of the National Fire Protection Association, all local governing codes and ordinances and with the regulations of the serving utility company. Provide required permits.

1.4 SUBMITTALS

A. Shop Drawings and Product Data:

1. Shop Drawings: Shall be submitted on equipment as indicated under each section of this division. Shop drawings shall include sufficient information to indicate complete compliance with specifications.
2. Product Data: Shall include illustrations, catalog sheets, installation instructions, drawings, and certifications as necessary. Each sheet shall show manufacturer's name or trademark. Edit product data to identify only those items to be provided for this project.

3. Where items are those specified, only a list of such items shall be provided, except where shop drawings and product data are specifically required.

4. For locations where floor penetrations must be made to serve electrical and communication equipment in millwork (ticket counters, check in counters, boarding pass, seating with computer plug-ins, etc.) where several elements of work must be sequenced and positioned with precision in order to align electrical and communications services with fabricated millwork, prepare coordination drawings at accurate scale showing the actual physical dimensions required for the installation to assure proper integration of equipment with building systems. Reference dimensions against building column lines, and confirm information with millwork contractor. Provide drawings as submittals to the engineer for approval prior to making floor penetrations.

5. At the time of each submission, any deviations from the Contract Documents shall be called to the attention of the Architect in writing, and be plainly marked on the shop drawings and product data.

B. Record Drawings:

1. Provide 1 complete set of contract drawings in clean, undamaged condition, indicating all significant changes from the work as shown. Use multiple pencil colors to aid in the distinction between work of separate electrical systems. In general, record every substantive installation of electrical work which previously is either not shown or field modified.

   a. Show exact locations of underground cable and conduits, both interior and exterior, drawn to scale and fully dimensioned from building column lines.
   b. Indicate mains and branches of wiring systems, with switchboard panelboards and control devices located and numbered. Locate devices requiring maintenance.
   c. Indicate changes in equipment ratings and locations.
   d. Indicate scope of each change order, noting change order number.

2. Refer to General Conditions and Division 1 for additional requirements pertaining to record documents.

C. Submit the following upon completion of the work:

1. Certificate of Final Inspection from local authority.

2. Tabulation of all motors listing respective manufacturer, horsepower, nameplate voltage and current, actual running current after installation and overload heater rating. This information may be complementeed with HVAC test and balance report.
3. O&M Manuals.

1.5 QUALITY ASSURANCE

A. Materials shall be new and comply with standards of UL, where standards have been established for the particular product and the various NEMA, ANSI, ASTM, IEEE, AEIC, ICEA or other publications referenced.

1.6 MANUFACTURERS' NAMES AND CATALOG NUMBERS

A. In some instances, specific references have been made to one or more manufacturer's names and model or catalog numbers. Use of names and catalog numbers does not indicate that the equipment specified is necessarily an "off the shelf" item. Variances may be due to requirement of a desired finish, material, or other modification. Provide additional components required to meet the functional requirements of the specified components.

B. In the case of panelboards, safety switches and other equipment requiring wire and cable terminations, ascertain that lug sizes and wiring gutters or space allowed for proper accommodation and termination of the wire and cables are adequate.

1.7 PROTECTION OF ELECTRICAL EQUIPMENT

A. Electrical equipment shall be protected from the weather, in particular, dripping or splashing water, at all times during shipment, storage and construction. Manufacturer's recommendations with regard to storage and protection shall be followed. Should any apparatus be subjected to possible injury by water, it shall be thoroughly dried and put through a dielectric test, at the expense of the Contractor, to ascertain the suitability of the apparatus or it shall be replaced without additional cost to the Owner.

B. Damaged or Defective Equipment: Inspect all electrical equipment and materials prior to installation. Damaged equipment and materials shall not be installed or placed in service until the Owner has been notified. Replace or repair to new condition and test repaired damaged equipment in compliance with industry standards at no additional cost to the Owner. Equipment required for the test shall be provided by the Contractor.

1.8 WORKING CLEARANCES

A. Working clearances around equipment requiring electrical service shall comply with code requirements. Should there be apparent violations of clearances, notify the Architect-Engineer before proceeding with connection or placement of equipment.

1.9 COORDINATION

A. Installation studies shall be made to coordinate the electrical work and to coordinate with the work of other trades. Contractor shall provide push button control wiring and conduit associated with equipment furnished by others.

B. For locations where several elements of electrical or combined mechanical and electrical work must be sequenced and positioned with precision in order to fit into the available space, prepare coordination drawings at accurate scale showing the actual physical dimensions required for the installation to assure proper integration of equipment with building systems.

C. Contractor shall, in a timely manner, request a copy of the approved shop drawings from other trades such as mechanical, plumbing, elevators and others requiring electrical service, and verify final electrical characteristics before roughing power feeds to any equipment. When electrical data on approved shop drawings differs from contemplated design, make the necessary adjustments to the wiring, disconnect, and branch-circuit protection for the equipment actually installed.

D. Damage from interference caused by inadequate coordination by the Contractor shall be rectified at no additional cost to the Owner.

E. For locations where floor penetrations must be made to serve electrical and communication equipment in millwork (ticket counters, check in counters, etc.) where several elements of work must be sequenced and positioned with precision in order to align electrical and communications services with fabricated millwork, prepare coordination drawings at accurate scale showing the actual physical dimensions required for the installation to assure proper integration of equipment with building systems. Reference dimensions against building column lines, and confirm information with millwork contractor. Provide drawings as submittals to the engineer for approval prior to making floor penetrations.

1.10 EXISTING CONDITIONS

A. Contractor shall visit the site and familiarize himself with the existing conditions. No additional compensation will be provided due to Contractor’s failure to visit the site prior to bidding.

B. Within 60 days of the notice to proceed, the Contractor shall verify in detail the existing conditions which may be different then the one shown on the drawings or not shown on the drawings. Contractor shall bring the findings to A/E's attention for disposition. If Contractor cannot verify the existing conditions within 60 days then he shall request in writing with justifications, the additional time required to complete the task. No additional compensation will be provided as a result of failure to verify existing conditions within the established time period.

PART 2 - PRODUCTS

2.1 GENERAL

A. All equipment of a particular kind such as wiring devices and panelboards, and all lighting fixtures of the same type, shall be the product of the same manufacturer.

2.2 ACCESS PANELS

A. Panels required for access to junction boxes, pull boxes and other equipment shall be provided as specified in Division 8.

2.3 LABELS

A. Labels shall be provided for each motor controller, safety switch, relay, panelboard, contactor, timer, control device, meter and circuit breaker. Labels shall be laminated, phenolic strips 1/16 inch thick and engraved to show black letters on white background not less than 1/4 inch in height. Strips shall be of size to properly fit manufacturer's brackets and legible. Where brackets are not provided, labels shall be mounted with screws, or approved adhesive.

B Provide 'Fed from ___, Room # ___' Label on each panel in addition to the panel designation.

PART 3 - EXECUTION

3.1 METHOD OF PROCEDURE

A. Erect equipment parts at such time and in such manner as to minimize interferences and delays in the execution of the work.

B. Care shall be used in the erection and installation of all equipment and materials to avoid marring surfaces of the work. Damages shall be repaired at no additional cost to the Owner.

3.2 PLACING EQUIPMENT IN SERVICE

A. Equipment requiring electrical service shall not be energized or placed in service until all interested parties have been duly notified and are present or have waived their right to be present. Where equipment to be placed in service involves service or connection from another contractor or the Owner, the Contractor shall notify the Owner in writing when the equipment will be ready. The Owner shall be notified as far in advance as possible, of the date the various items of equipment will be complete.

3.3 OPENING AND SLEEVES FOR ELECTRICAL WORK

A. Provide openings through walls, partitions, floors and roofs as required for electrical work.

B. Provide sleeves for electrical work passing through walls, partitions, floors and roofs, where indicated on the drawings.

1. Sleeves shall extend through floors, walls and partitions and shall be cut flush with each surface unless otherwise specified. Fire wall or floor integrity shall be restored after penetration.
2. Sleeves in concrete and masonry walls, concrete floors and roofs shall be of standard weight steel pipe, finished with smooth edges. Sleeves for walls and partitions other than masonry, concrete and suspended ceilings shall be No. 22 USG galvanized iron.
3. In fire rated floors or walls, all space between the floor or wall and conduit passing through the floor or wall shall be caulked with a fire barrier system classified by UL as a through-penetration firestop device. Acceptable: 3M Brand Fire Barrier Caulk and Putty; T&B Flame-Safe firestop Compound.

3.4 SUPPORTS FOR CONDUIT AND EQUIPMENT

A. Shall be supported from structural members and not from metal deck ceiling grid and slab assemblies.

B. All lighting fixtures shall be properly supported to structural members using independent supports. Ceiling grid wire shall not be used as a only means of support. Provide in dependable support at the two ends of the fixtures.

3.5 FINAL INSPECTION AND TESTING

A. The work shall be thoroughly tested in the presence of the Owner's representative to demonstrate that the entire system is in proper working order and in accordance with the drawings and specifications. Each motor with its control shall be run as nearly as possible under operating conditions for a sufficient length of time to demonstrate correct alignment, wiring capacity, speed and satisfactory operation. All main switches and circuit breakers shall be operated, but not necessarily at full load. During final inspection, furnish the test instruments and qualified personnel to perform complete testing.

B. Costs of tests, including expenses incident to retest occasioned by defects and failures of the equipment to meet the specifications shall be paid by the Contractor.

END OF SECTION 260510

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SECTION 260512 - ELECTRICAL POWER INTERRUPTION

PART 1 - GENERAL

0.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this section.

B. Refer to Section 260510 – Basic Electrical Requirements for general requirements.

0.2 SUMMARY

A. Service to all other areas in existing facility shall be continuous and uninterrupted. Where necessary, temporary protective devices and cables shall be provided and strung.

B. When interruption of electric power is required, written notice shall be given to the Owner 72 hours prior to the interruption. Notice of power interruption shall include a complete description of the work and the number of the Contractor's personnel that will be used to perform the work. The Contractor may be required to alter his schedule at the request of the Owner.

C. The Owner may only allow interruption of power during nonworking hours. If so, the Contractor shall not submit a claim for extra fir the overtime charges.

D. Power interruption shall be kept to a minimum time duration.

E. Refer to notes on the riser drawings to monitor and balance the loads on existing 5 KV feeders during construction,

PART 1 - PRODUCTS

NOT USED

PART 2 - EXECUTION

NOT USED

END OF SECTION 260512

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SECTION 260519 – LOW VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

0.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this section.

B. Refer to Section 260510– Basic Electrical Requirements for general requirements.

0.2 SUMMARY

A. Section includes furnishing and installing all wire, cable, and connectors required for the power distribution systems, lighting, motors, mechanical equipment, receptacles and miscellaneous items requiring electrical power.

1.3 SUBMITTALS

A. Product data.

B. Installation manual and details for 2 hour fire rated cables.

PART 1 - PRODUCTS

1.1 MANUFACTURERS

A. Acceptable Manufacturers of Wire and Cable: Subject to compliance with requirements, provide products by one of the following:

1. Anixter Bros. Inc.
2. Okonite Company.
3. Triangle Wire and Cable.
4. Cablec Corporation.
5. Rome Cable Division of Alcoa.
6. Southwire Corp.
7. American Insulated Wire.
8. AFC Cable Systems

B. Acceptable Manufacturers of 2 hour fire rated cables and Connectors:

1. Pyrotenax

C. Acceptable Manufacturers of Connectors: Subject to compliance with requirements, provide products by one of the following:

1. AMP Inc.
2. Burndy Corp.
3. 0.Z. /Gedney Company.
4. Thomas & Betts Company.
5. Ideal Industries.

6. General Electric Company.
7. Minnesota Mining & Mfg. Company.
8. King Technology, Inc.

1.2 MATERIALS

A. Cable:

1. Except as otherwise indicated, provide 600-volt rating insulated copper cable, copper wire and connectors of manufacturer's standard materials, as indicated by published product information, designed and constructed as recommended by the manufacturer, meeting ICEA-NEMA Standards.
2. Unless otherwise noted, wire No. 10 AWG and smaller shall be solid, factory-color coded, with type THHN or THWN insulation. Minimum wire size shall be No. 12 AWG except control wiring may be No. 14.
3. Wiring in under-floor ducts, direct burial raceway or damp locations shall be THWN or XHHW insulation.
4. Wire sizes No. 8 and larger shall be stranded with insulation type THHN, THWN, XHHW or specially selected insulation as indicated. Wire shall be factory color coded or coded with tape.
5. All insulation shall be rated for 90 degrees except fixture wire or as noted otherwise.
6. Provide high-temperature fixture wiring for incandescent, mercury and sodium lamp type socket connections.
7. Use following colors for coding:

208 Volt System	480 Volt System
Neutral - White	Neutral - Gray
Phase A - Black	Phase A - Brown
Phase B - Red	Phase B - Orange
Phase C - Blue	Phase C - Yellow

Grounding Conductor - Green
Phase Sequence - ABC, top to bottom, left to right, front to back

B. Pyrotenax System 1850:

1. Pyrotenax System 1850 mineral insulated, metal-sheathed cable shall be factory assembly of one or more conductors insulated with highly compacted magnesium oxide insulation and enclosed in a seamless, liquid and gas-tight continuous copper sheath.
2. Conductors shall be of solid, high electrical conductivity copper with a cross-section area corresponding to standard AWG sizes.
3. The insulation shall be of highly compressed magnesium oxide that will provide proper spacing for conductors. Thickness of insulation shall be at least 55 mils for all 600 volt power and control cables from 16 AWG to 500 kcmil and 23 mils for 300 volt twisted pair cables.
4. System 1850 cables shall comply with Article 330 and all other relevant provisions and articles of the National Electrical Code (NEC) and the Canadian Electrical Code (CEC). It shall be classified by Underwriters Laboratories as being 2-hour fire resistive.
5. Provide all accessories for terminating and installing System 1850 cables.

C. MC Cable:

1. Provide 600-volt rating insulated copper cable, copper wire, armored, (galvanized Interlocking steel strip), THHN/THWN, Polypropylene Tape, maximum temperature rating of 90-C, 2 grounding conductors, white neutral conductor, maximum voltage rating of 600V.
2. MC Cable shall be use in concealed construction only (and not exposed).
3. MC Cable shall be use for branch circuiting (for room circuiting), both lighting and power, but not for home run applications.

D. Connectors:

1. Connectors for splicing of No. 10 AWG and smaller conductors shall be 3-M Scotchlok, spring-type pressure connectors, or approved equal.
2. Splices for No. 8 AWG and larger shall be T&B compression type, or approved equal.
3. Terminations for motors with No. 10 AWG or smaller conductors shall be a spring-type pressure connector. Terminations for motors requiring No. 8 AWG and larger terminations shall provide taped connections of compression connectors of motor leads to compression connectors of input conductors, using machine bolt and nut arrangement.
4. Lug terminations for No. 8 AWG and larger cable shall be with T&B "color-keyed" compression connectors, or approved equal.
5. Electrical insulating tape shall be Scotch No. 88 or 99, or approved equal.

PART 2 - EXECUTION

2.1 EXAMINATION

A. Verification:

1. Before installing raceways and pulling wire to any mechanical equipment, verify electrical characteristics with final submittal on equipment to assure proper number and AWG of conductors.

2.2 PREPARATION

A. Conduit System:

1. No wire shall be pulled until the conduit system is complete, from pull-point to pull-point, and major equipment terminating conduits have been fixed in position.

2.3 INSTALLATION

A. Cable:

1. Cable insulation shall not be disturbed or torn while installing wire in conduits. A neutral lubricant may be used in pulling nonarmored conductors and shall be used if wire is pulled by mechanical means.
2. Bending radius of insulated wire or cable shall be not less than the minimum recommended by manufacturer.
3. Maximum pulling tension of any wire or cable shall not exceed manufacturer's recommended values.
4. Color coding is required at termination points and within junction boxes. Where tape is used it shall cover not less than 6 inches of the conductor at panelboards

and in each outlet box, junction box or termination. In switchboards, or other enclosures where more than 4 feet of conductor is exposed, conductor shall be taped at entrance to enclosure and at termination.

5. Allow adequate conductor lengths in all junction boxes, pull boxes and terminal cabinets. All termination of conductors in which conductor is in tension will be rejected and shall be replaced with conductors of adequate length. This requirement shall not include vertical cable supports in vertical raceway installations provided in pullboxes at proper vertical spacings.
6. Support conductors in vertical raceways in compliance with Table 300-19(a) of the National Electrical Code. Provide pull boxes as necessary for cable supports to be installed.

B. Two Hour Fire Rated Cables:

1. The 2-hour fire rated cables shall be installed in strict accordance with manufacturer's installation requirements and NEC.
2. The cables must be supported every 3 feet to meet the fire rating requirement for the cable.

C. Splices:

1. Splices shall not be made except in junction boxes, outlet boxes, or other permanently accessible locations.
2. Installed splices shall have equal to or better mechanical strength and insulation as the factory applied insulation.

2.4 FIELD QUALITY CONTROL

A. Inspection:

1. Prior to energizing, check cable and wire for circuit continuity, short circuits, and proper phasing of conductors.

END OF SECTION 260519

SECTION 260526 – GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes grounding and bonding systems and equipment.

B. Section includes grounding and bonding systems and equipment, plus the following special applications:
1. Underground distribution grounding.
2. Ground bonding common with lightning protection system.
3. Foundation steel electrodes.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

1.4 INFORMATIONAL SUBMITTALS

A. As-Built Data: Plans showing dimensioned as-built locations of grounding features specified in "Field Quality Control" Article, including the following:
1. Test wells.
2. Ground rods.
3. Ground rings.
4. Grounding arrangements and connections for separately derived systems.

B. Qualification Data: For testing agency and testing agency's field supervisor.

C. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For grounding to include in emergency, operation, and maintenance manuals.
1. In addition to items specified in Section 260598 "Operation and Maintenance Manuals," include the following:
a. Instructions for periodic testing and inspection of grounding features based on NFPA 70B (test wells, ground rings, grounding connections for separately derived systems).
1) Tests shall determine if ground-resistance or impedance values remain within specified maximums, and instructions shall recommend corrective action if values do not.
2) Include recommended testing intervals.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: Member company of NETA or an NRTL.
1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Comply with UL 467 for grounding and bonding materials and equipment.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Burndy; Part of Hubbell Electrical Systems.
2. Dossert; AFL Telecommunications LLC.
3. ERICO International Corporation.
4. Fushi Copperweld Inc.
5. Galvan Industries, Inc.; Electrical Products Division, LLC.
6. Harger Lightning and Grounding.
7. ILSCO.
8. O-Z/Gedney; A Brand of the EGS Electrical Group.
9. Robbins Lightning, Inc.
10. Siemens Power Transmission & Distribution, Inc.

2.2 SYSTEM DESCRIPTION

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with UL 467 for grounding and bonding materials and equipment.

2.3 CONDUCTORS

A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.

B. Bare Copper Conductors:
1. Solid Conductors: ASTM B 3.
2. Stranded Conductors: ASTM B 8.
3. Tinned Conductors: ASTM B 33.
4. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch (6 mm) in diameter.
5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
6. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches (41 mm) wide and 1/16 inch (1.6 mm) thick.
7. Tinned Bonding Jumper: Tinned-copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches (41 mm) wide and 1/16 inch (1.6 mm) thick.

C. Grounding Bus: Predrilled rectangular bars of annealed copper, 1/4 by 4 inches (6.3 by 100 mm) in cross section, with 9/32-inch (7.14-mm) holes spaced 1-1/8 inches (28 mm) apart. Stand-off insulators for mounting shall comply with UL 891 for use in switchboards, 600 V and shall be Lexan or PVC, impulse tested at 5000 V.

2.4 CONNECTORS

A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.

B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy.

C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

D. Bus-Bar Connectors: Mechanical type, cast silicon bronze, solderless exothermic-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.

2.5 GROUNDING ELECTRODES

A. Ground Rods: Copper-clad steel, sectional type; 3/4 inch by 10 feet (19 mm by 3 m).

PART 3 - EXECUTION

3.1 APPLICATIONS

A. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger unless otherwise indicated.

B. Underground Grounding Conductors: Install bare tinned-copper conductor, No. 2/0 AWG minimum.
   1. Bury at least 24 inches (600 mm) below grade.
   2. Duct-Bank Grounding Conductor: Bury 12 inches (300 mm) above duct bank when indicated as part of duct-bank installation.

C. Grounding Bus: Install in electrical equipment rooms, in rooms housing service equipment, and elsewhere as indicated.
   1. Install bus horizontally, on insulated spacers 2 inches (50 mm) minimum from wall, 6 inches (150 mm) above finished floor unless otherwise indicated.

D. Conductor Terminations and Connections:
   1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
   2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
   3. Connections to Ground Rods at Test Wells: Bolted connectors.
   4. Connections to Structural Steel: Welded connectors.

3.2 GROUNDING AT THE SERVICE

A. Equipment grounding conductors and grounding electrode conductors shall be connected to the ground bus. Install a main bonding jumper between the neutral and ground buses.

3.3 EQUIPMENT GROUNDING

A. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:
   1. Feeders and branch circuits.
   2. Lighting circuits.

3. Receptacle circuits.
4. Single-phase motor and appliance branch circuits.
5. Three-phase motor and appliance branch circuits.
6. Flexible raceway runs.
7. Armored and metal-clad cable runs.
8. Busway Supply Circuits: Install insulated equipment grounding conductor from grounding bus in the switchgear, switchboard, or distribution panel to equipment grounding bar terminal on busway.
9. TSA Security Check point Equipment Circuits: Install insulated equipment grounding conductor in circuits supplying x-ray equipment.

B. Air-Duct Equipment Circuits: Install insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners, heaters, dampers, humidifiers, and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping.

C. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Install a separate insulated equipment grounding conductor to each electric water heater and heat-tracing cable. Bond conductor to heater units, piping, connected equipment, and components.

D. Isolated Equipment Enclosure Circuits: For designated equipment supplied by a branch circuit or feeder, isolate equipment enclosure from supply circuit raceway with a nonmetallic raceway fitting listed for the purpose. Install fitting where raceway enters enclosure, and install a separate insulated equipment grounding conductor. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service unless otherwise indicated.

E. Poles Supporting Outdoor Lighting Fixtures: Install grounding electrode and a separate insulated equipment grounding conductor in addition to grounding conductor installed with branch-circuit conductors.

3.4 INSTALLATION

A. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

B. Ground Bonding Common with Lightning Protection System: Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system. Bond electrical power system ground directly to lightning protection system grounding conductor at closest point to electrical service grounding electrode. Use bonding conductor sized same as system grounding electrode conductor, and install in conduit.

C. Ground Rods: Drive rods until tops are 2 inches (50 mm) below finished floor or final grade unless otherwise indicated.
1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating if any.
2. For grounding electrode system, install at least three rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes, and connect to the service grounding electrode conductor.

D. Test Wells: Ground rod driven through drilled hole in bottom of handhole. and shall be at least 12 inches (300 mm) deep, with cover.

1. Test Wells: Install at least one test well for each service unless otherwise indicated. Install at the ground rod electrically closest to service entrance. Set top of test well flush with finished grade or floor.

E. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.
   1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
   2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.
   3. Use exothermic-welded connectors for outdoor locations; if a disconnect-type connection is required, use a bolted clamp.

F. Grounding and Bonding for Piping:
   1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes; use a bolted clamp connector or bolt a lug-type connector to a pipe flange by using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
   2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
   3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.

G. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install tinned bonding jumper to bond across flexible duct connections to achieve continuity.

H. Grounding for Steel Building Structure: Install a driven ground rod at base of each corner column and at intermediate exterior columns at distances not more than 60 feet (18 m) apart.

I. Ground Ring: Install a grounding conductor, electrically connected to each building structure ground rod and to each steel column, extending around the perimeter of building.
   1. Install tinned-copper conductor not less than No. 2/0 AWG for ground ring and for taps to building steel.
   2. Bury ground ring not less than 24 inches (600 mm) from building's foundation.

J. Concrete-Encased Grounding Electrode (Ufer Ground): Fabricate according to NFPA 70; use a minimum of 20 feet (6 m) of bare copper conductor not smaller than No. 4 AWG.
   1. If concrete foundation is less than 20 feet (6 m) long, coil excess conductor within base of foundation.
   2. Bond grounding conductor to reinforcing steel in at least four locations and to anchor bolts. Extend grounding conductor below grade and connect to building's grounding grid or to grounding electrode external to concrete.

3.5 FIELD QUALITY CONTROL

A. Perform tests and inspections.
   1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

B. Tests and Inspections:

1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.
3. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, at ground test wells, and at individual ground rods. Make tests at ground rods before any conductors are connected.
   a. Measure ground resistance no fewer than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
   b. Perform tests by fall-of-potential method according to IEEE 81.
4. Prepare dimensioned Drawings locating each test well, ground rod and ground-rod assembly, and other grounding electrodes. Identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location, and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.

C. Grounding system will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

E. Report measured ground resistances that exceed the following values:
   1. Power and Lighting Equipment or System with Capacity of 500 kVA and Less: 10 ohms.
   2. Power and Lighting Equipment or System with Capacity of 500 to 1000 kVA: 5 ohms.
   3. Power and Lighting Equipment or System with Capacity More Than 1000 kVA: 3 ohms.
   4. Power Distribution Units or Panelboards Serving Electronic Equipment: 3 ohms.
   5. Substations and Pad-Mounted Equipment: 5 ohms.
   6. Manhole Grounds: 10 ohms.

F. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

END OF SECTION 260526

SECTION 260533 - RACEWAYS

PART 1 - GENERAL

0.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this section.

B. Refer to Section 260510 – Basic Electrical Requirements for general requirements.

0.2 SUMMARY

A. All wiring, unless otherwise indicated, shall be installed in galvanized steel raceway. Minimum size shall be 1/2 inch unless otherwise noted. Raceway system shall be sized to suit number and size conductors to be installed or of size shown, if larger. Size may be increased to facilitate pulling of conductors.

B. All surface raceways shall be installed in neat and workman like manner using the openings provided in the precast structures. There shall not be any conduit and LB fittings installed around a beam or other similar structures.

0.3 SUBMITTALS

A. Shop Drawings: Include catalog cuts of raceway, fitting and expansion fittings.

PART 1 - PRODUCTS

1.1 GENERAL

A. For each electrical raceway system required, provide a complete assembly of conduit, tubing or duct, with fittings including, but not necessarily limited to, connectors, nipples, couplings, elbows, outlet box covers, expansion fittings, conductor support and other components and accessories as needed to form a complete system of type indicated.

B. The following types of conduit shall be installed as listed below unless otherwise permitted by these specifications or the drawings:

1. Rigid steel conduit per section 260535 - CONDUIT, RIGID STEEL.
2. EMT per Section 260536 - CONDUIT, ELECTRIC METALLIC TUBING.
3. PVC conduit per Section 260538 - CONDUIT, PVC.
4. Flexible metallic conduit and liquid flexible steel conduit per Section 260540 - CONDUIT, FLEXIBLE METALLIC.
5. Damp Interior, Exterior and Food Service Equipment - Liquid-tight flexible metallic conduit.
6. In Slab - Schedule 40 PVC.

1.2 CONDUIT HANGERS AND SUPPORTS

A. Surface Conduits: Pipe straps in interior locations shall be approved equal in weight and quality to T&B #1210 Series for GRC and T&B #4160 Series for EMT. Pipe straps for surface-mounted conduits in exterior locations and in service areas shall be one-hole, HDG finish malleable cast iron straps approved equal in weight and quality to T&B #1275-1288 series with matching spacer, T&B #1350 Series.

B. Suspended Conduits: Steel City #6HO Series or approved equal adjustable hanger for single installations. Multiple conduits shall be trapeze-type hangers where practicable. Support members shall be similar and equal to Unistrut #P-2000/4000, or approved equal, selected for span and loading in accordance with the manufacturer's recommendations, using 2 or more rods of 3/16-inch diameter or greater as required. GRC clamps shall be Unistrut #P-1109 Series, or approved equal. EMT Clamps shall be Unistrut #P-1425 Series, or approved equal.

C. Above suspended ceiling, single runs of 3/4-inch conduit or smaller may be run not less than 12 inches above "T" bar with caddy "kon" clip. Only one conduit per ceiling support wire.

1.3 INSERTS AND ANCHORS

A. New Concrete Work: Adjustable concrete inserts, Grinnell or approved equal.

B. Installation in Shear or Compression in Existing Concrete: Phillips Redhead, Pierce, A-J or Diamond.

C. Concrete Block Walls: Toggle bolt or "molly" anchors. Where loads require, provide thru-bolts and 3/16 inch thickness backup plates, properly concealed.

D. Steel Beam Clamps: Steel City #500 Series or approved equal.

E. Where loads require, provide galvanized structural steel framework, secured to structure above in an approved manner.

1.4 METAL SURFACE RACEWAY

A. Where indicated on drawings, provide metal surface raceway system complete with all factory fabricated fittings.

B. Provide two-piece surface steel raceway as follows:

1. Two piece with removable cover.
2. Size approximately 3.56 inches deep by 4.75 inches high.
3. With snap-in divider to create two compartments for power and communications.
4. With horizontally mounted duplex receptacles on 24-inch centers.
5. With raceway riser stubbed to above ceiling for conduit and cable connections.
6. Acceptable: Wiremold Series V4000 raceway; or approved equal.

1.5 PULL LINE

A. Shall be polyolefin pull line, Jet Line No. 232, or approved equal.

1.6 MARKING RACEWAY SYSTEM

A. Where raceway is located below grade, provide marking tape. Tape shall be equal to Carlon Mat standard tape or approved equal.

B. Raceways and Junction boxes for various systems shall be identified by 3 inch long at 20 foot interval or spray paint at 20 foot interval as follows:

1. Emergency Power System: Red color.
2. Emergency Alarm System: Orange.
3. Intercom System: Blue.
4. Communications/Data System: Gray.

5. Security System: Black.

1.7 CONDUIT TERMINATIONS

A. All conduit terminations in damp or wet locations shall be with threaded conduit hub.

PART 2 - EXECUTION

2.1 INSTALLATION

A. Concealed conduits shall be run in walls and overhead in ceiling space or slab above unless specifically indicated to be run in floor. All conduits shall be run down to outlets to avoid trapped runs wherever possible.

B. Exposed conduits and conduits in ceiling space shall be run parallel to building lines and supported as high as possible.

C. Where conduits turn out of or penetrate a slab, they shall be not less than 2-1/2 inches on center. Maximum size raceway concealed in concrete slabs shall be 3/4 inch trade size in suspended slabs of 2-1/2 inch thickness, and 1 inch trade size in suspended slabs of 4 inch thickness, all at center of slab. Conduits shall be installed so that only 2 cross at a given point and sufficiently within slab to prevent slab cracking. Route conduit on hangers below ceiling in locations specifically approved by the ARCHITECT-ENGINEER.

D. Field bends shall be made with tools designed for conduit bending. Heating of metal conduit to facilitate bending is not permitted. Changes in direction of runs shall be made with symmetrical bends or cast-metal fittings. Crushed or deformed raceways shall not be installed.

E. Conduit shall be secured in place and protected where necessary to prevent damage to the work during construction. Ends of conduit runs shall be plugged with cork, oakum, or other approved devices to avoid entrance of plaster, concrete or other debris.

F. Where conduit installed in concrete or masonry extends across building expansion joints, expansion fittings as manufactured by OZ, Crouse-Hinds, or Appleton, with approved ground straps and clamps, shall be provided.

G. Location and sizing of conduit sleeves for conduits passing through floors and walls, that are not shown on the drawings, shall be the responsibility of the Contractor.

H. Field cuts on conduit shall be made with a hand or power saw or approved conduit machine, and shall be made square. All male threads shall be cleaned and painted with cold galvanizing paint before fittings are applied.

I. Conduit parallel to, or crossing, uninsulated hot water pipes shall be separated 12 inches if parallel or 7 inches if crossing. Where hot water pipe lines are insulated, parallel or crossing conduit shall clear the insulated surface by 2 inches. Conduit shall not be run directly under cold water lines and shall be separated in other directions by at least 3 inches.

J. Conduit shall not be secured directly to other piping. Support conduit with separate supports directly from building structure.

K. Conduit bushings shall be of the nylon insulating type. Empty conduits shall terminate with smooth insulating bushings or be capped with blanks and bushings.

L. Conduit seals and firestops shall be provided where required by codes and where passing from an air conditioned space to nonconditioned space. Where conduits terminate in a pull-box or outlet box at a point separating the air conditioned space from the nonconditioned space, conduit end may be stuffed with fiberglass. If the conduit run is to be continuous, install conduit outlet or junction box and seal as above.

M. Raceway shall be supported at intervals of not more than 8 feet, with pipe straps, wall brackets, strap hangers, ceiling trapeze, toggle bolts through concrete or tile blocks, expansion bolts in concrete or brick and machine screws or welded studs on steel work. Wooden plugs in concrete and masonry are not acceptable. Raceways and pipe straps shall not be welded to steel structure members.

N. Conduit installation shall follow layout shown on drawings. Layout is, however, diagrammatic only and where changes are necessary due to structural conditions, interference with other apparatus or other causes, such changes shall be made without additional cost to the Owner. Offsets in conduits are not indicated but shall be installed as required by the conditions.

O. Pull lines shall be installed in empty raceways.

P. Verify exact stub up location and termination requirement for all power and control circuits for all items and equipment being served.

Q. Four, 3/4-inch spare conduits shall be installed from the top of each flush mounted lighting, power, telephone, and electronic systems panel or cabinet and shall be stubbed into suspended ceiling space.

R. Separate raceway systems shall be provided for conductors or systems in accordance with the following, except as otherwise indicated on the drawings:

1. Each lighting panelboard distribution system.
2. Each receptacle panelboard distribution system.
3. Each item of building equipment.
4. Each special system, including battery lighting, emergency and exit wiring, control, data, signal and communication.
5. Fire alarm system.

S. Conduits shall be concealed in all locations except:

1. Electrical and mechanical equipment spaces.
2. Where specifically noted as having conduits located on wall surfaces or exposed to view overhead.

T. Provide expansion fittings in long runs as necessary for contraction and expansion movement, and at each building expansion joint, whether conduits are within or below slabs.

U. In vibration isolated type construction of floors, walls or ceilings approved appropriate isolating fittings shall be installed. Where conduits extend between two independent structures, a 4-way neoprene type expansion fitting shall be used.

V. There shall be no more than three, 90-degree bends or 100 feet between wiring pulling points. For electronic cables of coaxial type and other special construction, pullboxes shall be installed after each two, 90-degree bends or equivalent summation of bending degrees. Conduit system layout shall be approved at the site by the installer of the cables to be contained, whether or not these cables are installed under this contract. The intent is to

require raceway layouts and fittings which will permit insertion of these special cables without degradation of the electrical properties required of these cables. Where conduits are installed rendering proper cable installation impossible, conduits shall be replaced with new conduits at no additional cost to the Owner.

W. Conduits shall not be installed to result in less than 7 feet, 6-inch headroom without specific approval of the ARCHITECT-ENGINEER.

X. All exposed conduit runs and conduit runs above ceiling shall be run as high as possible with offsets and bends to clear obstructions.

Y. Marking tape over conduit runs below slab or paved area shall be 2 inches below slab or pavement. In all other areas, tape shall be minimum 12 inches below finished grade.

Z. Where conduits and outlet boxes are indicated in reinforced columns or beams, coordinate conduit runs and box locations with placement of reinforcing steel.

END OF SECTION 260533

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SECTION 260534 – ELECTRICAL BOXES AND FITTINGS

PART 1 - GENERAL

0.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this section.

B. Refer to Division 26, Section 260510 – Basic Electrical Requirements for general requirements.

0.2 SUMMARY

A. Section includes furnishing and installing outlet boxes, floor boxes, pull boxes and junction boxes, including fittings and accessories, required for all raceway systems.

0.3 QUALITY ASSURANCE

A. Qualifications:
1. Materials shall be manufactured by firms regularly engaged in the manufacture of electrical units for not less than five years, of types and sizes required.

PART 1 - PRODUCTS

1.1 MANUFACTURERS

A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following, or an approved equal:
1. Steel City.
2. Raco.
3. Russell and Stoll.
4. Square D.
5. Raceway Components, Inc.
6. Carlon.
7. Appleton.
8. Crouse-Hinds.
9. Spring City.
10. Pilla.
11. Red Dot.

1.2 MANUFACTURED UNITS

A. Concealed Outlet Boxes:
1. Except where cast type boxes are specified or required, provide standard galvanized steel outlet boxes at each concealed outlet for lights, switches, wall receptacles, and similar devices. Boxes and covers shall be not less than code gauge thickness steel. Box shape and dimensions shall be selected for the specific use and location.
2. Ceiling outlet boxes shall be not less than 4 inches octagonal by 2 inches deep.
3. Switch and receptacle outlet boxes shall be not less than 4 inches square by 1-1/2 inches deep with standard device covers. Boxes in exposed masonry shall be square corner type. Thru-wall boxes shall not be installed in any location except as specifically permitted.

B. Device Covers:
1. Provide suitable device covers as required for concealed wiring boxes.
2. Provide 1-inch deep device cover for flush outlet boxes to be installed in areas where concrete will be exposed after construction is complete.
3. Provide device covers of sufficient depth for boxes without square corners to be installed wholly within cavity of masonry.

C. Exposed Outlet Boxes:
1. Exposed outlet boxes in damp locations and boxes located outdoors shall be cast or malleable iron or cast aluminum and shall have threaded hubs. Exposed outlet boxes used with aluminum conduit shall be of aluminum alloy containing less than 1 percent copper.

D. Individually Mounted Floor Boxes:
1. Provide steel, concrete tight adjustable leveling type floor boxes for floor outlets, with vertical adjusting rings, leveling screws, and gaskets.
2. Boxes shall be provided with carpet flanges where needed and all accessories required for the specific application.
3. Floor boxes shall be Steel City 664 or approved equal by Raceway component.

E. Combination Floor Boxes:
1. Provide recessed floor box with space for both high tension and low tension wiring. Height of box to be fully adjustable both prior to and after pouring of concrete. Hinged access cover shall be designed to accept floor covering and to be operable without exposing any metal parts.
2. Floor box shall be 14-gauge, cold-rolled steel galvanized with corner supports and leveling screws. Box shall have duplex receptacle as specified in Section 262726 - WIRING DEVICES.
3. Box shall have cast aluminum cover and leveling ring. Floor box shall be Walker, Inc., RFB4-RAKMII, or approved equal.

F. Weatherproof and Watertight Outlet Boxes:
1. For exterior locations and areas subject to moisture or water provide corrosion-resistant, cast metal, waterproof boxes as applicable. Boxes shall be of types, shapes and sizes required, shall be gasketed and have threaded hubs for conduit. Box accessory materials shall match the box for the specific application.

G. Junction and Pull Boxes:
1. Provide galvanized sheet steel junction and pull boxes, with screw secured covers unless otherwise noted of the type shape and size, to suit each respective location and installation, with welded seams and equipped with nuts, bolts, screws and washers approved for the specific application. Hinged cover boxes similar to Hoffman Bulletin A-90 shall be provided where indicated on the drawings.
2. Material thickness of boxes shall be:
   a. Up to 12-inch by 12-inch size: No. 14 gauge.
   b. Over 12-inch by 12-inch size: No. 12 gauge.
3. Covers shall be the same thickness as the box material and shall be reinforced where required by size.

H. Box Accessories:
1. Provide outlet box accessories as required for each installation, including mounting brackets, hangers, extension rings, fixture studs, cable clamps and metal straps for supporting outlet boxes compatible with outlet boxes being used and meeting requirements of individual wiring conditions.

PART 2 - EXECUTION

2.1 INSTALLATION

A. Boxes:
1. Install boxes for concealed wiring in an accessible location with suitable device cover as required.
2. Where boxes are installed in concrete which will be exposed after construction is complete, set box and device cover in position before concrete is poured so that concrete will surround and a cover plate can be installed flush upon the unfinished surface.
3. Where boxes are installed in block or tile, provide square cornered boxes or boxes fitted with device covers wholly within the cavity of the block or tile. Neatly saw out an opening for the device cover so that no mortar is required to fill between ring and construction. Verify with counter top heights and equipment dimensions.
4. In no instance, except as specifically approved by the D.P. in cases of special application, shall outlet boxes be installed back to back, nor shall outlets on each side of a wall be provided by use of two device covers and a "thru-wall" box. Each outlet shall have its separate, closed-back box. Outlet box depth shall be to permit installation of block or tile face on rear, including plaster finish conditions. Boxes shall be staggered horizontally, with offset conduit stubs between as required.
5. Provide knockout closures to cap unused knockout holes where blanks have been removed.
6. Locate boxes so as to ensure accessibility of electrical wiring.
7. Secure boxes rigidly to the substrate upon which they are being mounted, or solidly embed boxes in concrete or masonry.
8. Light fixtures, receptacles, equipment connections and other conduit termination shall be provided with outlet boxes.
9. Recessed mounted boxes shall not extend beyond the finished face of the wall nor be recessed into the wall more than 1/4 inch.

B. Special Techniques:
1. In suspended ceilings where outlet boxes support fixtures in instances in which the ceiling-suspension system does not have sufficient strength to prevent visible deflection of the ceiling surfaces, the boxes shall be supported directly by structural members, secured to building structure.
2. Boxes and supports shall be fastened to wood with wood screws or screw type nails of equal holding strength; to concrete or brick with bolts and expansion shields; to hollow masonry units with toggle bolts; and to steel work with machine screws or welded studs. Powder charge-type fasteners may be used in lieu of the above, except where otherwise specifically prohibited.
3. In open overhead spaces, cast metal boxes threaded to raceways need not be separately supported except where used for fixture support. Support cast metal boxes having threadless connectors and sheet metal boxes directly from the building structure or with bar hangers.
4. Where conduit supported outlet boxes are installed and conduit suspended from the structure with hangers, the hangers shall be attached to raceways on opposite sides of the box and shall be supported with an approved type fastener not more than 24 inches measured each side from the box. In addition, the box shall be adequately supported to the structure.
5. Fastenings shall not penetrate more than 1-1/2 inches into reinforced concrete beams or more than 3/4 inch into reinforced-concrete joists and shall not contact main reinforcing steel.

C. Location:

1. The approximate outlet locations are shown on the drawings. The exact locations shall be determined at the building site. The right is reserved by the Owner to change, without additional cost to the Owner, the exact location of any switch, ceiling or other outlet in any space before it is permanently installed. Unless otherwise indicated or directed, place or center outlet boxes at the following distances above finished floor. Mounting height shall comply with ADA.

Switch outlets	4 ft. maximum
Wall receptacles	1 ft. 4 in.
Wall mounted telephone outlets	4 ft. 6 in.
Interior and exterior brackets	As indicated or directed
Water cooler receptacles	Approximately 2 ft. and concealed within the water cooler
Emergency alarm pull stations	4 ft. maximum
Emergency alarm horns or	80 in. above finished floor to the bottom of the unit
Emergency shut trip stations	5 ft.

END OF SECTION 260534

SECTION 260535 - CONDUIT, RIGID STEEL

PART 1 - GENERAL

0.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this section.

B. Refer to Section 260510 – Basic Electrical Requirements for general requirements.

C. Refer to Section 260533 - Raceways for conduit general requirements.

PART 1 - PRODUCTS

PART 2 - PRODUCTS

1.1 STEEL CONDUIT

A. Shall be manufactured in accordance with ANSI C80.1, Specifications for Rigid Steel Conduit, Zinc Coated.

1.2 FITTINGS

A. Shall be threaded, galvanized or Sherardized for steel conduit and shall be manufactured in accordance with ANSI C80.4, Specifications for Fittings for Rigid Metal Conduit and Electrical Metallic Tubing.

PART 2 - EXECUTION

2.1 INSTALLATION

A. Install as specified and in compliance with manufacturer's instructions.

B. At couplings, conduit ends shall be threaded to meet in coupling. Split couplings and right and left couplings shall not be used.

C. Rigid steel conduit, couplings, elbows and fittings shall not be installed below grade unless asphaltum or PVC coated. Bare conduit installed below grade shall be thoroughly coated with two coats of asphaltum. All wrench marks on asphaltum-coated conduits shall be touched-up with asphaltum. Wrench marks, scuffs or cuts on PVC coated conduit shall be covered with Robroy Plasti-bond, or approved equal, coating material.

D. Rigid elbows installed below grade for direct buried PVC work, shall be asphaltum or PVC coated.

E. Except where conduits are contained within a specific structural column for service to outlets contained therein, conduits shall not pass through or below column footings.

F. Rigid steel conduit shall be used for all exterior applications.

2.2 SUPPORTS

A. Support conduit in compliance with Table 346-12 of the National Electrical Code. Where conduit racks are used, do not bundle or lay conduit on top of each other. A minimum of 1/8 inch spacing shall be maintained between parallel runs.

END OF SECTION 260535

SECTION 260536 CONDUIT, ELECTRIC METALLIC TUBING

PART 1 - GENERAL

0.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this section.

B. Refer to Section 260510 – Basic Electrical Requirements for general requirements.

C. Refer to Section 260533 - Raceways for conduit general requirements.

PART 1 - PRODUCTS

1.1 ELECTRIC METALLIC TUBING (EMT)

A. Shall be manufactured in accordance with ANSI Standard C80.3, Specifications for Electrical Metallic Tubing, Zinc Coated.

1.2 FITTINGS

A. Shall be in accordance with ANSI Standard C80.4, Specifications and fittings for Rigid Metal Conduit and Electrical Metallic Tubing. Fittings shall be compression type, screw type coupling will not be accepted. EMT fittings shall be malleable iron or steel, rain and concrete-tight as appropriate. Pot metal or die cast type and "sock-on" type fittings shall not be used.

B. Connectors shall have nylon insulated throats.

PART 2 - EXECUTION

2.1 INSTALLATION

A. EMT shall be installed in accordance with the manufacturer's instructions.

B. EMT shall not be installed in concrete slabs, light standard bases, below grade, or in locations where rigid steel conduit is specified or required.

C. Use EMT only for interior applications.

2.2 SUPPORTS

A. Support conduit in compliance with Paragraph 348-12 of the NEC. Where conduit racks are used, do not bundle or lay conduit on top of each other. A minimum of 1/8-inch spacing shall be maintained between parallel runs.

END OF SECTION 260536

SECTION 260537 – CABLE TRAYS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Furnish and install cable tray system where indicated. The cable tray system shall include, but not be limited to, the cable tray, dividers, risers, turns, cable drop-offs, hanger supports and related accessories for a complete system.

B. The Scope of Work includes providing cable tray system to accommodate ceiling system, HVAC ducts, mechanical piping and other building elements in the areas.

1.2 SUBMITTALS

A. Shop Drawings: Provide a description and coordinated shop drawing of the cable tray system.

PART 2 - PRODUCTS

2.1 CABLE TRAYS

A. Cable trays shall be in accordance with NEMA VEI-1971, ASCE Specifications, AWS Standards. As defined by NEMA, the tray shall be a mono-type of aluminum and shall have an equivalent load capacity equal or greater than 50 pounds per linear foot of 12-inch tray supported on 12-foot center. The load capacity shall vary in proportion to the tray width. Vertical deflection due to static cable loads shall not exceed the span length divided by 200 or a maximum fiber stress of ten psi with a safety factor of two. If the same configuration of side channel extrusion is used by the manufacturer regardless of tray width, the deflection limit shall be inversely proportional to the width of the tray.

B. Trays shall be furnished in lengths as required by the configuration of the building and to suit cable distribution.

C. Dimensions shown on the drawings are the minimum inside width and depth of tray acceptable. All appurtenances, straight sections, fittings, splice plates, blind ends, hold down units as necessary to furnish a complete installation shall be included. Rungs, dropouts, and other metal surfaces in contact with the cable shall have smooth, round edges. The rungs shall be joined to the sides by a homogeneous weld, and the weld shall be suitable to develop the equivalent mechanical and electrical strength in the tension both axial and radial, as well as conductivity per unit length.

1. Cable tray shall have transverse members spaced on 9 inch center-to-center intervals.
2. Central rail height shall be 4 inches with load depth of 3 inches minimum.

D. Provide partitions in the cable tray as indicated on drawings.

E. Accessories shall be suitable for use with the aluminum cable tray system. All support structures and hardware shall be suitable for the aluminum cable tray.

F. Cable tray supports shall be provided at intervals not to exceed the manufacturer's recommendations for maximum span for the design load, except that in no event shall supports exceed 10 foot intervals. Tray installations shall include all clamps, fittings, and required channel supports.

G. Acceptable cable tray manufacturers are Mono-Cable Tray, Husky-Bundy and B-Line Systems.

PART 3 - EXECUTION

3.1 INSTALLATION

A. The approximate location of trays are shown on the drawings. Tray locations shall be coordinated with the physical location on the project.

B. Provide hanger supports using threaded rods and channel supports for cable tray installed in the ceiling space. Cable tray installed vertically on walls shall be supported at minimum of three points using channel supports.

C. Provide openings through walls as required for cable tray installation. Openings through fire-rated walls shall be sealed using firestopping system No. CBJ4014 listed in UL fire resistance directory 1993 with expanded metal lath baskets. The firestopping system shall be manufactured by 3M Corporation and International Protective Coating Corporation.

3.2 GROUNDING

A. Cable tray shall be grounded to the building grounding system using a bare #6 copper ground conductor. In addition, a bare #6 copper grounding conductor shall be routed in the cable tray and clamped to the cable tray at a maximum of twenty-foot intervals.

3.3 COORDINATION

A. Coordinate installation with HVAC ductwork, piping, light fixtures and building structural framing. Submit layout drawings for approval.

END OF SECTION 260537

SECTION 260538 - CONDUIT, PVC

PART 1 - GENERAL

0.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this section.

B. Refer to Section 260510 – Basic Electrical Requirements for general requirements.

C. Refer to Section 260533 - Raceways for conduit general requirements.

0.2 SUMMARY

A. Work includes furnishing and installing PVC conduit, supports, fittings and accessories as shown on the drawings and specified.

B. Place and join pipe, fittings and appurtenances as shown on the drawings and specified herein.

C. Provide Carlon multigard conduit as shown on the drawings.

PART 1 - PRODUCTS

1.1 CONDUIT

A. Shall be made of polyvinyl chloride, Schedule 40 pipe, conforming to ASTM D1784.

1.2 FITTINGS

A. Shall be Schedule 40, socket type, solvent weld, complying with ASTM D2466. Joints shall be watertight.

B. Threaded type fittings may be used provided joints are made watertight. Fittings shall be Schedule 80, complying with ASTM D2464.

C. Transition from PVC to galvanized rigid conduit shall be by threaded fitting.

1.3 SOLVENT

A. PVC solvent cement shall be in compliance with ASTM D2564.

1.4 BENDS

A. Bends on conduit runs exceeding 50 feet shall be noncorrosive metallic. Bends on short runs shall be factory or field fabricated using manufacturer approved, heat applied methods.

PART 2 - EXECUTION

2.1 INSTALLATION

A. Install where shown on drawings and in compliance with manufacturer's instructions. Bends shall be smooth and uniform.

B. PVC conduit may be used in below-grade applications. All bends, elbows and risers shall be rigid galvanized and shall be asphaltum or PVC coated below grade.

2.2 JOINTING

A. Pipe and fittings shall be solvent welded or threaded and made watertight.

2.3 SUPPORTS

A. Support conduit in compliance with Table 347-8 of the National Electrical Code. Where conduit racks are used, do not bundle or lay conduit on top of each other. A minimum of 1/8 inch spacing shall be maintained between parallel runs.

END OF SECTION 260538

SECTION 260540 – CONDUIT, FLEXIBLE METALLIC

PART 1 - GENERAL

0.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this section.

B. Refer to Section 260510 – Basic Electrical Requirements for general requirements.

C. Refer to Section 260533 - Raceways for conduit general requirements.

PART 1 - PRODUCTS

1.1 FLEXIBLE METALLIC CONDUIT

A. Shall be in compliance with UL-1 Standard for Flexible Steel Conduit.

B. Connectors for flexible metallic conduit shall be steel or malleable iron.

1.2 LIQUID-TIGHT FLEXIBLE METALLIC CONDUIT

A. Jacketed, liquid-tight metallic conduit shall have galvanized steel core and continuous, liquid-tight PVC cover. Conduit shall be UA or EF series as manufactured by Anaconda Co., or approved equal.

B. Connectors shall be T&B liquid-tight, with nylon insulated throat, steel, malleable iron or approved equal.

PART 2 - EXECUTION

2.1 INSTALLATION

A. Flexible metallic conduit shall be used for connection from junction box, conduit or motor controllers to equipment and motors, panelboards to transformers, subject to continuous vibration or where the location of the connection is such that it is impractical to make a rigid conduit connection and from junction boxes to recessed lighting fixtures.

B. Liquid tight flexible metallic conduit shall be used for exterior locations, food preparation areas, motors internal in air handling equipment and other locations subject to dampness.

C. Length of flexible metallic conduit between equipment and conduit termination shall not exceed 24 inches or be less than 12 inches for sizes 1/2 inch to 2 inches. For 2-1/2 inches and larger, maximum length shall be 4 feet and minimum length shall be 18 inches. Specific instances and construction constraints which will require variance from the above, shall be approved by Architect-Engineer prior to placement of conduits.

END OF SECTION 260540

SECTION 260543 – UNDERGROUND RACEWAYS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 - General Requirements, apply to this section.

1.2 SUMMARY

A. Scope: The work specified in this section includes providing labor, material, equipment, and services necessary for duct banks as shown on the drawings and as herein specified.

B. Section Includes: The work specified in this section includes, but shall not be limited to, providing the following:

1. Duct banks for electrical services.
2. Duct banks for communication/signal cables.

C. Related Work Specified Elsewhere: Refer to other Division 26 sections pertaining to duct bank and manhole components which are not work of this section. Sections include, but shall not be limited to, the following:

1. Section 260533 - Raceways.

D. Related Sections: The following sections contain requirements that relate to this Section:

1. Section 312000 – Earth Moving

1.3 REFERENCES

A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

B. The edition/revision of the referenced publications shall be the latest date as of the date of the Contract Documents, unless otherwise specified.

1. National Fire Protection Association:
2. NFPA 70 National Electrical Code.

1.4 SUBMITTALS

A. Product Data: Submit manufacturer's product data showing material proposed. Product data shall include, but shall not be limited to, the following:

1. Conduits.
2. Ducts.
3. Spacers.

B. Shop Drawings: Submit complete shop drawings as required to determine acceptability. Shop drawings shall include, but shall not be limited to, the following:

1. Duct Bank Sections – Dimensioned.

1.5 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms shall be engaged in the manufacture of duct banks products of types and sizes required, and whose products have been in satisfactory use in similar service for not less than five years.

B. Contractor's Qualifications: Firms shall have at least five years of successful installation experience with projects utilizing duct banks similar to that required for this Project.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle carefully to avoid damage to materials, components, and products.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturer: Subject to compliance with requirements, provide products of one of the following:

1. Carlon.
2. Robroy Industries Inc.
2. Triangle PWC Inc.

2.2 GENERAL

A. Provide nonmetallic duct or metallic conduit in direct buried duct with compacted soil backfill as shown on the drawings.

2.3 CONDUIT

A. Provide (PVC) constructed of a polyvinyl chloride Schedule 40 compound UL rated for 90°C, unless otherwise noted.

2.4 PULLING BELLS

A. Provide pulling bells fabricated from malleable iron for duct when entering manholes.

2.5 DIRECT BURIED DUCT BANKS

A. Construct underground ducts of individual conduits direct buried as shown on the drawings.

2.6 RIGID CONDUIT

A. Turns or elbows in the duct bank shall be made with rigid metallic conduit.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions under which the work is to be installed, and notify the Owner in writing of any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected.

3.2 COORDINATION

A. Coordinate with other work including sewers, water lines, foundation and structural work, as necessary to interface the installation of duct banks with other work.

B. Coordinate electrical equipment installation work with duct bank work, as necessary for proper interface.

C. Coordinate the location of duct banks with the final termination location of electrical equipment. Duct banks, and conduit shall be located such that cables can be installed and connected to electrical equipment enclosure or panel within the manufacturer's recommended areas.

3.3 DUCT BANK INSTALLATION

A. Excavation: Do not excavate below required depth except as necessary for removal of unstable soil or rock. When rock is encountered, excavate 6 inches below the required depth and refill with granular material per Division 31 specifications. Replace all unstable soil in accordance with Division 31 specifications.

B. Backfilling: When backfilling around duct line use only approved material free from rock, boulders, sharp materials, and other unsuitable materials. Backfill in accordance with Division 31 specifications.

C. Duct Elevations: Depths are below finish grade and elevations shown are to the tops of duct lines and manholes unless otherwise indicated.

D. Duct Bends: Slope duct lines away from building and toward manholes. Except at conduit risers, accomplish changes in direction of runs exceeding 10 degrees, either vertical or horizontal, by long sweep bends having a minimum radius of curvature of 25 feet. Manufactured bends shall have a minimum radius of 18 inches for use with conduits of less than 3 inches in diameter and a minimum radius of 36 inches for ducts of less than 5 inches in diameter.

E. Spacing: Support ducts in tiers and from bottom of trench with spacers at intervals of not greater than five feet. Stagger duct joints and support each section of duct with not less than two spacers. Provide a minimum 7-7/8 inch separation between duct centerlines, for primary ducts and 7-1/2 inches for secondary conduits. When duct has been laid and all spacers are in place, tie assembly with two turns of galvanized wire. Secure duct/spacer assembly to hold down stakes not more than 10 feet apart.

F. Direct Burial: The duck bank with backfill surrounding the conduits shall be rectangular or square in cross-section. Provide at least 3 inches of backfill around ducts. Power and communication conduits shall be separated by a minimum distance of 24 inches or as shown on the drawings.

1. Settlement: Where ductlines are routed through foundation walls, or are less than 12 inch clear below footings or grade beams, provide a minimum 1 inch thick Styrofoam separator between the ductline and the adjacent work to allow for differential settlement.
2. Rigid Steel Transition: Make transition to rigid steel conduit, installed per Section 16120, 5 feet prior to entering the building, pull box, pit, or stubbing up above grade. No steel conduit is required in ductlines, passing through sleeves in foundation walls, where the ductline envelope is separated from the sleeve by sand or other compressible material. Conduit shall rigid steel when entering under the building.
3. Securing Conduits: Conduits shall be rigidly supported so that they do not move during backfill.

G. Capping: Cap conduit ends to prevent moisture entrance until cable is installed. After cable is installed, fill exposed stubs and risers with pliable, non-hardening compound to seal out moisture.

H. Utility Coordination: Where ducts enter Utility manholes or equipment pads, conform to the Utility's requirements. In manholes constructed for use by the Utilities, provide special fittings, supports, etc. as required.

I. Warning Tape: Provide a 6 inch plastic warning tape in the backfill approximately 12 inches below grade. Use a red plastic tape with integral warning legend repeated continuously throughout the entire length of the tape.

J. Cleaning: As each conduit run in completed, a testing mandrel not less 12 inches long, with a diameter 1/4 inch less than the inside diameter of the conduit, shall be drawn through. Following this, a brush with stiff bristles shall be drawn through, until the conduit is clear of particles of earth, sand, or gravel.

K. Swabbed and Mandrel: Use a mandrel for aligning the ducts and swab the duct prior to installing wires or cables.

L. Pulling Ropes: Install pulling ropes in all conduits.

END OF SECTION 260543.

SECTION 260548.16 - SEISMIC CONTROLS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Restraint channel bracings.
2. Restraint cables.
3. Seismic-restraint accessories.
4. Mechanical anchor bolts.
5. Adhesive anchor bolts.

B. Related Requirements:

C. Product Data: For each type of product.

1. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of seismic-restraint component used.

a. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by an evaluation service member of ICC-ES.
b. Annotate to indicate application of each product submitted and compliance with requirements.

1.3 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Show coordination of seismic bracing for electrical components with other systems and equipment in the vicinity, including other supports and seismic restraints.

1.4 QUALITY ASSURANCE

A. Comply with seismic-restraint requirements in the 2012 IBC & 2012 VCC unless requirements in this Section are more stringent.

B. Seismic-restraint devices shall have horizontal and vertical load testing and analysis. They shall bear anchorage showing maximum seismic-restraint ratings, by ICC-ES or another agency acceptable to authorities having jurisdiction. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are not available, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) that support seismic-restraint designs must be signed and sealed by a qualified professional engineer.

C. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 RESTRAINT CHANNEL BRACINGS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. B-line, an Eaton business.
2. Mason Industries, Inc.
3. Unistrut; Part of Atkore International.

B. Description: MFMA-4, shop- or field-fabricated bracing assembly made of slotted steel channels with accessories for attachment to braced component at one end and to building structure at the other end, with other matching components, and with corrosion-resistant coating; rated in tension, compression, and torsion forces.

2.2 RESTRAINT CABLES

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Kinetics Noise Control, Inc.
2. Loos & Co., Inc.
3. Vibration Mountings & Controls, Inc.

B. Restraint Cables: ASTM A 492 **stainless**-steel cables. End connections made of steel assemblies with thimbles, brackets, swivel, and bolts designed for restraining cable service; with a minimum of two clamping bolts for cable engagement.

2.3 SEISMIC-RESTRAINT ACCESSORIES

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. B-line, an Eaton business.
2. Kinetics Noise Control, Inc.
3. Mason Industries, Inc.

B. Bushings for Floor-Mounted Equipment Anchor Bolts: Neoprene bushings designed for rigid equipment mountings and matched to type and size of anchor bolts and studs.

C. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings and matched to type and size of attachment devices used.

D. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.

2.4 MECHANICAL ANCHOR BOLTS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. B-line, an Eaton business.
2. Hilti, Inc.
3. Kinetics Noise Control, Inc.

B. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

2.5 ADHESIVE ANCHOR BOLTS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:

1. Hilti, Inc.
2. Kinetics Noise Control, Inc.

B. Adhesive Anchor Bolts: Drilled-in and capsule anchor system containing PVC or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and equipment to receive vibration isolation and seismic-control devices for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for reinforcement and cast-in-place anchors to verify actual locations before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

A. Multiple Raceways or Cables: Secure raceways and cables to trapeze member with clamps approved for application by an evaluation service member of ICC-ES Indicate on Drawings, by details, schedules, or a combination of both, the locations where hanger rods for individual raceways, bus duct, cable trays, and hanger rods for trapeze hangers require hanger-rod stiffeners..

B. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static and seismic loads within specified loading limits.

3.3 SEISMIC-RESTRAINT DEVICE INSTALLATION

A. Equipment and Hanger Restraints:

1. Install resilient, bolt-isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch (3.2 mm).
2. Install seismic-restraint devices using methods approved by an evaluation service member of ICC-ES] providing required submittals for component.

B. Install cables so they do not bend across edges of adjacent equipment or building structure.

C. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.

D. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.

E. Drilled-in Anchors:

1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
5. Set anchors to manufacturer's recommended torque using a torque wrench.
6. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

3.4 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

A. Install flexible connections in runs of raceways, cables, wireways, cable trays, and busways where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where connection is terminated to equipment that is anchored to a different structural element from the one supporting them as they approach equipment.

3.5 ADJUSTING

A. Adjust restraints to permit free movement of equipment within normal mode of operation.

END OF SECTION 260548.16

SECTION 260553 – IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
1. Identification for raceways.
2. Identification of power and control cables.
3. Identification for conductors.
4. Underground-line warning tape.
5. Warning labels and signs.
6. Instruction signs.
7. Equipment identification labels.
8. Miscellaneous identification products.

1.3 ACTION SUBMITTALS

A. Product Data: For each electrical identification product indicated.

B. Samples: For each type of label and sign to illustrate size, colors, lettering style, mounting provisions, and graphic features of identification products.

C. Identification Schedule: An index of nomenclature of electrical equipment and system components used in identification signs and labels.

1.4 QUALITY ASSURANCE

A. Comply with ANSI A13.1 and IEEE C2.

B. Comply with NFPA 70.

C. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.

D. Comply with ANSI Z535.4 for safety signs and labels.

E. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

1.5 COORDINATION

A. Coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual; and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.

B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

C. Coordinate installation of identifying devices with location of access panels and doors.

D. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 POWER AND CONTROL RACEWAY IDENTIFICATION MATERIALS

A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway size.

B. Colors for Raceways Carrying Circuits at 600 V or Less:
   1. Black letters on an orange field.
   2. Legend: Indicate voltage and system or service type.

C. Colors for Raceways Carrying Circuits at More Than 600 V:
   1. Black letters on an orange field.
   2. Legend: "DANGER CONCEALED HIGH VOLTAGE WIRING."

D. Vinyl Labels for Raceways Carrying Circuits at 600 V or Less: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing ends of legend label.

E. Snap-Around Labels for Raceways Carrying Circuits at 600 V or Less: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeve, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.

F. Snap-Around, Color-Coding Bands for Raceways Carrying Circuits at 600 V or Less: Slit, pretensioned, flexible, solid-colored acrylic sleeve, 2 inches (50 mm) long, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.

G. Tape and Stencil for Raceways Carrying Circuits More Than 600 V: 4-inch- (100-mm-) wide black stripes on 10-inch (250-mm) centers diagonally over orange background that extends full length of raceway or duct and is 12 inches (300 mm) wide. Stop stripes at legends.

H. Metal Tags: Brass or aluminum, 2 by 2 by 0.05 inch (50 by 50 by 1.3 mm), with stamped legend, punched for use with self-locking cable tie fastener.

I. Write-On Tags: Polyester tag, 0.010 inch (0.25 mm) thick, with corrosion-resistant grommet and cable tie for attachment to conductor or cable.
   1. Marker for Tags: Permanent, waterproof, black ink marker recommended by tag manufacturer.
   2. Marker for Tags: Machine-printed, permanent, waterproof, black ink marker recommended by printer manufacturer.

2.2 ARMORED AND METAL-CLAD CABLE IDENTIFICATION MATERIALS

A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each cable size.

B. Colors for Cables Carrying Circuits at 600 V and Less:
   1. Black letters on an orange field.
   2. Legend: Indicate voltage and system or service type.

C. Colors for Cables Carrying Circuits at More Than 600 V:
   1. Black letters on an orange field.
   2. Legend: "DANGER HIGH VOLTAGE WIRING."

D. Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing ends of legend label.

E. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; 2 inches (50 mm) wide; compounded for outdoor use.

F. Heat-Shrink Preprinted Tubes: Flame-retardant polyolefin tube with machine-printed identification label. Sized to suit diameter of and shrinks to fit firmly around cable it identifies. Full shrink recovery at a maximum of 200 deg F (93 deg C). Comply with UL 224.

2.3 POWER AND CONTROL CABLE IDENTIFICATION MATERIALS

A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each cable size.

B. Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing ends of legend label.

C. Self-Adhesive, Self-Laminating Polyester Labels: Preprinted or Write-on, 3-mil- (0.08-mm-) thick flexible label with acrylic pressure-sensitive adhesive that provides a clear, weather- and chemical-resistant, self-laminating, protective shield over the legend. Labels sized to fit the cable diameter such that the clear shield overlaps the entire printed legend.

D. Heat-Shrink Preprinted Tubes: Flame-retardant polyolefin tube with machine-printed identification label. Sized to suit diameter of and shrinks to fit firmly around cable it identifies. Full shrink recovery at a maximum of 200 deg F (93 deg C). Comply with UL 224.

E. Metal Tags: Brass or aluminum, 2 by 2 by 0.05 inch (50 by 50 by 1.3 mm), with stamped legend, punched for use with self-locking cable tie fastener.

F. Write-On Tags: Polyester tag, 0.010 inch (0.25 mm) thick, with corrosion-resistant grommet and cable tie for attachment to conductor or cable.
   1. Marker for Tags: Permanent, waterproof, black ink marker recommended by tag manufacturer.
   2. Marker for Tags: Machine-printed, permanent, waterproof, black ink marker recommended by printer manufacturer.

G. Snap-Around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeve, with diameter sized to suit diameter of cable it identifies and to stay in place by gripping action.

H. Snap-Around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeve, 2 inches (50 mm) long, with diameter sized to suit diameter of cable it identifies and to stay in place by gripping action.

2.4 CONDUCTOR IDENTIFICATION MATERIALS

A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils (0.08 mm) thick by 1 to 2 inches (25 to 50 mm) wide.

B. Self-Adhesive, Self-Laminating Polyester Labels: Preprinted or Write-on, 3-mil- (0.08-mm-) thick flexible label with acrylic pressure-sensitive adhesive that provides a clear, weather- and chemical-resistant, self-laminating, protective shield over the legend. Labels sized to fit the conductor diameter such that the clear shield overlaps the entire printed legend.

C. Snap-Around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeve, with diameter sized to suit diameter of conductor it identifies and to stay in place by gripping action.

D. Snap-Around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeve with diameter sized to suit diameter of conductor it identifies and to stay in place by gripping action.

E. Heat-Shrink Preprinted Tubes: Flame-retardant polyolefin tube with machine-printed identification label. Sized to suit diameter of and shrinks to fit firmly around conductor it identifies. Full shrink recovery at a maximum of 200 deg F (93 deg C). Comply with UL 224.

F. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.

G. Write-On Tags: Polyester tag, 0.010 inch (0.25 mm) thick, with corrosion-resistant grommet and cable tie for attachment to conductor or cable.
   1. Marker for Tags: Permanent, waterproof, black ink marker recommended by tag manufacturer.
   2. Labels for Tags: Self-adhesive label, machine-printed with permanent, waterproof, black ink recommended by printer manufacturer, sized for attachment to tag.

2.5 FLOOR MARKING TAPE

A. 2-inch- (50-mm-) wide, 5-mil (0.125-mm) pressure-sensitive vinyl tape, with yellow and black stripes and clear vinyl overlay.

2.6 WARNING LABELS AND SIGNS

A. Comply with NFPA 70 and 29 CFR 1910.145.

B. Self-Adhesive Warning Labels: Factory-printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment unless otherwise indicated.

C. Baked-Enamel Warning Signs:
   1. Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for application.
   2. 1/4-inch (6.4-mm) grommets in corners for mounting.
   3. Nominal size, 7 by 10 inches (180 by 250 mm).

D. Metal-Backed, Butyrate Warning Signs:
   1. Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs with 0.0396-inch (1-mm) galvanized-steel backing; and with colors, legend, and size required for application.
   2. 1/4-inch (6.4-mm) grommets in corners for mounting.
   3. Nominal size, 10 by 14 inches (250 by 360 mm).

E. Warning label and sign shall include, but are not limited to, the following legends:
   1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."

2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 42 INCHES (915 MM)."
3. Arc-Flash Warning: NFPA 70E 2012 requires that one of two specific pieces of information appear on arc flash labels: available incident energy or the required level of PPE. These values are determined by an arc flash hazard analysis, and need to be calculated separately for each piece of equipment labeled. Additional information such as approach boundaries, voltage, and working distance shall be included on arc flash labels. See specification section 260574 “Overcurrent Protection Device Arc-Flash Study”.

2.7 INSTRUCTION SIGNS

A. Engraved, laminated acrylic or melamine plastic, minimum 1/16 inch (1.6 mm) thick for signs up to 20 sq. inches (129 sq. cm) and 1/8 inch (3.2 mm) thick for larger sizes.
1. Engraved legend with black letters on white face.
2. Punched or drilled for mechanical fasteners.
3. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

B. Adhesive Film Label: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch (10 mm).

C. Adhesive Film Label with Clear Protective Overlay: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch (10 mm). Overlay shall provide a weatherproof and UV-resistant seal for label.

2.8 EQUIPMENT IDENTIFICATION LABELS

A. Adhesive Film Label: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch (10 mm).

B. Adhesive Film Label with Clear Protective Overlay: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch (10 mm). Overlay shall provide a weatherproof and UV-resistant seal for label.

C. Self-Adhesive, Engraved, Laminated Acrylic or Melamine Label: Adhesive backed, with white letters on a dark-gray background. Minimum letter height shall be 3/8 inch (10 mm).

D. Engraved, Laminated Acrylic or Melamine Label: Punched or drilled for screw mounting. White letters on a dark-gray background. Minimum letter height shall be 3/8 inch (10 mm).

E. Stenciled Legend: In nonfading, waterproof, black ink or paint. Minimum letter height shall be 1 inch (25 mm).

2.9 CABLE TIES

A. General-Purpose Cable Ties: Fungus inert, self extinguishing, one piece, self locking, Type 6/6 nylon.
1. Minimum Width: 3/16 inch (5 mm).
2. Tensile Strength at 73 deg F (23 deg C), According to ASTM D 638: 12,000 psi (82.7 MPa).
3. Temperature Range: Minus 40 to plus 185 deg F (Minus 40 to plus 85 deg C).
4. Color: Black except where used for color-coding.

B. UV-Stabilized Cable Ties: Fungus inert, designed for continuous exposure to exterior sunlight, self extinguishing, one piece, self locking, Type 6/6 nylon.
   1. Minimum Width: 3/16 inch (5 mm).
   2. Tensile Strength at 73 deg F (23 deg C), According to ASTM D 638: 12,000 psi (82.7 MPa).
   3. Temperature Range: Minus 40 to plus 185 deg F (Minus 40 to plus 85 deg C).
   4. Color: Black.

C. Plenum-Rated Cable Ties: Self extinguishing, UV stabilized, one piece, self locking.
   1. Minimum Width: 3/16 inch (5 mm).
   2. Tensile Strength at 73 deg F ((23 deg C)), According to ASTM D 638: 7000 psi (48.2 MPa).
   3. UL 94 Flame Rating: 94V-0.
   4. Temperature Range: Minus 50 to plus 284 deg F (Minus 46 to plus 140 deg C).
   5. Color: Black.

2.10 CONDUIT/JUNCTION BOX COLOR CODE

A. All conduit system junction boxes (except those subject to view in public areas) shall be color coded as listed below. Submit shop drawings indicating samples for approval:

Color Code for Junction Boxes	Krylon Paint #
System Emergency 277/480 volt	Cherry Red k2101
System Emergency 120/208 volt	Zinger Pink s1150
Fire Alarm	Popsicle Orange k2410
Normal Power 277/480 volt	Leather Brown k2501
Normal Power 120/208 volt	Glossy Black k1601
Fiber Optics	Plum Purple k1929
Sound/PA System	Daisy Yellow k1813
Computer Data/Voice	Gold k1701
TV	Glossy White k1501
BAS	Antique White k1503
FIDS/BIDS	Beige k2504
Security/CCTV	John Deer Green k1817
Grounding	Fluorescent Green k3106
Fire Pump Status	Popsicle Orange k2410
Emergency Generator Status	Zinger Pink s1150

B. Conduits (not subject to public view) longer than 20 feet shall be painted with above color paint band 20 ft. on center. Paint band shall be 4" in length. Where conduits are parallel and on conduit racking, the paint bands shall be evenly aligned. Paint shall be neatly applied and uniformed. Paint boxes and raceways prior to installation or tape conduits and surrounding surfaces to avoid overspray. Paint overspray shall be removed.

C. Junction boxes and conduit located in public areas (i.e. areas that can be seen by the public) shall be painted to match surface attached to. Provide written request to OAR for interpretation of those public areas which may be in question.

D. Conduit/Junction Box color codes is for bidding only, final color code to be determined by BCAD.

MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Paint: Comply with requirements in painting Sections for paint materials and application requirements. Select paint system applicable for surface material and location (exterior or interior).

B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Verify identity of each item before installing identification products.

B. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.

C. Apply identification devices to surfaces that require finish after completing finish work.

D. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.

E. Attach signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.

F. Attach plastic raceway and cable labels that are not self-adhesive type with clear vinyl tape with adhesive appropriate to the location and substrate.

G. System Identification Color-Coding Bands for Raceways and Cables: Each color-coding band shall completely encircle cable or conduit. Place adjacent bands of two-color markings in contact, side by side. Locate bands at changes in direction, at penetrations of walls and floors, at 50-foot (15-m) maximum intervals in straight runs, and at 25-foot (7.6-m) maximum intervals in congested areas.

H. Aluminum Wraparound Marker Labels and Metal Tags: Secure tight to surface of conductor or cable at a location with high visibility and accessibility.

I. Cable Ties: For attaching tags. Use general-purpose type, except as listed below:
   1. Outdoors: UV-stabilized nylon.
   2. In Spaces Handling Environmental Air: Plenum rated.

J. Underground-Line Warning Tape: During backfilling of trenches install continuous underground-line warning tape directly above line at 6 to 8 inches (150 to 200 mm) below finished grade. Use multiple tapes where width of multiple lines installed in a common trench or concrete envelope exceeds 16 inches (400 mm) overall.

K. Painted Identification: Comply with requirements in painting Sections for surface preparation and paint application.

3.2 IDENTIFICATION SCHEDULE

A. Concealed Raceways, Duct Banks, More Than 600 V, within Buildings: Tape and stencil 4-inch-(100-mm-) wide black stripes on 10-inch (250-mm) centers over orange background that extends full length of raceway or duct and is 12 inches (300 mm) wide. Stencil legend

"DANGER CONCEALED HIGH VOLTAGE WIRING" with 3-inch- (75-mm-) high black letters on 20-inch (500-mm) centers. Stop stripes at legends. Apply to the following finished surfaces:

1. Floor surface directly above conduits running beneath and within 12 inches (300 mm) of a floor that is in contact with earth or is framed above unexcavated space.
2. Wall surfaces directly external to raceways concealed within wall.
3. Accessible surfaces of concrete envelope around raceways in vertical shafts, exposed in the building, or concealed above suspended ceilings.

B. Accessible Raceways, Armored and Metal-Clad Cables, More Than 600 V: Self-adhesive vinyl labels. Install labels at 10-foot (3-m) maximum intervals.

C. Accessible Raceways and Metal-Clad Cables, 600 V or Less, for Service, Feeder, and Branch Circuits More Than 30 A, and 120 V to ground: Identify with self-adhesive vinyl tape applied in bands. Install labels at 10-foot (3-m) maximum intervals.

D. Accessible Raceways and Cables within Buildings: Identify the covers of each junction and pull box of the following systems with self-adhesive vinyl labels with the wiring system legend and system voltage. System legends shall be as follows:

1. Emergency Power.
2. Power.
3. UPS.

E. Power-Circuit Conductor Identification, 600 V or less: For conductors in vaults, pull and junction boxes, manholes, and handholes, use color-coding conductor tape to identify the phase.

1. Color-Coding for Phase and Voltage Level Identification, 600 V or Less: Use colors listed below for ungrounded feeder and branch-circuit conductors.
   a. Color shall be factory applied or field applied for sizes larger than No. 8 AWG, if authorities having jurisdiction permit.
   b. Colors for 208/120-V Circuits:
      1) Phase A: Black.
      2) Phase B: Red.
      3) Phase C: Blue.
   c. Colors for 480/277-V Circuits:
      1) Phase A: Brown.
      2) Phase B: Orange.
      3) Phase C: Yellow.
   d. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches (150 mm) from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.

F. Power-Circuit Conductor Identification, more than 600 V: For conductors in vaults, pull and junction boxes, manholes, and handholes, use nonmetallic plastic tag holder with adhesive-backed phase tags, and a separate tag with the circuit designation.

G. Install instructional sign including the color-code for grounded and ungrounded conductors using adhesive-film-type labels.

H. Control-Circuit Conductor Identification: For conductors and cables in pull and junction boxes, manholes, and handholes, use self-adhesive, self-laminating polyester labels with the conductor or cable designation, origin, and destination.

I. Control-Circuit Conductor Termination Identification: For identification at terminations provide heat-shrink preprinted tubes with the conductor designation.

J. Conductors to Be Extended in the Future: Attach write-on tags and marker tape to conductors and list source.

K. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.
   1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
   2. Use system of marker tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections.
   3. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual.

L. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication, and control wiring and optical fiber cable.
   1. Limit use of underground-line warning tape to direct-buried cables.
   2. Install underground-line warning tape for both direct-buried cables and cables in raceway.

M. Workspace Indication: Install floor marking tape to show working clearances in the direction of access to live parts. Workspace shall be as required by NFPA 70 and 29 CFR 1926.403 unless otherwise indicated. Do not install at flush-mounted panelboards and similar equipment in finished spaces.

N. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Baked-enamel warning signs.
   1. Comply with 29 CFR 1910.145.
   2. Identify system voltage with black letters on an orange background.
   3. Apply to exterior of door, cover, or other access.
   4. For equipment with multiple power or control sources, apply to door or cover of equipment including, but not limited to, the following:
      a. Power transfer switches.
      b. Controls with external control power connections.

O. Operating Instruction Signs: Install instruction signs to facilitate proper operation and maintenance of electrical systems and items to which they connect. Install instruction signs with approved legend where instructions are needed for system or equipment operation.

P. Emergency Operating Instruction Signs: Install instruction signs with white legend on a red background with minimum 3/8-inch- (10-mm-) high letters for emergency instructions at equipment used for power transfer and load shedding.

Q. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and the Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.
   1. Labeling Instructions:
      a. Indoor Equipment: Self-adhesive, engraved, laminated acrylic or melamine label. Unless otherwise indicated, provide a single line of text with 1/2-inch- (13-mm-) high letters on 1-1/2-inch- (38-mm-) high label; where two lines of text are required, use labels 2 inches (50 mm) high.
      b. Outdoor Equipment: Engraved, laminated acrylic or melamine label 4 inches (100 mm) high.
      c. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.

d. Unless provided with self-adhesive means of attachment, fasten labels with appropriate mechanical fasteners that do not change the NEMA or NRTL rating of the enclosure.

2. Equipment to Be Labeled:
   a. Panelboards: Typewritten directory of circuits in the location provided by panelboard manufacturer. Panelboard identification shall be self-adhesive, engraved, laminated acrylic or melamine label.
   b. Enclosures and electrical cabinets.
   c. Access doors and panels for concealed electrical items.
   d. Switchgear.
   e. Switchboards.
   f. Transformers: Label that includes tag designation shown on Drawings for the transformer, feeder, and panelboards or equipment supplied by the secondary.
   g. Substations.
   h. Emergency system boxes and enclosures.
   i. Motor-control centers.
   j. Enclosed switches.
   k. Enclosed circuit breakers.
   l. Enclosed controllers.
   m. Variable-speed controllers.
   n. Push-button stations.
   o. Power transfer equipment.
   p. Contactors.
   q. Remote-controlled switches, dimmer modules, and control devices.
   r. Battery-inverter units.
   s. Battery racks.
   t. Power-generating units.
   u. Monitoring and control equipment.
   v. UPS equipment.

END OF SECTION 260553

SECTION 260598– OPERATION AND MAINTENANCE MANUALS

PART 1 - GENERAL

1.1 SUMMARY

A. Provide Instruction and Maintenance Manuals for each item of electrical equipment and product specified in Division 26 and shown on drawings, complete as specified herein.

B. Submit three (3) copies of Instruction and Maintenance Manuals unless otherwise indicated or specified.

PART 2 - PRODUCTS

2.1 INSTRUCTION AND MAINTENANCE MANUALS

A. Hardback three ring loose-leaf binder with reinforced holes in sheets and drawings neatly folded and not extending beyond the edge of the binder.

B. Title sheet with job name, and the names, addresses and phone numbers of the Contractor, all Subcontractors and suppliers.

C. Index of contents.

D. A signed copy of acknowledgement of instruction to the Owner or the Owner's authorized representative for all electrical and control systems provided.

E. Typewritten operating instructions for the Owner's personnel describing how to operate and maintain each piece of equipment. Where manufacturer's product is used, it shall be edited to exclude items not pertinent to this project.

F. Approved shop drawings, submittal data and parts and maintenance booklet for each item of material and equipment furnished under Division 16. Final drawings shall include all dimensions.

G. Record drawings of electrical and control diagrams.

H. Copies of final inspection certificates.

I. Guarantees and warranties including extended guarantees and warranties.

J. Binders shall not be more than 3/4 full.

PART 3 - EXECUTION

3.1 AVAILABILITY

A. Approved manuals shall be turned over to Owner's representative at the final inspection.

B. A draft copy of type-written instructions shall be available during any required Owner-instruction period.

END OF SECTION 260598

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SECTION 260922 LIGHTING CONTROL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this section.

B. Refer to Division 26, Section 260510 – Basic Electrical Requirements for general requirements.

0.2 SUMMARY

A. The work includes furnishing and installing a low-voltage lighting control system including programmable lighting panels (where used), associated low-voltage occupancy, indoor daylight, and outdoor photocell sensors and associated equipment and software for control of lighting circuits as indicated on the drawings.

0.3 SUBMITTALS

A. Product Data: Submit manufacturer's data and catalog sheets of all components proposed for use.

B. Wiring Diagrams: Submit typical wiring diagrams for all components.

C. Operation and Instruction Manuals: Provide operation and instruction manuals per Division 26, Section 260598 – OPERATION AND MAINTENANCE MANUALS requirements.

0.4 QUALITY ASSURANCE

A. Manufacturers: Firms regularly engaged in manufacture of lighting control equipment and ancillary equipment, of types and capacities required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Component Pretesting: All components and assemblies are to be factory pretested and burned-in prior to installation.

C. System Installation and Checkout: Factory-trained technicians shall be available for pre-installation overview with contractor and to functionally test each component in a programmable system after installation to verify proper operation and confirm that the panel wiring and addressing conform to the wiring documentation.

D. NEC Compliance: Comply to NEC as applicable to electrical wiring work.

E. NEMA Compliances: Comply with applicable portions of NEMA standards pertaining to types of electrical equipment and enclosures.

F. UL Approvals: Remote panels are to be UL listed under UL 916 Energy Management Equipment.

G. FCC Emissions: All assemblies are to be in compliance with FCC emissions standards specified in Part 15, Subpart J for Class A application.

0.5 DELIVERY AND STORAGE

A. Deliver all materials in manufacturer's packing in undamaged condition.

B. Store all materials in dry place and protect them from damage and the elements until installed.

PART 1 - PRODUCTS

1.1 MANUFACTURERS

A. Approved Manufacturers:
1. Hubbell Corporation
2. Lighting Control & Design
3. PLC Multipoint, Inc
4. Schneider Electric / Square D Company (PowerLink) – basis of design or approved equal

1.2 GENERAL

A. The lighting control system shall consist of programming equipment and computer preassembled relay panels, low-voltage controlled relays, masters switches, programmable controller cards, relay-driven cards and associated low-voltage panel wiring.

B. Manufacturer support services to be provided shall include Contractor documentation, programming, startup, training and 2-year extended warranty.

1.3 HARDWARE

A. Provide programming equipment and related hardware and software to allow programmable switching of the lighting circuits as shown on the drawings and specifications.

B. Provide an outdoor photocell to control outdoor lighting.

C. The lighting control panel shall include the following:
1. Enclosure sized to accept an interior sized for up to 42 circuits.
2. Status indication for each circuit
3. Manual override to by-pass automated control
4. Low voltage power supply.
5. Microprocessor based control networkable with Ethernet / RS232/485
5. Integral Astronomical clock and 16 wired inputs
7. Programmable blink OFF warning
8. BAS interface
9. Hinged, lockable cover with wiring directory

1.4 SOFTWARE

A. All initial programming and editing to be accomplished using laptop computer furnished by system installer.
B. Basic operating software to include multilevel password access

1.5 SUPPORT SERVICES

A. Pre-Installation Overview: Manufacturer shall provide a factory trained technician to provide the installer with a system overview and installation guidance prior to start of wiring.

B. System Startup: Manufacturer shall provide a trained technician to confirm proper installation and operation of all system components.

C. Training: Manufacturer shall provide factory-trained application engineer to train Owner personnel in the operation and programming of the lighting control system.

D. Documentation: Provide system documentation including:
1. System 1-line showing all panels, number and type of switches and sensors, data line, programmable system switches, telephone override modules and central PC.
2. Drawings for each panel showing hardware configuration and numbering.
3. Panel wiring schedules.
4. Typical wiring diagrams for each component.

E. Programming: Manufacturer shall provide system programming including:
1. Wiring documentation.
2. Programmable panel and system switch operation.

F. Extended Warranty: Manufacturer shall provide a 2-year extended warranty of all system components.
1. For the first year after installation all parts, labor and programming services shall be provided at no charge by the electrical Contractor.
2. Extended 2-year warranty period shall begin at the end of the first year of operation.
3. During the extended 2-year warranty period, all parts, labor and programming services shall be provided by the factory-trained service Contractor who initially installed the system, at no charge to the Owner.

PART 2 - EXECUTION

2.1 HARDWARE

A. Mount lighting automation panels as shown on the drawings.

B. Install the power supply, programmable system module and the telephone override module in the electric room. Provide wire and conduit between power supply, system switch module, telephone module and relay panels per manufacturer's requirements.

2.2 WIRING

A. Provide TSP/UTP cable in conduit as required by the manufacturer for sensor, remote switch, and panel interconnection

B. Provide 120 VAC receptacle for power supply and telephone override module operating power.

2.3 STARTUP

A. Provide checkout of all system hardware by a factory-trained technician.
1. Check that all lighting relay panels are properly installed and loads recorded on schedule cards.
2. Confirm operation of all relays.
3. Check panel address settings and confirm communications at each panel.
4. Check for proper wiring and data transmission by programmable system switch and phone override module.

5. Repair or replace any defective components.
6. Provide certification indicating the check out of the system by factory trained technicians.

B. Provide training for Owner's personnel by a factory applications engineer.

END OF SECTION 260922

SECTION 262200 – LOW VOLTAGE TRANSFORMERS

PART 1 - GENERAL

0.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this section.

B. Refer to Division 26, Section 260510 – Basic Electrical Requirements for general requirements.

0.2 SUMMARY

A. The work specified in this section includes providing labor, material, equipment, and services necessary for transformers as shown on the drawings.

B. This section includes providing the following:
1. Dry–type Distribution Transformers
2. K-rated, dry-type transformers, where indicated.

0.3 REFERENCES

A. American National Standards Institute (ANSI)
1. ANSI C57.96 Guide for Loading Dry-Type Distribution and Power Transformers

B. Institute of Electrical and Electronics Engineers, Inc. (IEEE)
1. ANSI/IEEE C57.12.01 General Requirements for Dry-Type Distribution and Power Transformers

C. National Electrical Manufacturers Association (NEMA)
1. NEMA ST20 Dry-Type Transformers for General Applications
2. NEMA TP-1 Guide for Determining Energey Effeiciency for Distribution Transformers
3. NEMA TP-2 Energy Efficiency Test Method for Distribution Transformer Energy Efficiency

D. National Fire Protection Association (NFPA)
1. NFPA 70 National Electric Code (NEC)

E. Underwriters Laboratories, Inc, (UL)
1. UL 486A Wire connectors and Soldering Lugs for Use with Copper Conductors
2. UL 506 Specialty Transformers
3. UL1561 Dry-Type General Purpose and Power Transformers

1.4 SUBMITTALS

A. Shop drawings shall be submitted consisting of certified outline drawings and wiring diagrams. Include the following data:
1. Rated kVA
2. Frequency
3. Primary and Secondary Voltages
4. Percent Taps
5. Polarity
6. Impedance
7. Percent Regulation (no-load, 25, 50, 100, 125, 175, & 200%)
8. Efficiency
9. No-load and full-load losses

10. Average temperature rise at 100% & 133% full-load
11. Sound level in decibels
12. Insulation temperature rating
13. "K" factor
14. Isolation transformer attenuation

0.5 QUALITY ASSURANCE

A. Manufacturer shall have manufactured transformers of the type and sizes required and shall have products in satisfactory use in similar service for not less than five years.

B. Products comply with the applicable requirements of references in article 1.3.

PART 1 - PRODUCTS

1.1 MANUFACTURER

A. The quality of transformers shall be approved equal to the products of the following manufacturers:
   1. Acme Transformer
   2. Eaton / Cutler-Hammer,
   3. Siemens Energy and Automation,
   4. Schneider Electric / Square D Company,
   5. General Electric Co.

1.2 PRODUCTS

A. General: Dry type transformers shall be 2 winding type conforming to the applicable requirements of NEMA Standard ST20, Transformers - Dry Type and also to applicable ANSI, UL and IEEE Standards. "T" connected windings will not be acceptable for 3-phase transformers.
   1. Transformers rated up to 15 kVA, 3-phase and 25 kVA single phase shall be UL listed for either indoor or outdoor use and shall be of totally enclosed design with encapsulated coils to protect core and coils against adverse atmospheric conditions.
   2. Transformers rated 37.5 kVA to 167 kVA single phase or 30 kVA to 500 kVA 3 phase shall be suitable for indoor use only but shall be resistant to thermal shock and high humidity.

B. Electrical Rating: Number of phases, frequency, self-cooled load rating, high and low voltage and phase connection are indicated on the drawings. A permanent nameplate shall be furnished with each transformer, giving complete data of transformer, including percent impedance, based on self-cooled rating and show tap settings.
   1. A minimum of 4, full-rated taps shall be provided in high voltage winding, two, 2-1/2 percent below and two, 2-1/2 percent above nominal voltage.

C. Temperature Classification: The transformer shall utilize an insulation system that has been properly temperature classified and approved by UL. Unless otherwise indicated, the insulation rating shall be as follows:

kVA Rating	Preferred Insulation System Temperature Classification	Winding Temperature Rise
5 kVA to 25 kVA	180 degrees C	115 degrees C

30 kVA to 500 kVA 220 degrees C 150 degrees C

Winding temperature rise limits applicable to the system temperature classification shall be in accordance with Specification UL 506.

D. Load Rating:
1. Transformers shall be capable of operating at 100 percent of nameplate rating continuously while in an ambient temperature not exceeding 40 degrees C.
2. Transformers shall be capable of long service life under the thermal conditions specified. There shall be no need for derating.

E. Sound Rating: The transformer shall have sound levels equal to or lower than those shown below:

Transformer Rating kVA	Maximum Sound Level Decibels in Accordance with ANSI C89
0-9	40
10-50	45
51-150	50
151-300	55
301-500	60

F. Other Requirements: The following requirements shall be in accordance with Specification UL 506:
1. Enclosures:
   a. Ventilation openings.
   b. Corrosion resistance.
   c. Cable bending space.
   d. Grounding provision.
   e. Surface temperatures.
   f. Wiring compartment temperature rise.
   g. Terminations.

G. Transformers indicated as K rated type transformers shall, in addition to the listed specifications, have the neutral capable of handing 200 percent of rated secondary phase current. In addition, an electrostatic shield shall be furnished between the primary and secondary windings to attenuate line source interference and undesirable frequencies. Transformer shall meet K13 standard for systems with 100 percent connected nonlinear electronic loads.

H. Transformers hung from ceiling or wall mounted shall be provided with protective screen over bottom to prevent the entry of foreign objects.

PART 2 - EXECUTION

2.1 INSTALLATION

A. Provide approved mounting for transformers as shown on the drawings.

B. Floor-Mounted Transformers:
1. Provide 3-inch concrete mounting pad with beveled edges, 2 inches larger than transformer on each side.

2. Verify position with engineer. for access, service, and location. Transformers shall not be less than 6 inches from nearest wall or ceiling.
3. Transformer installation shall not restrict access to terminal compartments or the flow or air through the transformer vents.

C. Transformer installations shall contain the following:
1. Flexible metallic conduit connection of adequate length to permit flexing by hand. Maximum length shall not exceed 36 inches without approval from engineer.
2. Neoprene covered flexible conduit where required for water-resistant installations.
3. Proper vibration isolating pads approved equal to Korfund, arranged to prevent 60- and 120-Hz transmission to structure and piping.

D. The neutral point on all single phase and 3-phase transformers shall be grounded by a continuous grounding conductor sized in compliance with NEC, Table 250-94. Bond ground conductor to transformer case.

E. Suspended transformers shall be supported with welded channel attached to structural steel of building. When point of support to structural member is not defined on drawings, obtain location of support from engineer.

F. Wall-Mounted Transformers (where indicated):
1. 30 kVA each maximum, and designed for wall support.
2. Larger than 30 kVA shall be supported as detailed on drawings.

END OF SECTION 262200

SECTION 262414 - SWITCHBOARDS

PART 1 GENERAL

The requirements of the Contract Division 1 apply to work in this Section.

1.01 SECTION INCLUDES

A. Individually mounted rear-accessible low voltage switchboards and circuit breakers utilized in the switchboards.

B. Summary of work; the summary of work includes reconfiguration of existing 1985 GE AV4 switchboard to accommodate the new feeders and circuit breakers. The scope of the work includes the following major elements:

1. Removal and replacement of existing sections as shown on the drawings and specified herein.

2. Performance of manufacturer (GE) recommended preventive maintenance to the entire existing switchboard MNB. The maintenance shall include infra-red scanning, visual inspection of the bus and connections, testing and adjusting of existing overcurrent devices to meet the manufacturer's standards, repair or replacement of any insulators and components torqueing of the bus connection to meet the factory specifications, cleaning and other items recommended by NETA standards and GE maintenance manuals.

3. Transient voltage suppression devices. 2.04

   The switchboard shall contain internal surge protection, which is rated to be compliant with UL 1449 3RD edition, and similar to GE TPHE277Y (for type 1 locations). Standard features include, surge rated disconnect (fused), surge event counter, audible alarm with test/silence, EMI filter, remote alarm contacts. MOV's shall be dual wafer (48 mm) rated at 200 kA, 8/20 us (matching type). The TVSS shall supersede specification section 264313, and be 3rd party tested (per NEMA LS-1 test standards).

4. Disconnecting And Overcurrent Protective Devices. 2.05

5. Circuit Breaker Trips For Molded Case Breakers 2.06

6. Metering 2.07

7. Control Power. 2.08

8. Mimic Bus. 2.09

1.02 REFERENCES

The low voltage switchboards shall be designed and manufactured according to latest revision of the following standards (unless otherwise noted).

A. UL 891, Dead-Front Switchboards

B. ANSI/NEMA PB 2, Deadfront Distribution Switchboards

C. ANSI/NFPA 70, National Electrical Code

D. NEMA AB 1, Molded Case Circuit Breakers and Molded Case Switches

E. UL 489, Molded-Case Circuit Breakers and Circuit-Breaker Enclosures

1.03 DEFINITIONS

A. Molded Case Circuit Breakers: Molded case circuit breakers built and listed to UL489 requirements.

1.04 RELATED DOCUMENTS

A. Specification 264313, Surge Protection

B. Specification 260553, Identification for Electrical Systems

C. Specification 260598 Operation and Maintenance Manuals

D. Specification 260572 Overcurrent Protective Device Short-Circuit Study

E. Specification 260573, Overcurrent Protective Device Coordination Study

F. Specification 260574 Overcurrent Protection Device Arc-Flash Study

1.05 SUBMITTALS FOR REVIEW

Manufacturer shall provide copies of following documents to owner for review and evaluation in accordance with general requirements of Division 26:

A. Front view and floor plan of switchboard

B. Switchboard anchoring locations

C. Conduit and busway entry / exit locations

D. Location of shipping splits

E. One-line diagram of switchboard bus and protective devices

F. Switchboard ratings including:

1. Short circuit rating

2. System voltage rating

3. Continuous current rating

G. Protective device schedule including:

1. Device type

2. Sensor and trip rating

3. Location within the switchboard

4. Cable quantity and size capabilities for each device

H. Panel drawing showing all major protection, instrumentation, and control devices mounted within the switchboard

I. Schematic (elementary) diagram showing power, metering, and control circuits for the switchboard and circuit breakers

J. Bill of Material listing (including quantity, location, catalog number, and ratings) of all major protection, instrumentation and control devices

K. Switchboard nameplate schedule

1.06 PROJECT RECORD DOCUMENTS

A. Maintain an up-to-date set of Contract documents. Note any and all revisions and deviations that are made during the course of the project.

B. Record drawings and information shall be furnished providing the following information:

1. All of the information listed in the “SUBMITTALS FOR REVIEW “ section.

2. Wiring diagrams for each switchboard section showing component location and tabulated wire listing for each component

3. Installation information for the switchboard

4. Certified test reports for switchboard production tests.

5. Submit ( ) copies of the above information for record

1.07 OPERATION AND MAINTENANCE DATA

A. Manufacturer shall provide (3) copies of installation, operation and maintenance procedures to owner.

1.08 QUALITY ASSURANCE (QUALIFICATIONS)

A. Manufacturer shall have specialized in the manufacture and assembly of low voltage switchboards for 25 years.

B. Switchboard manufacturer shall also be the manufacturer of the circuit breakers used in the switchboard.

1.09 REGULATORY REQUIREMENTS

A. Low voltage switchboards shall be listed and/or classified by Underwriters Laboratories in accordance with standards listed in Article 1.03 of this specification and shall bear UL labels in accordance with those standards.

B. Switchboard shall be qualified for use in seismic areas as follows:

1. High seismic loading as defined in IEEE Std. 693-1997, with 2.5 amplification factor.

2. IBC-2012, Std. = 2.0g, Ss = 300%, Ip = 1.5, for all z/h in accordance with ICC-ES-AC156.

3. Seismic compliance shall be qualified only through shake table testing. Compliance by calculation is not acceptable.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect, and handle products in accordance with recommended practices listed in manufacturer's Installation and Maintenance Manuals. Lift only by installed lifting eyes.

B. Deliver low voltage switchboard in shipping sections for ease of handling. Each section shall be mounted on shipping skids. Switchboard shall have adequate lifting means, and be able to be rolled or moved into installation position and bolted directly to floor without use of floor sills.

C. Contractor shall inspect and report concealed damage to carrier within specified time.

D. Store in a clean, dry space. Maintain factory protection or cover with heavy canvas or plastic to keep out dirt, water, construction debris, and protect from nearby traffic.

1.11 PROJECT CONDITIONS (SITE ENVIRONMENTAL CONDITIONS)

A. Low voltage switchboards shall be located in well-ventilated areas, free from excess humidity, dust and dirt and away from hazardous materials. Ambient temperature of area will be between minus 30 and plus 40 degrees C. Indoor locations shall be protected to prevent moisture from entering enclosure.

1.12 WARRANTY

A. Manufacturer warrants equipment to be free from defects in materials and workmanship for 1 year from date of startup or 18 months from date of shipment, whichever occurs first.

PART 2 PRODUCTS

2.01 MANUFACTURER

A. GE AV-3/ rear Access Switchboards and related products have been used as basis for design.

2.02 RATINGS

A. Switchboard assemblies shall be UL 891 listed, marked and rated to withstand the mechanical forces exerted during short circuit conditions. Switchboards shall be rated 100kA rms symmetrical at rated voltage.

B. Switchboard short circuit bracing shall be listed and marked per UL 891 for 100KAIC.

2.03 MANUFACTURED ASSEMBLIES

A. Structure construction

1. Switchboards shall be rated for NEMA 1. Switchboard shall be completely self-supporting, forming a single metal enclosed structure. Sides, top, and rear covers shall be code gauge steel bolted to the switchboard structure. Frame structure members shall be die-formed, 11 gauge steel, minimum, bolted together and reinforced at corners. Sides, front and rear covers shall be minimum, 13-gauge, steel.

2. Switchboard frames shall be provided with adequate lifting means and be capable of being rolled or moved into position, and bolted directly to the floor without the use of floor sills.

B. Breaker compartment construction, mounting and cable access

1. The switchboard shall be furnished with individually mounted feeder circuit breakers. Access to the circuit breaker load terminations shall be from the rear of the switchboard. The switchboard cable and bus compartment shall be isolated from the front-accessible protective device compartments by rigid glass-reinforced polyester barriers. Feeder breakers shall have insulated load bus extensions to the rear cable compartment. It shall be possible to make up the outgoing feeder cable terminations without reaching into or over the switchboard horizontal or vertical busses.

2. Rear covers shall be bolted.

3. The sides of each breaker and instrument compartment shall be isolated from adjacent compartments by a combination of steel and glass-reinforced polyester barriers. The top and bottom of each compartment shall be isolated with glass-reinforced polyester barriers. Switchboard sections shall have open bottoms.

C. Bus Bars

1. All bus bars shall be 98% conductivity copper, tin –plated, at all bolted vertical-to-horizontal bus connections and at points where the vertical bus connects to bus bars supplying power to circuit breaker compartments.

2. Bus bar cross section shall have a current density not exceeding 1000 amps per square inch. Main bus bars shall be braced to withstand the mechanical forces exerted during short circuit

3. Provide 50%-rated no neutral as shown on the switchboard 1-line drawing.

4. The continuous current rating of the bus shall be equivalent to the frame size of the main device or main incoming lug section. The main bus shall be arranged for future extension without modification and shall not be tapered. All feeder device line and load connections shall be rated to carry the full continuous current rating of the feeder device frame. Load connections shall be insulated and shall extend beyond the main bus into the termination compartment.

5. The main bus and riser bus shall be fully isolated from the circuit breaker, instrument, and auxiliary compartments. The vertical bus shall be mounted on supports of high impact, non-tracking, flame retardant, molded, glass-reinforced polyester. Vertical bus in molded case breaker sections shall be extended to all compartments in the section including blank compartments that may be at the top and / or bottom of the section.

6. A copper ground bus, .75 sq inches minimum, shall be secured to the rear frame of each vertical section and shall extend through the entire length of the switchboard. The ground bus shall be provided with a 4/0 terminal for connection to the electrical system groundA-B-C bus arrangement (left-to-right, top-to-bottom, front-to-rear) shall be used throughout the switchboard to assure convenient and safe testing and maintenance. When special circuitry precludes this arrangement, bus bars shall be labeled.

7. All bus hardware shall be high tensile strength, grade 5, zinc-plated steel. All bolted bus joints shall be provided with split-type lock washers.

D. Incoming Section

1. Transition section to existing GE PowerBreak switchboard.

2.04 TRANSIENT VOLTAGE SUPPRESSION DEVICES

A. The switchboard shall contain internal surge protection, which is rated to be compliant with UL 1449 3RD edition, and similar to GE TPHE277Y (for type 1 locations). Standard features include, surge rated disconnect (fused), surge event counter, audible alarm with test/silence, EMI filter, remote alarm contacts. MOV's shall be dual wafer (48 mm) rated at 200 kA, 8/20 us (matching type). The TVSS shall supersede specification section 264313, and be 3rd party tested (per NEMA LS-1 test standards).

2.05 PROTECTIVE DEVICES

A. Switchboard shall contained circuit breakers as shown on the contract drawings and as described below: All circuit breakers shall be 100% rated.

B. Feeder devices 1200 amps and smaller shall be individually mounted molded case circuit breakers with plug-in construction. All feeder protective devices shall be UL489 Listed.

1. Where indicated provide the following with the feeder device(s):

a. Shunt trip

b. Auxiliary contacts

c. Bell alarm

C. Molded case circuit breakers, where required, shall be manually operated with features and accessories as described in this specification.

1. Furnish GE Spectra Molded Case Circuit Breakers.

2. Circuit breakers shall be individually mounted and connected to the vertical bus by plug-in construction.

3. Circuit breaker frames shall be constructed of a high-strength, molded, glass-reinforced polyester case and cover. Breakers shall have an overcenter, toggle handle-operated, trip free mechanism with quick make, quick break action independent of the speed of the toggle handle operation. The design shall provide common tripping of all poles. Breakers shall be suitable for reverse feeding.

4. Breakers shall have ON and OFF position clearly marked on escutcheon. Breakers shall include a trip-to-test means on the escutcheon for manually tripping the breaker and exercising the mechanism and trip latch.

5. Breakers shall use digital true RMS sensing trip units and a rating plug to determine the breaker trip rating.

6. Breakers shall be UL listed as 100 percent continuous duty rated.

D. As a minimum, the trip unit shall include the following features:

1. Long time and short time protective functions, if provided, shall have true RMS sensing technology and thermal long time memory.

2. Ground fault protective function, if provided, shall contain a memory circuit to integrate low level arcing fault currents with time, to sum the intermittent ground fault spikes.

3. High contrast liquid crystal display (LCD) unit shall display settings, trip targets, and the specified metering displays.

4. Multi-button keypad to provide local setup and readout of all trip settings on the LCD.

5. UL Listed interchangeable rating plug. It shall not be necessary to remove the trip unit to change the rating plug.

6. An integral test jack for testing via a portable test set and connection to a battery source.

7. A mechanism for sealing the rating plug and the trip unit.

8. Noise immunity shall meet the requirements of IEEE C37.90.2.

9. Display trip targets for long time, short time, and ground fault, if included.

10. The trip unit shall keep a log of the last ten events including overcurrent trips, protective relay trips. The log shall store rms currents, phase, type of trip, trip counter, time and date for each event.

11. Instantaneous trip shall utilize filtering which permits fully selective operation with downstream current limiting devices up to the short time rating of the circuit breaker, when the instantaneous pickup is set above the current limiting threshold.

E. The trip unit shall include the following additional metering functions, which shall be displayed on the LCD (if the manufacturers trip unit can not incorporate the specified functions, separate device(s) with equal function shall be provided for each breaker):

1. Voltage, RMS (V), line-to-line or line-to-neutral.

2. Energy (kWh, MWH, GWH), each phase and total, user resettable.

3. Peak Power Demand (KW, MW), user resettable.

4. Real power (KW, MW), each phase and total.

5. Reactive power (KVAR, MVAR), each phase and total.

6. Apparent power (KVA, MVA) , each phase and total

7. Frequency (Hz).

8. Power factor.

2.06 CIRCUIT BREAKER TRIPS FOR MOLDED CASE BREAKERS

A. Furnish GE microEntelliGuard digital electronic trip units or equal that complies with all of the following.

B. The protective trip unit shall consist of a solid state, microprocessor based programmer; tripping means; current sensors; power supply and other devices as required for proper operation.

C. Long time and short time protective functions shall have true RMS sensing technology for harmonic rich currents including up to the 19th harmonic.

D. High contrast liquid crystal display (LCD) unit shall display settings, trip targets, and the specified metering displays.

E. Multi-button keypad to provide local setup and readout of all trip settings on the LCD.

F. UL Listed interchangeable rating plug. It shall not be necessary to remove the trip unit to change the rating plug. Rating plugs shall be available in sizes from 40% to 100% of the breaker sensor rating

G. An integral test jack for testing via a portable test set and connection to a battery source.

H. Noise immunity shall meet the requirements of IEEE C37.90.

I. Display trip targets for long time, short time, and ground fault, if included.

J. Visual illuminated indication of the trip unit (normal, pickup, trip, error).

K. The trip unit shall be provided with a 10 event trip history log. Each trip event shall be recorded with type, phase and magnitude of fault that caused the trip

L. As a minimum, the trip unit shall have the following protective functions:

1. Current setting or long time pickup, adjustable from 50% to 100% of the rating plug value.

2. Adjustable long time delay with typical inverse time characteristics (minimum of 10 bands). In addition, a set of straight line fuse shaped long time delay bands shall be provided to facilitate selectivity with downstream fuses (minimum 7 bands).

3. Instantaneous pickup, adjustable from 2.0 to 10 times the rating plug in 0.5 increments

4. Short time pickup and delay. Short time pickup shall be adjustable from 1.5 to 9 times the long time pickup setting in 0.5 increments with an OFF option. Provide minimum of 12 short time delay bands with three selectable I2t bands.

5. Adjustable ground fault pickup and delay. Ground fault pickup shall be adjustable from 0.4 to 1.0 times the breaker sensor rating in 0.05 increments.

M. Trip shall be provided with serial communications using Modbus RTU protocol. Manufacturer's literature shall provide full register map.

N. The trip unit shall display rms current, each phase, on the LCD.

O. The following monitored values shall also be displayed on the trip unit LCD:

1. Voltage, rms, line - to - line, or line - to - neutral;

2. Energy, KWH, total;

3. Demand KWH, over an adjustable time period of 5 to 60 minutes;

4. Peak demand, KW, user resettable;

5. Real power, KW, line - to - line, line - to - neutral;

6. Total (apparent) power, KVA, line - to - line, line - to - neutral.

7. Reactive Power, KVAR, line - to - line, line - to - neutral.

8. Power Factor (%)

9. Frequency (Hz)]

P. Trip shall be provided with serial communications using Modbus RTU protocol. Manufacturer's literature shall provide full register map.

Q. Trip unit shall provide waveform capture capability for fault events. Capture data shall include 4 cycles before and 4 cycles after the event or can be initiated thru a Modbus command. Data shall be provided in a Comtrade file format for use by power management system.

2.07 METERING

A. Switchboard Quality Meter, Multilin PQM II-T20-C-A with

- MOD 501: 20 – 60 VDC/20 – 48 VAC control power
- MOD 504: Removable terminal blocks
- MOD 525: Harsh Environments Conformal Coating
- Multilink Ethernet Switch
- Viewpoint Monitoring ML1600-HI-A2-A2
- Multinet Multinet-FE
- Viewpoint Monitoring VP-1
- GE Multiline F485 converter Laptop Interface
- GC-NET485-EIP-MB

2.08 WIRING AND CONTROLS

A. Small wiring, necessary fuse blocks and terminal blocks within switchboard shall be furnished as required. All groups of control wires leaving switchboard shall have terminal blocks with suitable numbering strips.

B. On multi-source switchboards with AC control power, control power automatic throw-over equipment shall transfer control bus from one control power source to another when one is de-energized.

C. Control wiring shall be SIS type wire. All wiring shall have [origin] [destination] [origin / destination] labels that identify each end of the wire. Maximum voltage at front panels and instrumentation shall be 240 volts. Instrument transformers shall be used for all metering.

2.09 MIIMIC BUS

A. Extend existing mimic bus to new sections to match existing.

2.10 MANUFACTURER'S TESTING

1. Manufacturer shall perform the following production tests on the assembled switchboard

2. Device check – visual inspection of device catalog number to verify compliance to specification

3. Control lead check – continuity test to ensure correctness of all wiring

4. Instrument transformer ground test – verify that instrument transformer frame is grounded

5. Meter and relay check - induce current on the secondary side of current and voltage transformers to verify device functionality

6. Control power check – apply power to control circuits

7. Bus check – visual check of phase, neutral, and ground buses in accordance with switchboard one-line diagram

8. Clearance check – inspect buses and devices for proper electrical clearances

9. Connection test – check tightness of all bolted connections

10. Nameplate check – verify nameplate engraving and location are per drawings

11. Current and voltage transformer polarity check – visually inspect transformer polarities are in accordance with drawings

12. Secondary high potential test – 1500vAC for 1 minute on control wiring

13. Primary high potential test – 2200vAC for 1 minute on bus system

14. Power management communication test – verify all devices are able to communicate on the switchboard communication bus

2.11 FINISH

A. All steel surfaces shall be chemically cleaned prior to painting

B. All steel surfaces shall be chemically cleaned and given an iron phosphate corrosion resistant treatment providing a strong bond for paint adhesion. All parts shall be immersed in paint applying 0.7 - 0.8 mils of cathodic epoxy paint electrically bonded to all surfaces for maximum adhesion. The finish shall be cured in an oven at to insure maximum toughness and prolong service in severe environments.

C. All exterior surfaces of the switchgear assembly shall be given final finish coats of ANSI 61 light gray air dried acrylic enamel light gray air dried acrylic enamel. Dry film thickness shall be a minimum of 1.5 mils.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that low voltage switchboards are ready to install.

B. Verify field measurements are as [shown on Drawings] [shown in manufacturer's submittals].

C. Verify that required utilities are available, in proper location and ready for use.

D. Beginning of installation means installer accepts conditions.

3.02 LOCATION

A. Switchboards shall have adequate clearance for required rear access and maintenance.

3.03 INSTALLATION

A. Install per manufacturer's instructions.

B. Install required safety labels.

C. The services of the manufacturer’s field testing organization must be used for the start-up and commisioning of this equipment. Start-up servcies shall include all manufacturer’s recommended procedures and field testing of the switchboard, and all circuit breakers, and instrumentation installed in the equipment.

3.04 FIELD QUALITY CONTROL

A. Inspect installed low voltage switchboards for anchoring, alignment, grounding and physical damage.

B. Check tightness of all accessible mechanical and electrical connections with calibrated torque wrench. Minimum acceptable values are should be specified in manufacturer's instructions.

3.05 ADJUSTING

A. Adjust all circuit breakers, switches, access doors, operating handles for free mechanical and electrical operation as described in manufacturer's instructions.

B. Adjust circuit breaker trip and time delay settings to values as specified by Engineer.

3.06 CLEANING

A. Clean interiors of equipment to remove construction debris, dirt, shipping materials.

B. Repaint scratched or marred exterior surfaces to match original finish.

END OF SECTION 262414

SECTION 262416 – PANELBOARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:
   1. Distribution panelboards.
   2. Lighting and appliance branch-circuit panelboards.
   3. Load centers.
   4. Transient voltage suppression panelboards.

1.3 DEFINITIONS

A. EMI: Electromagnetic interference.

B. GFCI: Ground-fault circuit interrupter.

C. RFI: Radio-frequency interference.

D. RMS: Root mean square.

E. SPDT: Single pole, double throw.

1.4 SUBMITTALS

A. Product Data: For each type of panelboard, overcurrent protective device, transient voltage suppression device, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.

B. Shop Drawings: For each panelboard and related equipment.
   1. Dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings. Include the following:
      a. Enclosure types and details for types other than NEMA 250, Type 1.
      b. Bus configuration, current, and voltage ratings.
      c. Short-circuit current rating of panelboards and overcurrent protective devices.
      d. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
   2. Wiring Diagrams: Power, signal, and control wiring.

C. Manufacturer Seismic Qualification Certification: Submit certification that panelboards, overcurrent protective devices, accessories, and components will withstand seismic forces defined in ANSI/IEEE 344 – 1987 and ANSI/IEEE C37.81. Include the following:
   1. Basis of Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

D. Panelboard Schedules: For installation in panelboards. Submit final versions after load balancing.

E. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 1 Section "Operation and Maintenance Data" include the following:
1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
2. Time-current curves, including selectable ranges for each type of overcurrent protective device.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain panelboards, overcurrent protective devices, components, and accessories through one source from a single manufacturer.

B. Product Options: Drawings indicate size, profiles, and dimensional requirements of panelboards and are based on the specific system indicated.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

D. Comply with:
1. NEMA 250 Enclosures for Electrical Equipment
2. NEMA AB 1 Molded Case Circuit Breakers and Molded Case Switches
3. NEMA KS 1 Enclosed Switches
4. NEMA PB 1 Panelboards
5. NFPA 70 National Electric Code
6. UL 50 Cabinets and Boxes
7. UL 67 Panelboards
8. UL 486A Wire Connectors and Soldering Lugs for Use with Copper Conductors
9. UL869 Service Equipment

E. Provide factory trained technician for equipment commissioning and ownber’s personnel traiining.

1.6 WARRANTY

A. Panelboards shall be warrantied for a minimum period of one year after project completion, or longer in the manufacturer’s warranty allows

1.7 COORDINATION

A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, and encumbrances to workspace clearance requirements.

1.8 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Keys: Provide one spare key for every three panelboards installed and every different cabinet lock.

Part 2 – PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers: Subject to compliance with requirements, provide products manufactured by one of the following, or an approved equal:
   1. Eaton / Cutler Hammer.
   2. General Electric.
   3. Siemens.
   4. Square D.

B. Panelboards, Overcurrent Protective Devices, Controllers, Contactors, and Accessories:
   1. Eaton Corporation; Cutler-Hammer Products
   2. Schneider Electric; Square D Company (Basis of Design)
   3. Siemens Energy & Automation, Inc

C. Transient Voltage Suppression Panelboards: Surge protective device shall be provided and factory assemnbled by the panelboard manufacturer integral to the panelboard.

D. Programmable Panelboard Circuit Panelboards: Programmable circuit breaker Controller shall be provided together with remote sitching circuit breakers (as specified / scheduled) and factory assembled by the panelboard manufacturer integral to the panelboard.

2.2 MANUFACTURED UNITS

A. Enclosures: Flush- and surface-mounted cabinets. NEMA PB 1, Type 1.
   1. NEMA 250, Type enclosure rated for environmental conditions at installed location. Interior box shall be galvanized steel
   2. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box.
   3. Finish: Manufacturer's standard enamel finish over corrosion-resistant treatment or primer coat.
   4. Directory Card: With transparent protective cover, mounted in metal frame, inside panelboard door.

B. Phase and Ground Buses:
   1. Material: Hard-drawn copper, 98 percent conductivity
   2. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment ground conductors; bonded to box.
   3. Isolated Equipment Ground Bus: Adequate for branch-circuit equipment ground conductors; insulated from box.

4. Extra-Capacity Neutral Bus: Neutral bus rated 200 percent of phase bus and UL listed as suitable for nonlinear loads.

C. Conductor Connectors: Suitable for use with conductor material and sized for rated conductor sizes.

D. Future Devices: Mounting brackets, bus connections, and necessary appurtenances required for future installation of devices.

2.3 PANELBOARD SHORT-CIRCUIT RATING

A. Panelboards shall be fully rated for the short circuit interrupting rating shown on the panelboard schedules on the drawings (minimum of 22kAIC). Use of a series connected rating in not acceptable.

2.4 DISTRIBUTION PANELBOARDS

A. Doors: Secured with vault-type latch with tumbler lock; keyed alike. Omit for fused-switch panelboards.

B. Main Overcurrent Protective Devices: Circuit breaker

C. Branch Overcurrent Protective Devices:
1. For Circuit-Breaker Frame Sizes 125 A and Smaller: Bolt-on circuit breaker.
2. For Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breaker.

2.5 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

A. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.
B. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.

2.6 TRANSIENT VOLTAGE SUPPRESSION PANELBOARDS

A. Doors: Secured with vault-type latch with tumbler lock; keyed alike.

B. Main Overcurrent Devices: Thermal-magnetic circuit breaker.

C. Branch Overcurrent Protective Devices: Bolt-on circuit breakers.

D. Bus: Copper phase and neutral buses; 200 percent capacity neutral bus and lugs.

E. Transient Voltage Suppression Device: IEEE C62.41, integrally mounted, plug-in-style, solid-state, parallel-connected, sine-wave tracking suppression and filtering modules.
1. Minimum Single-Impulse Current Ratings:
a. Line to Neutral: 150,000 A.
b. Line to Ground: 60,000 A.
c. Neutral to Ground: 50,000 A.
2. EMI/RFI Noise Attenuation Using 50-ohm Insertion Loss Test: 55 dB at 100 kHz.
3. Maximum UL 1449 Clamping Levels (measured at the bus):
a. 450 V, line to neutral, line to ground, and neutral to ground and 700 V line to line on 120/208 V systems
b. 880 V, line to neutral, line to ground, and neutral to ground and 1500 V line to line on 277/480 V systems.

4. Withstand Capabilities: 3000 Category C surges with less than 5 percent change in clamping voltage.

2.7 OVERCURRENT PROTECTIVE DEVICES

A. Molded-Case Circuit Breaker: UL 489, with interrupting capacity to meet available fault currents (minimum of 22kAIC, unless noted otherwise).
   1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
   2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
   3. Electronic trip-unit circuit breakers shall have RMS sensing; field-replaceable rating plug; and with the following field-adjustable settings:
      a. Instantaneous trip.
      b. Long- and short-time pickup levels.
      c. Long- and short-time time adjustments.
      d. Ground-fault pickup level, time delay, and I2t response.
   4. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.
   5. Integrally Fused Circuit Breakers: Thermal-magnetic trip element with integral limiter-style fuse listed for use with circuit breaker; trip activation on fuse opening or on opening of fuse compartment door.
   6. GFCI Circuit Breakers: Single- and two-pole configurations with [5] [30]-mA trip sensitivity.

B. Molded-Case Circuit-Breaker Features and Accessories: Standard frame sizes, trip ratings, and number of poles.
   1. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.
   2. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HACR for heating, air-conditioning, and refrigerating equipment.
   3. Zone-Selective Interlocking: Integral with electronic trip unit; for interlocking ground-fault protection function.
   4. Multipole units enclosed in a single housing or factory-assembled to operate as a single unit.

C. Fused Switch: NEMA KS 1, Type HD; clips to accommodate specified fuses; lockable handle.

D. Fuses are specified in Division 26 Section "Fuses."

PART 3 – EXECUTION

3.1 INSTALLATION

A. Install panelboards and accessories according to NEMA PB 1.1.

B. Comply with mounting and anchoring requirements specified in Division 26 Section "Seismic Controls for Electrical Systems”.

C. Mount top of trim 74 inches above finished floor, unless otherwise indicated.

D. Mount plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish.

E. Install overcurrent protective devices and controllers.

F. Set field-adjustable switches and circuit-breaker trip ranges.

G. Install filler plates in unused spaces.

H. Arrange conductors in gutters into groups and bundle and wrap with wire ties after completing load balancing.

3.2 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Division 26 Section "Identification for Electrical Systems."

B. Create a directory to indicate installed circuit loads after balancing panelboard loads. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable.

C. Panelboard Nameplates: Label each panelboard with engraved metal or laminated-plastic nameplate mounted with corrosion-resistant screws.

3.3 CONNECTIONS

A. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems".

B. Connect wiring according to Division 26 Section “Low-Voltage Electrical Power Conductors and Cables”.

3.4 FIELD QUALITY CONTROL

A. Prepare for acceptance tests as follows:
   1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
   2. Test continuity of each circuit.

B. Perform the following field tests and inspections and prepare test reports:
   1. Perform each electrical test and visual and mechanical inspection stated in NETA ATS, Section 7.5 for switches and Section 7.6 for molded-case circuit breakers. Certify compliance with test parameters.
   2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

C. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scanning of each panelboard. Remove panel fronts so joints and connections are accessible to portable scanner.

3.5 CLEANING

A. On completion of installation, inspect interior and exterior of panelboards. Remove paint splatters and other spots. Vacuum dirt and debris; do not use compressed air to assist in cleaning. Repair exposed surfaces to match original finish.

END OF SECTION 262416

SECTION 262718 - SAFETY SWITCHES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this section.

B. Refer to Division 26, Section 260510 – Basic Electrical Requirements for general requirements.

1.2 SUMMARY

A. Section Includes: The work includes providing safety switches as indicated or required.

1.3 SUBMITTALS

A. Shop Drawings: Showing fuses, number of poles, enclosures and ratings.

1.4 QUALITY ASSURANCE

A. Compatibility: Insure that ratings of installed switch and motor is compatible when switch is serving as motor-disconnect.

PART 2 - PRODUCTS

2.1 MANUFACTURER

A. Acceptable Manufacturers: Subject to compliance with requirements, provide products manufactured by one of the following, or an approved equal:
   1. Switches:
      a. Eaton / Cutler Hammer.
      b. General Electric.
      c. Siemens.
      d. Square D.
   2. Fuses:
      a. Bussman.
      b. General Electric.
      c. Gould Shawmut.

2.2 MATERIALS

A. Safety switches shall be NEMA heavy duty, fused or nonfused, of rating and number of poles as indicated or required.

B. Safety switches shall be provided with rejection fuse clips where current limiting fuses are specified.

C. Interior enclosures shall be NEMA 1, except as otherwise indicated. Exterior shall be NEMA 4X, except as otherwise indicated.

D. Doors to safety switches shall interlock so that cover cannot be opened when switch is closed but shall be provided with a defeat mechanism to allow authorized personnel to open enclosure without opening switch.

E. Switches shall be quick-make, quick-break type, constructed so switch blades are visible in "OFF" position with door open, equipped with operating handle which is an integral part of the enclosure base and whose position is easily recognizable and is padlockable in the "OFF" position. Current carrying parts shall be constructed of high-conductivity copper, and silver-tungsten type switch contacts with positive pressure type reinforced fuse clips in fusible switches.

F. Provide fuses for fusible switches, of class, type and rating as follows:
1. General: Fuses shall be rated for the voltage indicated on the drawings and shall be rated for the continuous current indicated.
2. Motor Application: Dual element type, selected in accordance with the applicable requirements of Articles 430 and 440 of the NEC. Fuses shall include rejection slots, UL class RK5. Characteristics shall be essentially equivalent to Shawmut Amp Trap Dual Element with Time Delay, Class RK5.
3. Other Applications: Unless otherwise indicated, fuses selected for all applications other than for use with motors shall be current limiting types, dual element with time delay, UL class ARK1" rated 600 volts. Current limitation shall be essentially equivalent to Shawmut AAmp Trap@ Class RK1.
4. Interrupting Ratings: All fuses shall be rated to interrupt 200,000 RMS symmetrical amperes.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Switches shall be plumb and securely mounted.

B. Install safety switches in accordance with the manufacturer's written instructions, the applicable requirements of NEC and the National Electrical Contractors Association's "Standard of Installation," and in accordance with recognized industry practices to ensure that products serve the intended function.

C. Install disconnect switches used with motor-driven appliances, and motors within sight of the motor position unless otherwise indicated.

D. Exterior switches shall be mounted on supports to prevent trapping of moisture.

END OF SECTION 262718

SECTION 262726 – WIRING DEVICES

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this section.

B. Division 26

1.2 SUMMARY

A. Provide and install all equipment, labor, material, accessories and mounting hardware for a complete and operating system for the following:

1. Receptacles.
2. Switches.
3. Wall plates and covers.
4. Plugs.
5. Connectors.
6. Special devices, as noted
7. Floor service outlets, poke-through assemblies, service poles, and multi-outlet assemblies

1.3 DEFINITIONS

A. EMI: Electromagnetic interference.

B. GFCI: Ground-fault circuit interrupter.

C. Pigtail: Short lead used to connect a device to a branch-circuit conductor.

D. RFI: Radio-frequency interference.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Receptacles for Owner-Furnished Equipment: Match plug configurations.

1.5 ACTION SUBMITTALS

A. Submit Product Data: Provide manufacturer's catalog information showing dimensions, colors, and configurations. Submit product data on all types of wiring devices including plates and engraving

B. Samples: Upon request.

1.6 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.7 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing-label warnings and instruction manuals that include labeling conditions.

PART 2- PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers' Names: Shortened versions (shown in parentheses) of the following manufacturers' names:

1. Hubbell Incorporated; Wiring Device-Kellems (Hubbell).
2. Leviton Mfg. Company Inc. (Leviton).
3. Pass & Seymour/Legrand (Pass & Seymour).

2.2 GENERAL WIRING-DEVICE REQUIREMENTS

A. Wiring Devices, Components, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with NFPA 70.

C. Corrosion resistant devices shall be as specified for normal usages, and fabricated of yellow color melamine plastic.

D. Devices that are manufactured for use with modular plug-in connectors may be substituted under the following conditions:

1. Connectors shall comply with UL 2459 and shall be made with stranding building wire.
2. Devices shall comply with the requirements in this Section.

2.3 STRAIGHT-BLADE RECEPTACLES

A. General Description:

1. Duplex Convenience Receptacles
2. 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498, and FS W-C-596.

2.4 GFCI RECEPTACLES

A. General Description:

1. Straight blade, non-feed-through type.
2. 125 V, 20 A. Comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498, UL 943 Class A, and FS W-C-596.

3. Include indicator light that shows when the GFCI has malfunctioned and no longer provides proper GFCI protection.

2.5 TWIST-LOCKING RECEPTACLES

A. Special purpose receptacles for specific equipment shall conform to the requirements of NEMA Standard WD-1, WD 6 and UL 498 Wiring Devices, Specific Purpose, and shall be of the NEMA style number shown or manufacturer's number indicated. Provide a matching cap for each special purpose outlet supplied, each cap being equipped with a cord grip. Special purpose outlets shall be manufacturer's standard color.

2.6 TOGGLE SWITCHES

A. Comply with NEMA WD 1, UL 20, and FS W-S-896.

B. Devices shall be Specification Grade as minimum, 120/277 V, 20 A:

C. Snap switches for general use shall be maintained contact types, and shall be single-pole, double-pole, three-way, or four-way as required for the specific switching arrangements shown on the drawings. They shall be quiet tumbler operation types, having silver alloy contacts, and meeting all NEMA performance standards. Color to match plates unless specifically noted otherwise in specifications and/or on drawings.

D. Switches shall be toggle or key-operated types, as indicated on the drawings. All key-operated switches shall be keyed alike.

E. Switches shall be ivory in color, except as indicated otherwise.

2.7 WALL PLATES

A. Single and combination types shall match corresponding wiring devices.

1. Plate-Securing Screws: Metal with head color to match plate finish.
2. Material for Finished Spaces: Smooth, high-impact thermoplastic.
3. Material for Unfinished Spaces: Galvanized steel.
4. Material for Damp Locations: Cast aluminum with spring-loaded lift cover, and listed and labeled for use in wet and damp locations.

B. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with Type 3R, weather-resistant, die-cast aluminum with lockable cover.

2.8 FLOOR SERVICE FITTINGS

A. Type: Modular, flush-type, dual-service units suitable for wiring method used.

B. Compartments: Barrier separates power from voice and data communication cabling.

C. Service Plate: Rectangular with satin finish.

D. Power Receptacle: NEMA WD 6 Configuration 5-20R, black finish, unless otherwise indicated.

E. Voice and Data Communication Outlet: Two modular, keyed, color-coded, RJ-45 jacks for UTP cable.

2.9 POKE-THROUGH ASSEMBLIES

A. Basis-of-Design Product: Subject to compliance with requirements, provide Wiremold/Legrand or comparable product.

B. Description:

1. Factory-fabricated and -wired assembly of below-floor junction box with multi-channeled, through-floor raceway/firestop unit and detachable matching floor service-outlet assembly.
2. Comply with UL 514 scrub water exclusion requirements.
3. Service-Outlet Assembly: Flush type with two simplex receptacles and space for two RJ-45 jacks or as otherwise indicated on the drawings
4. Fire Rating: Unit listed and labeled for fire rating of floor-ceiling assembly.
5. Closure Plug: Arranged to close unused cored openings and reestablish fire rating of floor.

2.10 FINISHES

C. Device Color:

1. Wiring Devices Connected to Normal Power System: Ivory unless otherwise indicated or required by NFPA 70 or device listing.
2. Wiring Devices Connected to Emergency Power System: Red.
3. TVSS Devices: Blue.

D. Wall Plate Color: For plastic covers, match device color.

2.11 SHUNT TRIP STATION:

A. Provide complete station with hammer, backbox and face plate. Operator shall be beneath a glass disc. When the glass disc is broken with the hammer, the button becomes accessible to depress. Operator shall be provided with (1) NO and (1) NC contact.

B. Unit shall be mounted as indicated on the drawings with the appropriate type of backbox, flush mount station in NEMA 1 box unless otherwise indicated.

C. Engrave faceplate as follows unless otherwise indicated on the drawings: "ELECTRIC DISCONNECT, BREAK GLASS, PUSH BUTTON."

D. Unit shall be Pilla Electrical Products or equal.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1, including mounting heights listed in that standard, unless otherwise indicated.

B. Coordination with Other Trades:

1. Protect installed devices and their boxes. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of boxes.
2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
4. Install wiring devices after all wall preparation, including painting, is complete.

C. Conductors:

1. Do not strip insulation from conductors until right before they are spliced or terminated on devices.
2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.
4. Existing Conductors:

   a. Cut back and pigtail, or replace all damaged conductors.
   b. Straighten conductors that remain and remove corrosion and foreign matter.
   c. Pigtailing existing conductors is permitted, provided the outlet box is large enough.

D. Device Installation:

1. Replace devices that have been in temporary use during construction and that were installed before building finishing operations were complete.
2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
4. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
5. Tighten unused terminal screws on the device.
6. When mounting into metal boxes, remove the fiber or plastic washers used to hold device-mounting screws in yokes, allowing metal-to-metal contact.
7. Devices and cover plates shall be securely installed, with cover plates in true vertical or horizontal alignment, as applicable. Plates shall properly contact surfaces to which attached.
8. Install products in accordance with manufacturer's instructions.

9. Install wall dimmers to achieve full rating specified and indicated after derating for ganging as instructed by manufacturer.
10. Electrical boxes shall be cleaned and completely free of any debris, dust, etc. prior to the installation of wiring devices.
11. To minimize sound transmission through walls, back to back receptacles shall be installed at an offset of at least 6 inches. Back to back outlets are prohibited.
12. All receptacles and switches shall be grounded by means of a ground wire from device ground screw to outlet box screw and branch circuit ground conductor. Strap alone will not constitute an acceptable ground.
13. All devices shall be installed so that only one wire is connected to each terminal. At each receptacle "in" and "out" phase and neutral conductors shall have an additional conductor for connection to device. The practice of "looping" conductors through receptacle boxes shall not be acceptable.
14. Connect wiring devices by wrapping conductor around screw terminal.
15. Install local room area wall switches at door locations on the lock side of the door, approximately four inches from the jamb. Where locations shown on the drawings are in question, provide written request for information to A/E prior to rough-in.
16. GFCI receptacles shall be provided in, Toilet Rooms, Kitchen, near sinks, outdoors and wet/damp areas and as required by local codes.

E. Receptacle Orientation:

1. Install ground pin of vertically mounted receptacles down, and on horizontally mounted receptacles to the right.

F. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

G. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical. Group adjacent switches under single, multi-gang wall plates.

H. Adjust locations of floor service outlets to suit arrangement of partitions and furnishings.

3.2 IDENTIFICATION

A. Comply with Section 26 05 53 "Electrical Identification."

3.3 FIELD QUALITY CONTROL

A. Perform tests and inspections:

1. Test Instruments: Use instruments that comply with UL 1436.
2. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated digital-display indicators of measurement.

B. Tests for Convenience Receptacles:

1. Line Voltage: Acceptable range is 105 to 132 V.
2. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is unacceptable.
3. Ground Impedance: Values of up to 2 ohms are acceptable.

4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
5. Using the test plug, verify that the device and its outlet box are securely mounted.
6. Tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.

C. Wiring device will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

END OF SECTION 262726

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SECTION 262813 - FUSES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Cartridge fuses rated 600 V ac and less for use in the following:

   a. Control circuits.
   b. Motor-control centers.
   c. Panelboards.
   d. Switchboards.
   e. Enclosed controllers.
   f. Enclosed switches.

2. Spare-fuse cabinets.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for spare-fuse cabinets. Include the following for each fuse type indicated:

1. Ambient Temperature Adjustment Information: If ratings of fuses have been adjusted to accommodate ambient temperatures, provide list of fuses with adjusted ratings.

   a. For each fuse having adjusted ratings, include location of fuse, original fuse rating, local ambient temperature, and adjusted fuse rating.
   b. Provide manufacturer's technical data on which ambient temperature adjustment calculations are based.

2. Dimensions and manufacturer's technical data on features, performance, electrical characteristics, and ratings.
3. Current-limitation curves for fuses with current-limiting characteristics.
4. Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) for each type and rating of fuse. Submit [**in electronic format suitable for use in coordination software**] [**and**] [**in PDF format**].
5. Coordination charts and tables and related data.
6. Fuse sizes for elevator feeders and elevator disconnect switches.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For fuses to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 260598 "Operation and Maintenance Manuals**",** include the following:

1. Ambient temperature adjustment information.
2. Current-limitation curves for fuses with current-limiting characteristics.
3. Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) for each type and rating of fuse used on the Project. Submit [in electronic format suitable for use in coordination software] [and] [in PDF format].
4. Coordination charts and tables and related data.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fuses: Equal to [**10**] <**Insert number**> percent of quantity installed for each size and type, but no fewer than [**three**] <**Insert number**> of each size and type.

1.6 FIELD CONDITIONS

A. Where ambient temperature to which fuses are directly exposed is less than [40 deg F (5 deg C)] or more than [100 deg F (38 deg C)] , apply manufacturer's ambient temperature adjustment factors to fuse ratings.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Bussmann, an Eaton business.
2. Edison; a brand of Bussmann by Eaton.
3. Mersen USA.

B. Source Limitations: Obtain fuses, for use within a specific product or circuit, from single source from single manufacturer.

2.2 CARTRIDGE FUSES

A. Characteristics: NEMA FU 1, current-limiting, nonrenewable cartridge fuses with voltage ratings consistent with circuit voltages.

1. Type RK-1: [250] [600]-V, zero- to 600-A rating, 200 kAIC[, time delay].
2. Type RK-5: [250] [600]-V, zero- to 600-A rating, 200 kAIC[, time delay].

3. Type CC: 600-V, zero- to 30-A rating, 200 kAIC[, fast acting] [, time delay].
4. Type CD: 600-V, 31- to 60-A rating, 200 kAIC[, fast acting] [, time delay].
5. Type J: 600-V, zero- to 600-A rating, 200 kAIC[, time delay].
6. Type L: 600-V, 601- to 6000-A rating, 200 kAIC[, time delay].
7. Type T: [250-V, zero- to 1200-A] [600-V, zero- to 800-A] rating, 200 kAIC[, very fast acting] [, time delay].

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Comply with NEMA FU 1 for cartridge fuses.

D. Comply with NFPA 70.

E. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size and with system short-circuit current levels.

2.3 SPARE-FUSE CABINET

A. Characteristics: Wall-mounted steel unit with full-length, recessed piano-hinged door and key-coded cam lock and pull.

1. Size: Adequate for storage of spare fuses specified with [**15**] <**Insert number**> percent spare capacity minimum.
2. Finish: Gray, baked enamel.
3. Identification: "SPARE FUSES" in 1-1/2-inch- (38-mm-) high letters on exterior of door.
4. Fuse Pullers: For each size of fuse, where applicable and available, from fuse manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine fuses before installation. Reject fuses that are moisture damaged or physically damaged.

B. Examine holders to receive fuses for compliance with installation tolerances and other conditions affecting performance, such as rejection features.

C. Examine utilization equipment nameplates and installation instructions. Install fuses of sizes and with characteristics appropriate for each piece of equipment.

D. Evaluate ambient temperatures to determine if fuse rating adjustment factors must be applied to fuse ratings.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 FUSE APPLICATIONS

A. Cartridge Fuses:

1. Service Entrance: [Class L, fast acting] [Class L, time delay] [Class RK1, fast acting] [Class RK1, time delay] [Class J, fast acting] [Class J, time delay] [Class T, fast acting].
2. Feeders: [Class L, fast acting] [Class L, time delay] [Class RK1, fast acting] [Class RK1, time delay] [Class RK5, fast acting] [Class RK5, time delay] [Class J, fast acting] [Class J, time delay].
3. Motor Branch Circuits: [Class RK1] [Class RK5] [Class CC, motor duty], time delay.
4. Large Motor Branch (601-4000 A): Class L, time delay.
5. Power Electronics Circuits: [Class J, high speed] [Class T, fast acting].
6. Other Branch Circuits: [Class RK1, time delay] [Class RK5, time delay] [Class J, fast acting] [Class J, time delay] [Class CC, fast acting].
7. Control Transformer Circuits: Class CC, time delay, control transformer duty.
8. Provide open-fuse indicator fuses or fuse covers with open fuse indication.

3.3 INSTALLATION

A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.

B. Install spare-fuse cabinet(s) in location shown on the Drawings.

3.4 IDENTIFICATION

A. Install labels complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems" and indicating fuse replacement information inside of door of each fused switch and adjacent to each fuse block, socket, and holder.

END OF SECTION 262813

SECTION 262924 – INDIVIDUALLY MOUNTED MOTOR CONTROLLER

PART 1 - GENERAL

0.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this section.

B. Refer to Division 26, Section 260510 – Basic Electrical Requirements for general requirements.

0.2 SUMMARY

A. Unless otherwise indicated, every motor or piece of equipment not specified to be provided with a controller at the factory shall be provided with a controller as specified herein.

0.3 SUBMITTALS

A. Product Data: Manufacturer's product data / specification including
1. Voltage.
2. Phase
3. Horsepower Rating
4. NEMA size
5. Enclosure type
6. Elementary wiring diagrams.
7. Outline and wiring diagrams.
8. Overcurrent protection

B. Shop Drawings: Installation specific drawings showing:
1. Location of starters
2. Control devices, indicating lights, timers, overload rating, etc.
3. Wiring diagrams

0.4 REFERENCES

A. Institute of Electrical and Electronics Engineers, Inc. (IEEE)
1. IEEE 74 test Code for Industrial Control (600 Volts or Less)

B. National Electrical Manufacturing Association
1. NEMA 250 Enclosures for Electrical Equipment (100 Volts Maximum)
2. NEMA ICS 1 General Standards for Industrial Controls and Systems
3. NEMA ICS 2 Industrial Control Devices, Controllers and Assemblies
4. NEMA ICS 3 Industrial Systems
5. NEMA ICS 4 Terminal Blocks for Industrial Use
6. NEMA ICS 6 Enclosures for Industrial Controls and Systems

C. National Fire Protection Association
1. NFPA 70 National Electric Code (NEC)

D. Underwriters Laboratories
1. UL 294 Access Control System Units
2. UL486A Wire Connectors and Soldering Lugs for Use with Copper Conductors

3. UL508 Industrial Control Equipment

1.5 QUALITY ASSURANCE

A. Manufacturer shall have manufactured motor starters of the type and sizes required and shall have products in satisfactory use in similar service for not less than five years.

B. Products comply with the applicable requirements of references in article 1.4.

PART 1 - PRODUCTS

1.1 GENERAL

A. Acceptable Manufacturers: Subject to compliance with requirements, provide products manufactured by one of the following, or an approved equal:
1. Eaton / Cutler Hammer.
2. General Electric.
3. Siemens.
4. Square D.

B. Motor controllers shall conform to the applicable requirements of NEMA S Standard IC-1 Industrial Control. Controller sizes shall be verified to be compatible with horsepower of the motor.

1.2 MANUAL MOTOR STARTERS

A. Switches shall be tumbler-switch style. The manual motor starters shall provide overload protection which closely follows the motor load. Manual motor starters shall be in the following enclosures unless otherwise noted.
1. For outdoor installation - NEMA Type 4X Rainproof.
2. For indoor installation - NEMA Type 1, General Purpose.

1.3 MAGNETIC ONLY MOTOR CONTROLLERS

A. Nonreversing Magnetic Controllers: Nonreversing magnetic controllers shall start full voltage, nonreversing, AC single speed motors. The controllers shall be sized for the load unless otherwise indicated.

B. Control transformers shall be provided. Both legs of the primary and one leg of the secondary of the control transformer shall be protected by NEMA Class J fuses. The other leg of the secondary shall be grounded. The capacity of the control transformers shall be adequate to operate all the control devices in the circuit.

C. Overload Relays: Bimetallic relays are preferred. Overload relays shall be supplied in each leg. Overload relays shall be matched to load and shall be adjustable from 90 percent to 110 percent. A single reset button shall be mounted on the starter door to permit external reset. The relay shall be convertible from manual to automatic reset by a simple adjustment.

D. Where multispeed motors are scheduled on the drawings, the motor controls shall be compatible with the type motor shown.

E. Reduced Voltage, Auto-Transformer Type: Reduced voltage controllers shall be provided for all motors rated above 40 HP at 480 volts. The controllers shall be of the closed transition type, with definite time transfer from start to run. Taps shall be provided at 50 percent, 65 percent, and 80 percent of line voltage. Contactors shall be mechanically and electrically interlocked.

F. In size 3 & 4 reduced voltage nonreversing and Size 5 & 6 starters the contactor coil shall be operated at line voltage. The starters shall be operated by a control relay with 120 volt coil. Two NEMA Class J fuses shall be provided connected from line to starter coil circuit.

G. Unless otherwise indicated, all motor starters shall be provided with HAND-OFF-AUTOMATIC (HOA) switch and Red RUN indicating light in the door.

H. Auxiliary Contacts: Motor controllers shall be provided with all control devices including auxiliary contacts for equipment to operate as specified.

I. Controllers shall be in the following enclosures unless otherwise noted:
   1. For indoor installation - NEMA Type 1, General Purpose.
   2. For outdoor installation - NEMA Type 4X, Rainproof.

J. Provide phase loss protection for motors 3 HP and larger.

1.4 COMBINATION MOTOR CONTROLLERS

A. Combination motor controllers shall be provided with "Mag-Break" motor circuit protective device unless noted otherwise. Motor circuit protective device shall have 25,000 symmetrical RMS amperes short-circuit rating unless indicated otherwise. Unit control circuit fusing shall be provided. The motor circuit protective device shall be mounted in the same enclosure as the magnetic controller and shall be operable by hand from outside the enclosure. The handle shall be so interlocked with the door that it must be returned to the "OFF" position before the door can be opened, but a defeat mechanism shall be provided to allow authorized personnel to open the enclosure door without opening the disconnecting device. Provision for padlocking the disconnect handle in the "OFF" position shall be made.

B. Motor circuit protectors shall be the continuously adjustable, instantaneous magnetic trip type circuit breaker and shall be so constructed that all poles open, close and trip simultaneously. The continuous current rating of the motor circuit protector and the minimum fault-current, interrupting capability of the combination motor controller and motor circuit protector, shall be as indicated on the drawings.

1.5 OVERLOAD PROTECTION

A. Bi-metallic heater elements shall be provided for overload protection.

PART 2 - EXECUTION

2.1 SETTINGS, OVERLOAD AND SHORT CIRCUIT PROTECTION

A. Establish heater element size and establish and set the instantaneous trip point of the motor circuit protector, if used, based upon the nameplate data of equipment actually supplied and in accordance with the NEC.

2.2 INSTALLATION

A. Coordinate vertical and horizontal clearances with adjacent equipment.

END OF SECTION 262924

SECTION 263213 – ENGINE GENERATORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this section.

1.2 SUMMARY

A. Emergency electric system shall consist of a complete and operating electric generating unit, which, upon interruption of normal power, will start automatically and, by an automatic transfer switch, will disconnect load from normal supply and connect load to emergency generator. Diesel engine driven electric generator set shall be of the latest commercial type and design with all necessary switches, controls and accessories.

B. The emergency generator system shall pick up its connected load within 10 seconds after failure of the utility power supply.

C. The scope of work includes a new generator in a sound attenuating enclosure as specified here-in and shown on the drawings.

1.3 SUBMITTALS

A. List of one or more operating installations using major components of the same or similar type equipment furnished for this project.

B. Name of nearest location of permanent parts supply from which parts may be obtained in sufficient quantity on a 24-hour basis.

C. Shop drawings of the generator set, modifications to its existing foundation, auxiliary equipment required including switches, controls, remote panel, wiring and accessories.

D. Manufacturer's product data describing unit, auxiliary equipment required, including switches, engine, pump and motor. Include the following.

1. Specifications for fuel.
2. Make of engine.
3. Number of cylinders.
4. Compression ratio.
5. Bore, inches.
6. Stroke, inches.
7. Piston displacement cubic inches.
8. Piston speed at rated RPM, feet per minute.
9. Make and type of generator.
10. Generator electrical rating, kVA.
11. Number and type of generator bearings.
12. Exciter type and drive.

E. Operating and maintenance manuals shall be supplied for the electric set and for auxiliary equipment as specified in Section 260598 – OPERATION AND MAINTENANCE MANUALS.

F. Manufacturer's warranty.

1.4 QUALITY ASSURANCE

A. Unit shall be the product of a firm regularly engaged in the manufacture of engines, and a standard model in regular production at the manufacturer's place of business. Engine and generator shall be manufactured by the same manufacturer to establish single source responsibility.

B. Parts Service: Only current units which can be properly maintained and serviced without the necessity of the Owner carrying extensive parts stocks, or being subject to long periods of interrupted service due to unavailable parts will be considered. Engine-generator supplier shall maintain a local parts and service facility. Service facility shall have no less than 60 percent of all engine replacement parts in his stock at all times.

1.5 RATING

A. Electric set shall be capable of producing KW as indicated on the drawings at 0.8 PF rated output at standby duty at rated generator RPM when equipped with necessary operating accessories such as air cleaners, lubricating oil pump, fuel transfer pump, radiator fan, jacket water pump, governor, alternating current generator and exciter. Unit shall be 1800 RPM, 3-phase, 4 wire, 60-hertz, 277/480 volt.

1.6 WARRANTY

A. All units of the emergency electric system shall be covered by the manufacturer's standard warranty or guarantee for the new emergency generator set.

B. On completion of the installation, the initial start-up shall be performed by a factory trained representative of the manufacturer. At the time of start-up, operating instructions and maintenance procedures shall be thoroughly explained to Owner's operating personnel.

1.7 FACTORY TESTS

A. Provide written records of the testing procedure and the data obtained.

B. Unit shall be tested for compliance with Paragraph 2.2.C regarding generator set performance.

C. Provide written notification for the factory test date to allow Owner to determine if they desire to witness the testing of the unit. Contractor shall accompany and make arrangements for the Owner or their representative to witness test. Owner will pay own expenses.

1.8 REFERENCES AND STANDARDS

A. The equipment, control, alarms and installation of the system shall comply with the following references and standards.

1. National Electrical Code, Article 700.
2. National Fire Protection Association Standard: NFPA 110.
3. State and local building codes.
4. Local authorities having jurisdiction.
5. Applicable UL approvals.

PART 2 - PRODUCTS

2.1 APPROVED MANUFACTURERS

A. Caterpillar.

B. Kohler.

C. Cummins/Onan.

2.2 DIESEL ENGINE

A. Diesel engine shall be vertical or "V" multicylinder, full diesel, mechanical injection, heavy-duty type, arranged for direct connection to an alternating current generator, and shall be the product of a manufacturer regularly engaged in the building of full diesel engines. Engine shall be a current model which has been in regular production for at least 3 years. Engine shall develop sufficient brake horsepower, net at rated RPM, corrected to sea level barometric pressure (29.92 in. HG.) and 110 degrees F, to operate generator continuously at its rated output with all losses included without undue heating, vibration or wear. Diesel engine shall be water cooled either two or four cycle compression ignition diesel turbocharged for maximum efficiency.

B. BHP rating, overall generator efficiency, required auxiliaries, guarantee of fuel consumption, governor performance and torsional vibration shall be in accordance with manufacturer's standard published curves and data. Special ratings for a particular application are not acceptable.

C. Engine shall be equipped with an electronic speed sensing governor capable of isochronous speed regulation from no load to full-rated load.

D. Engine shall be equipped with a pressure lubrication system supplying oil to all surfaces requiring lubrication. Circulation shall be by a positive displacement pump. Lubrication system shall include a full-flow strainer, oil filter, and an oil cooler of sufficient capacity to properly cool all lubricating oil circulated.

E. Engine shall have an individual mechanical fuel injection pump and injection valve for each cylinder, any one of which may be removed and replaced from parts stock. Injection pumps and injection valves shall not require adjustment in service. Fuel injection pumps shall be positive action, constant-stroke pumps, actuated by a cam driven by gears from the engine crankshaft.

1. Fuel lines between injection pump and valves shall be heavy seamless tubing; and, to eliminate irregularity of fuel injections, shall be of the same length for all cylinders.
2. Fuel system shall be equipped with replaceable fuel filter elements which may be easily removed without breaking any fuel line connections or disturbing the fuel pumps or any other part of the engine.

3. All fuel filters shall be conveniently located in one accessible housing, ahead of injection pumps so that fuel will have been thoroughly filtered before it reaches the pumps. No screens or filters requiring cleaning or replacement shall be used in injection pump or injection valve assemblies.
4. Engine shall be equipped with a built-in, gear-type, engine-driven fuel transfer pump, capable of lifting fuel against a head of 12 feet, for supplying fuel through filters to injection pump at constant pressure.

F. Engine shall be provided with suitable safety controls to automatically stop the unit when low oil pressure, water temperature or engine speed exceeds safe limits. Pilot lights shall be provided to visually indicate the cause of engine shut down. Pilot lights shall operate off battery circuit and shall be on engine generator control panel.

G. Engine shall be equipped with high ambient radiator and blower fan system of sufficient capacity for cooling engine when diesel electric set is delivering full rated load in an ambient temperature of 125 degrees F. Air flow restriction from radiator shall not exceed 0.5 inch H_20. Engine shall have a thermostat integral with jacket water circuit to maintain water at proper operating temperature. Engine shall have an engine driven centrifugal type water circulating pump for circulating water through cooling system.

H. Engine shall be equipped with a precombustion chamber fuel system or have suitable emission control equipment to ensure that gaseous exhaust emissions do not exceed current limits in effect as of the date of manufacturer of the engine.

1. These maximum levels shall be at manufacturers rated speed and load as measured by SAE-J177 and SAE-J215 recommended practices. Verification of ability to meet emission specifications shall be available from engine manufacturer.

I. Engine shall be provided with an antifreeze solution of 50 percent ethylene glycol, and suitable unit mounted, thermal circulation type water heater incorporating a thermostatic switch to maintain engine jacket water at 90 degrees F in an ambient temperature of 32 degrees F. Heater shall be minimum 2,500 watts, single-phase, 60 Hertz, 208 volts, Chromalox or approved equal.

J. Engine shall be equipped with suitable base for mounting on concrete foundation. Engine-generator unit shall be designed for mounting on suitable vibration dampers recommended by engine manufacturer. Vibration dampers shall be furnished with engine-generator unit and shall be manufactured by Korfund, Inc., or approved equal.

K. Furnish a set of spare parts and tools regularly supplied with engine. Include all tools of special nature required to properly service engine.

L. Provide one or more engine-mounted, heavy-duty, dry-type air cleaners of sufficient capacity to protect working parts of the engine from dust and grit.

2.3 GENERATOR

A. Generator shall be engine driven, single bearing, self-aligning, continuous duty, salient pole, synchronous type with amortisseur windings. It shall be of the drip-proof type, entirely self- contained with only line leads brought out for load connections. Generator insulation used shall be NEMA Class F, such that generator life will match that of the prime mover. Generator shall be designed so all components are accessible with a minimum amount of labor. Both engine and generator shall be warranted and serviced by same manufacturer.

B. Generator shall be brushless type, rated at KW as indicated on the drawings at 0.8 PF, three phase, 60 hertz, 277/480 volt, 4-wire, 1,800 RPM.

C. Voltage regulator shall be modular construction, replaceable as an assembly and shall provide regulation for single-unit operation within plus or minus 2 percent from rated voltage at any load between "no load" and "full load."

D. Generator shall have permanent magnet excitation system which shall incorporate silicon control rectifiers to provide alternator field excitation. Excitation system shall incorporated circuitry to permit voltage built-up from residual magnetism. Field flashing from a separate source is not acceptable.

E. Voltage level, voltage drop and voltage gain controls are to be provided, easily accessible for normal operating adjustments. Voltage level control shall have a minimum range of plus or minus 5 percent from rated voltage. Provide voltage adjustment instructions and generator schematic wiring diagram permanently attached on inside of exciter assembly.

F. Generator drive shall be free from critical torsional vibration within the operating speed range.

G. Provide generator space heater for 120 volts operation.

2.4 GENERATOR STARTING AND CONTROL PANEL

A. Furnish and install automatic generator starting and control panel in a metal enclosure. Starting section shall automatically start engine upon failure of normal source through starting contracts in automatic transfer switch.

B. Transfer unit shall serve to operate as follows: Failure of normal supply shall cause its voltage sensitive relay to close a normally open contact initiating starting cycle of diesel engine. Closing of this contact shall cause power to be fed to a throttle solenoid, which picks up, opening fuel rack and energizing starting motor through one of its contacts. As generator voltage approaches normal, relay coil in cranking panel picks up, opening starting circuit through one of its contacts, thereby disconnecting starting motor from the rest of the circuit. Lack of oil pressure or over- temperature of cooling system will cause second relay in cranking panel to be energized, as normal alternator voltage is approached, causing starting cycle to be terminated immediately. Should engine fail to start for any reason, a time delay relay in cranking panel limits its cranking period to 30 seconds. A pushbutton switch mounted on cranking panel shall allow engine to be further cranked at the operator's discretion. Resumption of normal power shall open engine contacts in transfer switch and shall cause engine to begin shut down cycle.

C. Generator control section shall include the following:

1. Two 600-volt, 3-pole generator output electronic circuit breakers (see drawing for size) with auxiliary contacts. Breaker shall be rated minimum 125 percent of generator full load current. Provide ground fault indication in accordance with Article 700-7-d of the NEC-99. The audible and visual signal shall be located at the entrance of the generator room. Provide red sign indicating “General Ground Fault” next to the signaling devices. Breakers shall have solid state alarm that are coordinated with alternator thermal overload, alarm shall initiate signal to ATCT cab when current exceeds 110% of rated current for more than 60 seconds.

2. One A.C. ammeter, 3-1/2 inch, 2 percent accuracy.
3. One ammeter selector switch.4. One voltmeter switch.

5. One voltmeter, 0 to 600 volts, 3-1/2 inch, 2 percent accuracy.
6. One frequency meter 55 to 65 cycles, 3-1/2 inch, dial type.
7. One set dry contacts for remote alarm wired to terminal strips.
8. One voltage adjusting rheostat
9. Three instrument transformers.
10. One elapsed time meter (hours of operation) necessary auxiliary relay, necessary terminals and nameplates.
11. One 4-position control switch, G.E. SB-1 or equal which shall accomplish the following.

    a. Selector Switch at "AUTOMATIC" Position: Engine starting will commence automatically upon utility failure and closure of start contact in ATS.
    b. Selector Switch "MANUAL" Position. Engine will start manually.
    c. Selector Switch in "STOP/RESET" Position: Engine will be stopped and all controls reset to starting position.
    d. Selector Switch in "OFF" Position. Engine starting circuit disabled.

D. Provide remote emergency stop button where indicated on plans.

2.5 EXHAUST SYSTEM

A. Exhaust Silencer: A Nelson critical "300" level silencer, muffler companion flanges, exhaust piping and a flexible stainless steel exhaust fitting properly sized shall be furnished and installed according to the manufacturer's recommendation. Internal enclosure mounting shall be provided by the engine supplier. The silencer shall be mounted so that its weight is not supported by the engine nor will exhaust system growth due to thermal expansion be imposed on the engine. Exhaust pipe size shall be sufficient to ensure that exhaust back pressure does not exceed the maximum limitations specified by the engine manufacturer.

B. Insulation: The silencer shall be insulated as required to maintain the enclosure temperature within the engine operating range as specified in Division 23. The insulation shall be installed so that it does not interfere with the functioning of the flexible exhaust fitting.

2.6 FUEL TANK

A. Provide approved double-wall sub base fuel tank with capacity of 1750 gallons.

B. The factory-installed double-wall sub base fuel tank shall be a standard product of the engine-generator set manufacturer. The fuel tank shall be constructed of steel, welded construction and pressure tested. It shall be supplied with a lockable exterior fuel cap. All necessary fuel vent lines for proper engine performance shall be provided as well as a means to readily detect the fuel tank level in the tank without the use of a measuring stick.

    1. The bottom tank sheet shall be a minimum of 1 inch above the concrete pad.
    2. The base shall be primed and painted with a high-grade, commercial enamel paint. All interior areas of the tank shall be epoxy coated.
    3. The base shall have a minimum of three lifting points per side and maintain structural integrity during normal site installation.
    4. Tank shall be labeled to UL 142 and shall be supplied and warranted by the engine-generator supplier.

C. Supply a low fuel and high fuel level sensing device to signal the electrical set alarm annunciator panel specified herein, installed on the base fuel tank. The sensing device to be adjusted to signal low fuel level when the tank contains less than 40 percent capacity.

D. Supply a leak detector mounted in the double wall cavity of the base fuel tank that will sense the presence of diesel fuel and alarm the condition. The audible and visual alarm shall annunciate at the generator control panel and at the remote alarm panel.

E. Fill fuel tank for initial operation of the engine-generator plus replace all fuel used during testing of the system.

F. Provide fuel cooler, if required, for the fuel returning to the fuel tank.

2.7 FLEXIBLE CONNECTIONS (NON-ELECTRICAL)

A. Flexible connections of all types for fuel system shall be stainless steel metal-armored construction, of adequate lengths to isolate fixed piping from engine-generator units.

2.8 AUTOMATIC STARTING SYSTEM

A. 24 VDC electric starting system with positive engagement shall be furnished.

B. Battery: A lead acid storage battery set of the heavy duty diesel starting type shall be provided. Battery voltage shall be compatible with the starting system. The battery set shall be rated not less than 135 ampere hours. Necessary cables and clamps shall be provided.

C. Battery Trays: A battery tray shall be provided for the battery and shall conform to NEC 480-7(b). It shall be constructed of wood or PVC protected metal, so treated as to be resistant to deterioration by battery electrolyte. Further, construction shall be such that any spillage or boil over of battery electrolyte shall be contained within the tray to prevent a direct path to the surrounding soil or drains. Provide battery strip heater for 120 VAC operation to maintain battery at 65 degrees F minimum temperature.

D. The battery shall have sufficient capacity for emergency controls, to operate engine governor system, and for cranking the engine for at least 40 seconds at firing speed in the 110 degrees F maximum and 0 degrees F minimum temperature range.

E. Battery Charger: A current limiting battery charger, La Marche or equal, shall be furnished to automatically recharge the batteries. The charger shall float at 2.17 volts per cell and equalize at 2.33 volts per cell. It shall include overload protection, silicon diode full wave rectifiers, voltage surge suppressor, DC ammeter, DC voltmeter and fused AC input. AC input voltage shall be 120 volts, single phase. The charger shall be suitable for operation in an ambient atmosphere of 0 degrees F to 140 degrees F. Battery charger shall comply with NFPA 110 code requirements and shall include low battery voltage, high battery voltage and charger malfunction alarm contacts.

2.9 AUTOMATIC TRANSFER SWITCH (ATS)

A. Refer to specification Section 263600 for ATS requirements.

2.10 REMOTE ALARM PANEL

A. Provide a remote alarm panel at the Airport Operations Center (Police/Security #228) in the Terminal Building with the minimum following points:

1. Generator circuit breaker open.
2. Generator running.
3. Battery charger malfunction (low battery voltage).
4. Low oil pressure.
5. High water temperature.
6. Low water temperature.
7. Over crank.
8. Over speed.
9. Fuel tank alarm on leak, low fuel or overflow.

B. Panel shall contain a properly labeled "push to test" light and an audible device to annunciate each point. A silence switch shall also be provided.

C. Panel shall be powered from the generator set cranking batteries.

D. Panel shall be suitable for flush mounting in a nominal 4-inch wall.

E. The remote annunciator alarm panel shall meet the standards of NFPA 99, NFPA 110 (Level 1) and NEC article 700-7.

2.11 OUTDOOR GENERATOR-SET ENCLOSURE

A. Description: Prefabricated or pre-engineered walk-in sound attenuating enclosure with the following features:

1. Construction: Galvanized-steel, metal-clad, integral structural-steel-framed building erected on concrete foundation.
2. Structural Design and Anchorage: Comply with ASCE 7 for wind loads.
3. Space Heater: Thermostatically controlled and sized to prevent condensation.
4. Louvers: Equipped with bird screen and filter arranged to permit air circulation when engine is not running while excluding exterior dust, birds, and rodents.
5. Hinged Doors: With padlocking provisions.
6. Ventilation: Louvers equipped with bird screen and filter arranged to permit air circulation while excluding exterior dust, birds, and rodents.
7. Thermal Insulation: Manufacturer's standard materials and thickness selected in coordination with space heater to maintain winter interior temperature within operating limits required by engine-generator-set components.
8. Muffler Location: External to enclosure.

B. Engine Cooling Airflow through Enclosure: Maintain temperature rise of system components within required limits when unit operates at 110 percent of rated load for 2 hours with ambient temperature at top of range specified in system service conditions.

1. Louvers: Fixed-engine, cooling-air inlet and discharge. Storm-proof and drainable louvers prevent entry of rain and snow.
2. Automatic Dampers: At engine cooling-air inlet and discharge. Dampers shall be closed to reduce enclosure heat loss in cold weather when unit is not operating.

C. Interior Lights with Switch: Factory-wired, vapor proof-type fixtures within housing; arranged to illuminate controls and accessible interior. Arrange for external electrical connection.

1. AC lighting system and connection point for operation when remote source is available.

2. DC lighting system for operation when remote source and generator are both unavailable.

D. Convenience Outlets: Factory wired, GFCI. Arrange for external electrical connection.

E. Sound Attenuation - The entire enclosure except for the louvered openings shall have sound attenuation material mechanically attached to the interior surfaces of the unit. Sound absorbing material shall be held in place by a perforated mill finish galvanized liner to form a removable section easily inspected by maintenance personnel. The sound attenuation material and fastening system shall apply to the enclosure roof as well as side panels and doors as required to achieve a 85 dBa sound rating when measured at a distance of 10 feet, free field.

F. The enclosure shall be manufactured by Chillicothe metal Company or equal.

G. The enclosure shall include service panel for battery charger, lighting, block heater, controls, tank instrumentation, etc.

2.12 GENERATOR GROUNDING

A. Provide 4/0 bare copper grounding electrode conductor to a ¾" diameter copper ground rod through the bottom conduit entry hole in the generator fuel tank with a maximum 25 ohm resistance reading.

PART 3 - EXECUTION

3.1 INSTALLATION, EMERGENCY GENERATOR

A. Size of items and arrangement of all equipment shall be verified to be correct for space provided, allowing for moving into place, for normal maintenance and servicing and removal. Verify clearances of equipment to permit convenient installation and removal of complete assemblies, prior to commencing any work in this area.

B. Provide concrete base properly sized and suitable for mounting of the diesel-generator set and sub base fuel tank. Concrete base shall extend minimum 12 inches beyond each side of enclosure and shall be minimum 6 inches above grade. Edges of concrete base shall be beveled 1 inch at 45-degree angle and surfaces shall be smooth and free of depressions. Reinforce concrete base with No. 6 reinforcing bars on 12-inch centers horizontally. Bars should clear foundation surfaces 3 inches minimum.

C. Contractor shall connect all cabling for load bank testing of diesel-generator and automatic transfer switch.

D. All power, control and alarm connections shall be made to engine generator through flexible, neoprene-jacketed raceways, of length to permit hand flexing.

E. Provide vibration control for engine mounting to base.

F. Installation shall meet all applicable codes, including NEC, NFPA No. 30 and No. 37.

G. All engine-generator controls shall be provided with permanent lithographed, engraved or stamped tags, manufactured of metal or lamacoid material.

H. Provide all required conductors of proper AWG in conduits to generator and controls. Contractor shall verify these details prior to bid with proposed engine supplier.

I. All power connections to the generator set shall be made using compression type lugs furnished by the Contractor.

J. Install remote monitoring panel as indicated on the drawings. Provide conduit and wiring for proper operation of panel.

K. Provide signal to elevator controllers prior to transfer from emergency generator power back to utility power. Provide conduit and wiring from automatic transfer switch to elevator machine room.

L. Install automatic transfer switches as indicated on the drawings. Provide signal wiring with conduit to engine-generator control panel for starting.

3.2 TESTS

A. Prior to acceptance of the installation, equipment shall be tested to show it is free of defects and will start automatically and be subjected to full load test by using portable load banks and cables provided by the Contractor. Load bank shall be capable of definite and precise incremental loading and shall not be dependent on generator control instrumentation to read amperage and voltage of each phase. Test instrumentation shall serve as a check of generator set meters. Testing shall be done in the presence of the Owner's representative after unit is permanently installed in accordance with the drawings and specifications. Testing shall be for a minimum of four hours. Fuel for testing shall be supplied by the Contractor.

B. The on-site installation test shall be conducted in the following manner:

1. With diesel-generator in a "cold start" condition and emergency load at normal level, initiate a normal power failure by opening the breaker supplying the normal power to the emergency panel board. Test load shall be that load that is served by the generator.
2. Observe and record the time delay on start.
3. Observe and record the cranking time until the engine starts and runs.
4. Observe and record the time required to come up to operating speed.
5. Record voltage and frequency overshoot.
6. Observe and record time required to achieve steady-state condition with all switches transferred to the emergency position.
7. Record voltage, frequency and amperes.
8. Record engine oil pressure, water temperature and battery charge rate at 5-minute intervals for the first 15 minutes and at 15-minute intervals thereafter.
9. Continue load test with building load for 2 hours maximum, observing and recording load changes and the resultant effect on voltage and frequency.
10. Return normal power to the emergency panelboard record the time delay on retransfer to normal (minimum setting: 5 minutes), and the time delay on cool down period and shutdown.
11. After completion of the test above, the diesel generator shall be allowed to cool and a resistive load bank shall be connected to the output of the automatic transfer switch for a 2-hour full load test.
12. A full-load test shall be initiated as soon as possible after the 5-minute cool down period. Start the diesel generator system by opening the normal breaker to the emergency panelboard and have the diesel generator pickup 100 percent of nameplate kW rating in one step.

13. Record the data listed in (3) through (8) at first load acceptance and every 15 minutes thereafter until the completion of the 2-hour test period.
14. Utilize any method recommended by the manufacturer to prevent the prime mover from running. Put the control switch into "run" to cause the engine to crank. Observe the complete crank/rest cycle.
15. Test all safeties specified and as recommended by the manufacturer.

C. Prior to acceptance, any defects which became evident during this test shall be corrected at no additional expense to the Owner.

D. On completion of the installation, the initial start-up and testing shall be performed by a factory trained representative of the engine supplier. Minimum time at the site for the factory trained representative shall be one day. At the time of start-up, operating instructions and maintenance procedures shall be thoroughly explained to the operating personnel. Two copies of operating and maintenance instruction books shall be supplied for the electric set and such auxiliary equipment as may require same.

E. After completion of testing, replace engine oil and filters in unit. Refill fuel oil tank to replace fuel used.

3.3 CLEANING

A. The Contractor shall provide suitable protection from moisture, dust and construction debris until acceptance of equipment by Owner. All items shall be cleaned, touched up as necessary and left in first-class condition to the satisfaction of the Architect.

PART 4 - MEASUREMENT AND PAYMENT

4.1 METHOD OF MEASUREMENT

A. Payment will be made at the lump sum price bid for this Section.

B. The lump sum price bid shall include all materials, labor, equipment, submittals, shop drawings, warranties, transportation, incidentals, and services required to install a complete and operating electric generating unit and sound-attenuating enclosure per this Section, the Contract drawings, and all other contract specifications, and provisions.

Payment will be made under

Pay Item 263213 - 1 Emergency Generator System - Per Lump Sum.

END OF SECTION 263213

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SECTION 263353 – STATIC UNINTERRUPTIBLE POWER SUPPLY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provision of the contract, including general and supplementary conditions and Division 1 specification sections apply to this section.

1.2 SUMMARY

A. The uninterruptible power supply shall provide continuous high quality regulated sine wave power to the digital control system for boiler controls and for flame safeguard systems.

1.3 SUBMITTALS

A. Submittals Package: Submit the shop drawings, product data, and quality control submittals specified below at the same time as a package.

B. Shop Drawings:

1. Wiring and/or schematic diagram of the complete system as proposed to be installed (standard diagrams will not be accepted).

C. Product Data:

1. Catalog sheets, specifications and installation instructions.

2. Company's data indicating volt-amp rating with proof that the unit will meet the final system test.

3. Name, address and telephone number of nearest fully equipped service organization.

D. Quality Control Submittals:

1. Battery Purchase Data: Statement indicating proposed date for battery purchase and installation.

2. Company Field Advisor Data: Include:

a. Name, business address and telephone number of Company Field Advisor secured for the required services.

b. Certified statement from the Company listing the qualifications of the Company Field Advisor.

c. Services and each product for which authorization is given by the Company, listed specifically for this project.

E. Contract Closeout Submittals:

1. Test Report: System acceptance test report.

2. Certificate: Affidavit, signed by the Company Field Advisor and notarized, certifying that the system meets the contract requirements and is operating properly.

3. Battery Manufacture Certified Date: Upon battery purchase, submit certified data from the battery manufacturer indicating date batteries were manufactured.

4. Operation and Maintenance Data: Deliver 2 copies, covering the installed products, to the Owner.

1.4 QUALITY ASSURANCE

A. Source Quality Control: The company producing the system shall have test facilities available which can demonstrate that the proposed system meet contract requirement s.

1. If brand names other than those specified are proposed for use, pay all costs, including travel expenses to the test facility for the Owner's Representative to witness test demonstration.

B. List of Completed Installations: If brand names other than those specified are proposed for use, furnish the name, address, and telephone number of at least 5 comparable installations which can prove the proposed products have operated satisfactorily for 3 years.

C. Company Field Advisor: Secure the services of a Company Field Advisor for a minimum of 24 working hours for the following:

1. Render advice regarding installation and final adjustment of the system.

2. Verify that batteries are properly matched to units.

3. Witness final system test and then certify with a sworn affidavit that the system is installed in accordance with the contract documents and is operating properly.

4. Train facility personnel on the operation and maintenance of the system (minimum of two 4 hour sessions).

5. Explain available service program s to facility supervisory personnel for their consideration.

D. Service Availability: A fully equipped service organization capable of guaranteeing response time within 24 hours to service calls shall be available to service the completed Work.

1.5 DELIVERY, STORAGE AND HANDLING

A. Do not purchase batteries more than 60 days before completion date, just prior to final system test.

B. Batteries shall not have been in an active state prior to purchase. Shelf life shall not exceed battery manufacturer's recommendations.

1.6 PROJECT CONDITIONS

A. The uninterruptible power supply shall meet all requirements at the following ambient temperatures (actual site conditions): Springfield, MO area.

1.7 MAINTENANCE

A. Spare Parts:

1. Set of cell numbers for mounting on rack.

2. Anti -corrosion compound for battery connections.

3. 50 percent spare of each type fuse.

PART 2 - PRODUCTS

2.1 UNINTERRUPTIBLE POWER SUPPLY

A. See Drawings for Information.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Genera l: Install uninterruptible power supply complete and ready for service.

B. Identification:

1. Stencil on front of unit with white paint in I inch high lettering "UNINTERRUPTIBLE POWER SUPPLY".

2. Label function of each branch circuit.

3.2 FIELD QUALITY CONTROL

A. Preliminary System Test:

1. Preparation: Have the Company Field Advisor adjust the completed system and then operate it long enough to assure that it is performing properly.

2. Run a preliminary test for the purpose of:

a. Determining whether the system is in a suitable condition to conduct an acceptance test.

b. Checking and adjusting equipment.

c. Training facility personnel.

B. System Acceptance Test:

1. Preparation: Notify the Owner's Representative at least three working days prior to the test so arrangements can be made to have a Facility Representative witness the test.

2. Make the following tests:

a. Simulated utility power failure at full load to prove un interruption of load power supply.

b. Simulated UPS failure at full load to prove transfer to utility power upon malfunction of UPS (disconnect batteries with temporary disconnect switch or other methods to temporarily disable unit).

c. Full load test for 30 minutes to prove capacity of system (utility power source disconnected). Record battery voltage and current at start and end of period. Record AC output voltage at start and end of period. Battery cell voltage under full load at the end of 30 minutes shall not be less than 1.75V.

d. Continue at full load beyond 30 minute period to automatic shutdown of inverter due to low battery voltage. Record battery voltage at shutdown and time interval beyond the 30 minute period to shut down.

e. Reactive utility power source, recharge batteries and record time interval required to restore unit to full charge.

f. Connect unit to digital control system and flame safeguard systems and simulate utility power failure to prove compatibility of UPS with the connected systems.

3. Supply an adjustable resistive load bank or other approved apparatus to load UPS to full rated load.

4. Supply all equipment necessary for system adjustment and testing.

5. Submit written report of test results signed by Company Field Advisor and the Owner's Representative. Mount a copy of the final report in a plexiglass enclosed frame assembly adjacent to the UPS.

END OF SECTION 263353

SECTION 263600 – TRANSFER SWITCHES

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes open transition automatic transfer switches rated 600 V or less, and includes the following:
   1. Automatic transfer switches.

1.3 SUBMITTALS

A. Product Data: Provide manufacturer's product data / specification sheet. Include rated capacities, weights, operating characteristics, furnished specialties, and accessories.

B. Shop Drawings: Dimensioned plans, elevations, sections, and details showing minimum clearances, conductor entry provisions, gutter space, installed features and devices, and material lists for each switch specified.
   1. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
   2. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

C. Field quality-control test reports.

D. Operation and Maintenance Data: For each type of product to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 26 Section "Operation and Maintenance Manuals," include the following:
   1. Features and operating sequences, both automatic and manual.
   2. List of all factory settings of relays; provide relay-setting and calibration instructions, including software, where applicable.

1.4 QUALITY ASSURANCE

A. The manufacturer of the assembly shall be the manufacturer of the major components within the assembly.

B. For the equipment specified herein, the manufacturer shall be ISO 9001 or 9002 certified.

C. The manufacturer of this equipment shall have produced similar electrical equipment for a minimum period of five (5) years. When requested by the Engineer, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.

1.5 CODES AND STANDARDS

A. The automatic transfer switches and controls shall conform to the following standards:
   1. UL 508 Industrial Control Equipment
   2. UL 991 Tests for Safety Related Controls Employing Solid State Devices

3. UL 1008 - Standard for Transfer Switch Equipment
4. IEC 947-6-1 Low-voltage Switchgear and Control gear; Multifunction equipment; Automatic Transfer Switching Equipment
5. IEEE Standard 446 - IEEE Recommended Practice for Emergency and Standby Power Systems for Commercial and Industrial Applications
6. NEMA Standard ICS10-1993 (formerly ICS2-447) - AC Automatic Transfer Switches
7. NFPA 70 - National Electrical Code
8. NFPA 99 - Essential Electrical Systems for Health Care Facilities
9. NFPA 110 - Emergency and Standby Power Systems

1.6 DELIVERY STORAGE AND HANDLING

A. Equipment shall be handled and stored in accordance with manufacturer's instructions. One (1) copy of these instructions shall be included with the equipment at time of shipment.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following, (ASCO 7000 series ATS is basis of design):
1. ASCO 7000 series
2. Eaton / Cutler- Hammer
3. Generac
4. GE Zenith Controls.
5. Kohler
6. Russelectric, Inc.

2.2 GENERAL TRANSFER SWITCH PRODUCT REQUIREMENTS

A. The automatic transfer switch shall be furnished with the number of poles, voltage and current rating as shown on the drawings.

B. Indicated Current Ratings: Apply as defined in UL 1008 for continuous loading and total system transfer, including tungsten filament lamp loads not exceeding 30 percent of switch ampere rating, unless otherwise indicated.

C. Tested Fault-Current Closing and Withstand Ratings: Adequate for duty imposed by protective devices at installation locations in Project under the fault conditions indicated, based on testing according to UL 1008.
1. Where transfer switch includes internal fault-current protection, rating of switch and trip unit combination shall exceed indicated fault-current value at installation location.

D. Solid-State Controls: Repetitive accuracy of all settings shall be plus or minus 2 percent or better over an operating temperature range of minus 20 to plus 70 deg C.

E. Resistance to Damage by Voltage Transients: Components shall meet or exceed voltage-surge withstand capability requirements when tested according to IEEE C62.41. Components shall meet or exceed voltage-impulse withstand test of NEMA ICS 1.

F. Electrical Operation: Accomplish by a nonfused, momentarily energized solenoid or electric-motor-operated mechanism, mechanically and electrically interlocked in both directions.

G. Switch Characteristics: Designed for continuous-duty repetitive transfer of full-rated current between active power sources.
   1. Limitation: Switches using molded-case switches or circuit breakers or insulated-case circuit-breaker components are not acceptable.
   2. Switch Action: Double throw; mechanically held in both directions.
   3. Contacts: Silver composition or silver alloy for load-current switching. Conventional automatic transfer-switch units, rated 225 A and higher, shall have separate arcing contacts.

H. Neutral Switching. Where four-pole switches are indicated, provide overlapping neutral contacts.

I. Neutral Terminal: Solid and fully rated, unless otherwise indicated.

J. Factory Wiring: Control components and wiring shall be front accessible. Train and bundle factory wiring and label, consistent with Shop Drawings, either by color-code or by numbered or lettered wire and cable tape markers at terminations. Color-coding and wire and cable tape markers are specified in Division 26 Section "Identification for Electrical Systems."
   1. Designated Terminals: Pressure type, suitable for types and sizes of field wiring indicated.
   2. Power-Terminal Arrangement and Field-Wiring Space: Suitable for top, side, or bottom entrance of feeder conductors as indicated.
   3. Control Wiring: Equipped with lugs suitable for connection to terminal strips.

K. Enclosures: The automatic transfer switch shall be mounted in a free standing general-purpose NEMA 1 enclosure, complying with NEMA ICS 6 and UL 508, unless otherwise indicated. Enclosure shall have an internal welded steel pocket housing an operation and maintenance manual.

2.3 AUTOMATIC TRANSFER SWITCHES

A. The transfer switch shall be electrically operated and mechanically held. The electrical operator shall be a momentarily energized, single-solenoid mechanism. Main operators utilizing overcurrent disconnect devices, linear motors or gears shall not be acceptable. The switch shall be mechanically interlocked to ensure only two possible positions, normal or emergency.

B. All transfer switch sizes shall use only one type of main operator for ease of maintenance and commonality of parts.

C. The switch shall be positively locked and unaffected by momentary outages, so that contact pressure is maintained at a constant value and contact temperature rise is minimized for maximum reliability and operating life.

D. All main contacts shall be silver composition. Switches rated 600 amperes and above shall have segmented, blow-on construction for high withstand and close-on capability and be protected by separate arcing contacts.

E. Inspection of all contacts shall be possible from the front of the switch without disassembly of operating linkages and without disconnection of power conductors. Switches rated 600 amps and higher shall have front removable and replaceable contacts. All stationary and moveable contacts shall be replaceable without removing power conductors and/or bus bars.

F. Designs utilizing components of molded-case circuit breakers, contactors, or parts thereof, which are not intended for continuous duty, repetitive switching or transfer between two active power sources, are not acceptable.

G. Where neutral conductors are to be solidly connected as shown on the plans, a neutral conductor plate with fully rated AL-CU pressure connectors shall be provided.

H. Automatic Transfer-Switch Features:
1. Undervoltage Sensing for Each Phase of Normal Source: Sense low phase-to-ground voltage on each phase. Pickup voltage shall be adjustable from 85 to 100 percent of nominal, and dropout voltage is adjustable from 75 to 98 percent of pickup value. Factory set for pickup at 90 percent and dropout at 85 percent.
2. Adjustable Time Delay: For override of normal-source voltage sensing to delay transfer and engine start signals. Adjustable from zero to six seconds, and factory set for one second.
3. Voltage / Frequency Lockout Relay: Prevent premature transfer to generator. Pickup voltage shall be adjustable from 85 to 100 percent of nominal. Factory set for pickup at 90 percent. Pickup frequency shall be adjustable from 90 to 100 percent of nominal. Factory set for pickup at 95 percent.
4. Time Delay for Retransfer to Normal Source: Adjustable from 0 to 30 minutes, and factory set for 10 minutes to automatically defeat delay on loss of voltage or sustained undervoltage of emergency source, provided normal supply has been restored.
5. Test Switch: Simulate normal-source failure.
6. Switch-Position Pilot Lights: Indicate source to which load is connected.
7. Source-Available Indicating Lights: Supervise sources via transfer-switch normal- and emergency-source sensing circuits.
   a. Normal Power Supervision: Green light with nameplate engraved "Normal Source Available."
   b. Emergency Power Supervision: Red light with nameplate engraved "Emergency Source Available."
8. Unassigned Auxiliary Contacts: Two normally open, single-pole, double-throw contacts for each switch position, rated 10 A at 240-V ac.
9. Transfer Override Switch: Overrides automatic retransfer control so automatic transfer switch will remain connected to emergency power source regardless of condition of normal source. Pilot light indicates override status.
10. Engine Starting Contacts: One isolated and normally closed, and one isolated and normally open; rated 10 A at 32-V dc minimum.
11. Engine Shutdown Contacts: Time delay adjustable from zero to five minutes, and factory set for five minutes. Contacts shall initiate shutdown at remote engine-generator controls after retransfer of load to normal source.
12. Engine-Generator Exerciser: Solid-state, programmable-time switch starts engine generator and transfers load to it from normal source for a preset time, then retransfers and shuts down engine after a preset cool-down period. Initiates exercise cycle at preset intervals adjustable from 7 to 30 days. Running periods are adjustable from 10 to 30 minutes. Factory settings are for 7-day exercise cycle, 20-minute running period, and 5-minute cool-down period. Exerciser features include the following:
   a. Exerciser Transfer Selector Switch: Permits selection of exercise with and without load transfer.
   b. Push-button programming control with digital display of settings.
   c. Integral battery operation of time switch when normal control power is not available.

2.6 SOURCE QUALITY CONTROL

A. Factory test and inspect components, assembled switches, and associated equipment. Ensure proper operation. Check transfer time and voltage, frequency, and time-delay settings for compliance with specified requirements. Perform dielectric strength test complying with NEMA ICS 1.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Identify components according to Division 26 Section "Identification for Electrical Systems".
B. Set field-adjustable intervals and delays, relays, and engine exerciser clock.

3.2 CONNECTIONS

A. Wiring to Remote Components: Match type and number of cables and conductors to control and communication requirements of transfer switches as recommended by manufacturer. Increase raceway sizes at no additional cost to Owner if necessary to accommodate required wiring.

B. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems".

C. Connect wiring according to Division 26 Section "Low Voltage Electrical Power Conductors and Cables".

3.3 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections. Report results in writing.

B. Perform tests and inspections and prepare test reports.
   1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installation, including connections, and to assist in testing.
   2. After installing equipment and after electrical circuitry has been energized, test for compliance with requirements.
   3. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
   4. Measure insulation resistance phase-to-phase and phase-to-ground with insulation-resistance tester. Include external annunciation and control circuits. Use test voltages and procedure recommended by manufacturer. Comply with manufacturer's specified minimum resistance.
      a. Check for electrical continuity of circuits and for short circuits.
      b. Inspect for physical damage, proper installation and connection, and integrity of barriers, covers, and safety features.
      c. Verify that manual transfer warnings are properly placed.
      d. Perform manual transfer operation.
   5. After energizing circuits, demonstrate interlocking sequence and operational function for each switch at least three times.
      a. Simulate power failures of normal source to automatic transfer switches and of emergency source with normal source available.
      b. Simulate loss of phase-to-ground voltage for each phase of normal source.

c. Verify time-delay settings.
d. Verify pickup and dropout voltages by data readout or inspection of control settings.
e. Verify proper sequence and correct timing of automatic engine starting, transfer time delay, retransfer time delay on restoration of normal power, and engine cool-down and shutdown.

6. Ground-Fault Tests: Coordinate with testing of ground-fault protective devices for power delivery from both sources.
   a. Verify grounding connections and locations and ratings of sensors.

C. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation and contact resistances and time delays. Attach a label or tag to each tested component indicating satisfactory completion of tests.

D. Remove and replace malfunctioning units and retest as specified above.

E. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each switch. Remove all access panels so joints and connections are accessible to portable scanner.
   1. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each switch 11 months after date of Substantial Completion.
   2. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
   3. Record of Infrared Scanning: Prepare a certified report that identifies switches checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.4 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain transfer switches and related equipment as specified."

B. Coordinate this training with that for generator equipment.

END OF SECTION 263600

SECTION 264113 – LIGHTNING PROTECTION FOR STRUCTURES

PART 1 - GENERAL

1.1 SUMMARY

A. The work includes providing a functional and UNOBTRUSIVE lightning protection UL Master Label system as specified herein.

B. If any departure from the submittal drawings covered below are deemed necessary by the Contractor, details of such departures and reasons therefore shall be submitted as soon as practicable to the Architect-Engineer for approval. No such departures shall be made without prior written approval of the Architect-Engineer.

1.2 SUBMITTALS

A. Shop Drawings: Submit the type, size, and locations of all equipment, grounds, and cable routing on a set of drawings prepared by the Contractor to the same scale as the contract drawings.

B. Manufacturer's product data.

C. Samples: Submit a complete selection where requested.

D. UL Master Label application form.

1.3 QUALITY ASSURANCE

A. The lightning protection system shall conform to the following requirements:

1. Underwriter's Laboratories (UL) Master Label Code 96A.
2. National Fire Protection Association (NFPA) Code NO. 780.

B. The lightning protection system shall conform to the requirements of UL, Standards for Lightning Protection Systems. UL Master Label shall be furnished affixed as directed.

C. The system shall be the standard product of a manufacturer regularly engaged in the production of lightning protection systems and equipment and shall be the manufacturer's latest approved design.

D. System manufacturer shall be UL listed and approved manufacturer.

E. Materials shall be manufactured by Thompson Lightning Protection, Inc., 901 Sibley Highway, St. Paul, Minnesota, 55118; National Lightning Protection, Inc., Denver, CO 80216; Harger Lightning Protection, Inc., Grayslake, IL 60030; Robbins Lightning, Inc., Maryville, MO or approved equal.

PART 2 - PRODUCTS

2.1 GENERAL

A. All material and equipment shall be UL approved and labeled.

B. All equipment shall be the product of a single manufacturer and of a design and construction to suit the application for which it is to be used, in accordance with accepted industry standards, NFPA and UL Code requirements.

C. The products of the Thompson Co. are specified to indicate the type and quality required. Equal products of other manufacturers are acceptable only if approved by the shop drawing process.

D. For standing seam style roof (e.g. BEMO panels), attachment devices must be of the clamp type and have NO penetrating screws.

2.2 EQUIPMENT

A. Conductors shall be copper for down conductors and aluminum for roof loop conductors for use in structures as recommended by manufacturer.

B. Conductors: Copper - 29 strands, 17 gauge, as manufactured by Thompson, No. 29X. Aluminum - 24 strands, 14 gauge, Thompson No. A24.

C. Air Terminals: Solid, round copper bar, 1/2 inch minimum diameter, Thompson Co. or equal. Shall project 10 inches minimum above the object to be protected.

D. Air Terminal Bases: Cast bronze with bolt pressure cable connections securely mounted with stainless steel screws or bolts. Thompson Nos. No. A680, A678, 78, 611, as required. Bases on built-up or single ply gravel roofing shall be secured with the proper adhesive and shall have a minimum surface contact area of 18.5 square inches, Thompson Cat. No. A688.

E. Ground Rods: Minimum of 5/8 inches in diameter and 10 feet long, Thompson Cat. No. 225. Connect to system with a 2-bolt cast stainless bronze clamp, Thompson Cat No. 231, having a minimum length of 1-1/2 inches and using stainless steel cap screws.

F. Cable Fasteners: Electrolytically compatible with conductor and mounting surface, Thompson No. A730, and 166, as required.

G. Bonding Devices, Cable Splicers and Miscellaneous Connectors: Cast bronze with bolt pressure connections to cable. Cast or stamped crimp fittings are not acceptable. Splicers shall be similar to Thompson Nos. A423B, A705, and A706, as required, Bonding devices similar to Thompson Cat. No. A702 as required.

H. Miscellaneous Bolts, Nuts and Screws: Brass, bronze, or stainless steel.

I. Copper to aluminum connectors shall be via or approved bimetallic connector, Thompson 709M.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Installation shall be accomplished by an experienced installer employed by the approved manufacturer.

B. All equipment shall be installed in the most inconspicuous manner possible. System shall be installed complete with cable network on the roof, air terminals, splices, and bonds with cable downleads routed concealed directly in the building construction or in conduit to ground.

C. Downlead cables shall not be brought directly through the roof. Connectors with solid rods or conduit through pitch pockets shall be used for through roof connector. Downlead conductors shall be installed in PVC conduit concealed in building construction, or building steel may be used for down leads.

D. Equipment shall not be connected to aluminum surfaces except by a UL approved fitting.

E. Air terminals and cable fasteners shall be located and spaced in compliance with UL requirements unless shown on drawings.

F. All connections to building steel shall be inconspicuous and shall be by approved means.

3.2 COORDINATION

A. Coordinate lightning protection work to ensure a correct, neat, and unobtrusive installation.

B. Provide a tight, mechanical sound bond to the main water service to assure inter-connecting with other building ground systems, including both telephone and electrical.

C. Verify that proper arrestors have been installed on the power service.

3.3 LABEL

A. Secure and deliver a UL Master label to the Architect-Engineer.

END OF SECTION 264113

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SECTION 264314 – TRANSIENT VOLTAGE SURGE PROTECTION

PART 1 - GENERAL

0.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this section.

B. Refer to Section 260510 – Basic Electrical Requirements for general requirements.

C. Refer to Section 262414 – Switchboards for installation of TVSS-1 in switchboard.

0.2 SUMMARY

A. These specifications describe requirements for an integrated UL Listed TVSS System. Note that particular care must be taken to install the system as described in the Execution Section of this specification to ensure maximum performance.

0.3 DESIGN REQUIREMENTS

A. The TVSS system shall be by Advance Protection Technologies, GE, SQD, Siemens, Cutler-Hammer LEA, Liebert, Wiremold, United Power or Leviton and shall be designed, manufactured, tested and installed in compliance with:

1. ANSI/IEEE C62.41 & C62.45
2. FIPS PUB 94
3. NEMA
4. NFPA 70.
5. MIL-STD 220A
6. UL 1449. Systems not UL 1449 Listed are not acceptable.

B. The ANSI/IEEE C62.41 Category C3 waveform is a 20 kV, 1.2 x 50 microseconds and 10 kAmp 8 x 20 microsecond waveform. All systems provided per this section shall be from the same manufacturer. The system shall not utilize encapsulated components.

0.4 SUBMITTALS

A. Submittals shall include documentation of:

1. UL 1449 Listing and UL 1449 clamping voltage rating.
2. ANSI/IEEE C62.41 & C62.45 Category C3 clamping voltage.
3. Sequential surge survivability per ANSI/IEEE C62.45.
4. Confirmation of L-G, L-N & N-G mode where specified.
5. Description of internal circuitry and components.
6. Dimensions and weights.
7. Warranty Statement.
8. Recommended connection wiring diagram.
9. Certification that manufacturer has been manufacturing TVSS systems for a minimum of 5 years.

B. Submittals shall include a copy of these specifications with each section marked with either "C" for comply or "D" for deviation. A written explanation shall be provided for each deviation for the system to be considered for acceptance. Any deviation may result in the system being determined "Not Acceptable".

0.5 SCHEDULE

A. The Main Service Switchboard, and each indicated 208Y/120V Distribution Panel as marked with 'TVSS' on the drawings shall be provided with TVSS. TVSS-1 in main switchboard shall be integral mounted in switchboard.

TAG	LOCATION	VOLTAGE
TVSS-1	Main Switchboard	480Y/277
TVSS-2	Panels	208Y/120

PART 1 - PRODUCTS

1.1 SERVICE ENTRANCE - THREE PHASE

A. Modes of Protection: L-L, L-N & N-G
Surge Capacity per Phase: 125,000 Amps
Survivability of Category C3 Surges: 1000 sequential occurrences
Maximum UL1449 Rating, each phase mode: 500 @ 120/240, 120/208; 800 @ 277/480; 1500 @ 480
Category C3 Performance: 552 @ 120/240, 120/208; 940 @ 277/480
EMI/RFI Noise Rejection: 50 dB Common Mode, 40 dB Normal Mode
Connection Method: Parallel
Design Requirements: System shall be composed of a minimum of seven internal modules which may be replaced without replacing the entire unit.
Fused Disconnect: System shall include an internal fused disconnect switch with replaceable 60 amp, 200 kAIC, Class
J fuses or provide circuit breaker in the panel to isolate TVSS.
Monitoring: Redundant illuminated LED on each internal module and additional enclosure mounted LEDs duplicating each internal module's status. LEDs to extinguish when protection fails. Audible alarm, enclosure mounted surge counter and a set of dry NO & NC alarm contacts shall be provided.
Warranty: Five years with unlimited replacement during warranty.

1.2 DISTRIBUTION PANELS

A. Modes of Protection: L-L, L-N & N-G
Surge Capacity per Phase: 50,000 Amps for three-phase panels
Survivability of Category B3 Surges: 1,000 sequential occurrences
Maximum UL 1449 Rating, each phase mode: 500 @ 120/240, 120/208
Category B Performance: 600 @ 120/240, 120/208
Connection Method: Parallel, Provide Factory 24-inch Lead
Connection Length to be Field Trimmed
Monitoring: Illuminated LED for each Phase Displaying Normal Protection Existing Operation. LEDs to extinguish when protection fails.
Warranty: Five years with unlimited replacement during warranty.

1.3 PROTECTIVE CIRCUITRY

A. The TVSS shall be designed utilizing multiple solid state components arranged in a symmetrically balanced circuit where each component is equidistant to the input and output leads, thus evenly distributing surge current and reducing stress on individual components. Encapsulation of the internal components shall not be acceptable. Each solid state component shall be individually fused.

PART 2 - EXECUTION

2.1 TERMINATION POINT

A. Service Entrance systems shall be installed to provide termination as close as possible to the load side of the main disconnect. Panel systems shall be connected to a breaker/non-fused disconnect as close to the main lugs/main breaker as possible.

2.2 INSTALLATION - SERVICE ENTRANCE UNITS

A. Input connections shall be made for each phase, the neutral and safety ground with #6 AWG conductors. An additional #2 conductor shall be connected between the TVSS surge ground terminal and earth ground directly beneath the TVSS. Non-ferrous conduit shall be used. Conduit shall be separated by a minimum of 4 inches from other conduits and conductors to minimize potential reintroduction of induced transients. A separate surge ground rod shall be provided by the installing contractor. The surge ground rod shall also be bonded to the main electrical system ground system. If the surge ground driven directly beneath the TVSS panel would be within 10 feet of the building electrical system ground, the surge ground may be deleted and the #2 conductor shall connect to the building electrical system ground rod directly. Conductors shall be run as straight and short as possible.

2.3 INSPECTION/TRAINING

A. Manufacturer's representative shall inspect the TVSS installation and provide dated documentation certifying the installation has been inspected and is installed properly. The manufacturer's representative shall provide instructional training on system operation to the owner.

END OF SECTION 264314

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SECTION 265100 –LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this section.

B. Refer to Section 260510 – Basic Electrical Requirements for general requirements.

C. Refer to Section 265110 – LAMPS.

1.2 SUMMARY

A. Furnish and install lighting fixtures as indicated and specified, complete with lamps and required ballasts and accessories. Proper supports for lighting fixtures shall be provided.

1.3 JOB CONDITIONS

A. Verify the compatibility of recessed lighting fixtures with the ceiling in which each fixture is to be located.

1.4 PRODUCT HANDLING

A. Deliver fixtures sufficiently in advance of installation to prevent delay of work.

B. Store all materials in a closed building, in original packaging, and protect from damage and the elements.

C. Decorative elements of fixtures shall be packed by the manufacturer separately from the housing of the fixture, stored at the job site and installed only after completion of plastering, ceiling tile work, painting and general cleanup in area.

1.5 SUBMITTALS

A. Shop Drawings: Show fixture locations and support details. Materials shall not be purchased until approved. Include copy of ballast warranty for each type of ballast required.

B. Product Data: Provide lighting fixture brochures in a single, bound and indexed assembly for all lighting fixtures. Incomplete submittals will be returned without processing.

1. Fixture brochures shall contain manufacturer's name and catalog illustration and number, dimensions and details, ballast and diffuser information, metal gages, pretreatment and paint data, UL-ETL approval, and connection details. Provide photometric data for fixture with lamp and ballast specified. Provide sound rating of ballast. Provide information on adjustable fixtures if such type fixture is required. Provide fuse type and size when specified.
2. Fixture submittal data shall include lamp data with ANSI ordering code. Where no code has been established, the manufacturer's complete descriptive literature shall be provided with fixture data.

3. When catalog cuts are submitted, each fixture type shall have the manufacturer's name and catalog number in an obvious location. Cut sheet shall also indicate the type of ballast and lamps to be used.

C. Submit the following fluorescent lamp ballast data when requested:

1. Manufacturer's certified test data.

PART 2 - PRODUCTS

2.1 GENERAL FIXTURE REQUIREMENTS

A. Labels: Fixtures shall bear UL and manufacturer's label. Exit fixtures shall comply with NFPA 101, latest edition, visibility standards.

B. Housings: Constructed of steel, bonderized treated to prevent corrosion and finished with baked white enamel, except where otherwise indicated.

C. Frame: Furnish necessary "plaster" frames for lighting fixtures recessed in plaster or stucco ceilings and for other non-lay-in installations.

D. Finish:

1. All metal parts, except cadmium plated hardware, shall have a five-stage, prepainting hot process similar and equal to bonderizing, applied in accordance with hot bonding process.
2. Final Painted Enamel Finish: Approved equal to DuPont white having a minimum reflection factor of 85 percent. Final finish shall cover all metal portions and be uniform in color, coverage and gloss. Flat test samples shall withstand 300 hours of salt spray in accordance with ASTM B117.
3. Porcelain Enamel Finish: Smoothly applied, 90 percent reflectance material and of proper thickness to resist chipping, 0.015-inch maximum.
4. Aluminizing or Anodizing. Finish process shall be approved equal to Alcoa 202 finish, which shall be 20 minutes minimum in bath, 15 minutes minimum in sealer with final thickness of at least 0.00025 inch.
5. Duranodic type finishes shall be in accordance with sample approved by D.P.

E. Ballasts and Fusing:

1. Electronic Ballasts: Use with all T8 fluorescent lamps. Provide high frequency electronic ballasts designed to operate 265 ma. rapid start T8 lamps.

a. Ballast shall be UL listed Class P with power factor of 0.90 or above and sound levels shall not exceed Class A ambient noise levels.
b. Input current total harmonic distortion (THD) content shall be below 10 percent (expressed in percentage of full light output current level.
c. Ballast shall have a frequency of operation of 20,000 hertz or greater and operate without visible flicker.
d. Ballast shall have an average lamp current crest factor of 1.7 or below and shall withstand line transients as defined in ANSI/IEEE C62.41, Category A.
e. Ballast case temperature shall not exceed 25 degrees C temperature rise over 40 degrees C ambient.
f. Ballast shall operate rapid start lamps connected in series.
g. Ballast shall comply with FCC requirements governing electromagnetic and radio frequency interference.

h. Ballast Factor (BF) shall be 88 percent or above and ballast shall provide starting sequence consistent with lamp manufacturer's recommendations so as to provide full rated lamp life.
i. Ballast shall operate on 120 volts or 277 volts as indicated on the drawings.
j. Ballast manufacture shall have at least 5 years experience manufacturing electronic ballasts with a documentable low failure rate.
k. Ballast manufacture shall warrant ballasts to be free from defects in material or workmanship for at least 3 years from date of manufacture under normal conditions of use.
l. Acceptable Manufacturers: Advance; Magnetek TRIAD; and Motorola.

2. Two lamp-type ballasts shall be provided to allow inboard/outboard switching of lamps.
3. Provide low-temperature starting ballasts of required type for outdoor fixtures and in unheated areas. Starting temperature shall be minus 20 degrees F where available to the trade and 0 degrees F otherwise.
4. Ballasts for metal halide lamps and high-pressure sodium lamps shall be properly selected for lamp characteristics as indicated on the drawings, operating temperatures and lamp position, where critical. Where available, ballasts shall be HPF. Where proper operation can be secured, ballasts shall be provided which accommodate plus or minus 10 percent input voltage range. Insulation type for ballasts shall be selected by fixture manufacturer for high ambient temperatures in ballast mounting space of fixture. Provide two-winding type ballasts. Starting aid for high- pressure sodium lamps shall be separate from ballast, and encapsulated. Where indicated on drawings, provide ballast with auxiliary winding to operate instant-on quartz lamp. Lamp shall come on instantly on momentary loss of power and remain on until metal halide lamp reaches 40 percent of its full lumen output. Relay for operation of the quartz lamp shall not cause a loss in secondary starting current for H.1.D. lamp. Relay shall be solid state encapsulated designed for operation in 150 degrees F ambient and have a 3-year warranty.
5. Fixture fusing shall be provided as follows:

   a. All 277V high-intensity discharge interior fixtures as indicated.
   b. All exterior lighting for all voltages. Fuses shall be in accessible location, approved equal to Buss and of proper style. Exterior fixture fuses shall be Buss "TRON", or approved equal, in water-resistant enclosure where fixtures may come in contact with moisture or water.

6. Noisy ballasts shall be replaced, at no additional cost to Owner. Ballasts for indoor application shall be encased in a housing, which provides necessary wiring compartments and provisions for required electrical connectors or devices. Ballast components shall be surrounded with a thermosetting fill to ensure adequate heat dissipation and quiet operation, below local ambient noise level. Ballasts shall be provided with necessary mounting hardware and vibration dampers. Ballasts for outdoor use shall be encased in weather-tight enclosures with proper outdoor type wiring devices.

   a. Class A sound rating for ballast operating standard fluorescent lamps.
   b. Remote-mounted ballast for operation of metal halid lamps shall be encapsulated for quiet operation.

7. Dimmable Ballast:

   a. Ballast shall dim continuously from 100 percent to 5 percent light lumens output.

b. Ballast shall maintain full filament heat throughout the dimming range for long lamp life.
c. Ballast dimming circuit shall be UL Class 2 and shall be fully isolated from ballast input power.
d. For compact fluorescent lamps, ballast shall operate specified four-pin configuration.
e. Ballast shall be UL listed, Class P, thermally protected, Type 1 outdoor and CSA approved.
f. Ballast sound levels shall not exceed Class A ambient noise levels.
g. Input line current total harmonic distortion shall not exceed 10 percent.
h. Ballast shall have an average maximum lamp current crest factor of not more than 1.5.
i. Ballast shall have a soft start/rapid start function, which preheats the cathode filaments and then ignites the lamp for maximum lamp life.
j. Ballast shall withstand line transients as defined in ANSI/IEEE C62.11, Category A.
k. Ballast shall have a frequency of operation of over 30 kHz and operate without visible lamp flicker.
l. Ballast shall have a power factor of 95 percent or better.
m. Ballast shall not contain PCBs.
n. Ballast shall meet requirements of FCC rules and regulations, Part 18.
o. Ballast shall have push-in wire connections suitable for 18 AWG solid copper wire.

F. Sockets:

1. Fluorescent Lamp Sockets: "Tombstone" or "butt-on" type for use with bipin lamps shall be provided with plated contacts which depend upon base support only, or contacts of "edge-wipe" style. Lamp insertion channelway of the socket shall be of "D" design. Pigtails attached to "butt-on" type sockets shall be soldered or welded to contacts. Crimp connections are not acceptable. Leads to "tombstone" type sockets shall be tinned before connection.
2. Sockets shall hold lamps securely against normal vibrations and maintenance handling. Provide solid nickel or nickel and silver plated contacts in sockets for the following types of lamps:

   a. Mogul base - large sizes, incandescent, metal halide, mercury vapor.
   b. Lamps in all outdoor fixtures.
   c. Tungsten halogen lamps.

G. Adjustable Fixtures: In adjustable fixtures, provide aiming lock devices. Fixtures with adjustable lamps and using lamps with asymmetrical light patterns shall have an aiming stop which can be permanently set so that the lamp shall remain correctly positioned after service or relamping.

H. Diffusers of Light Fixtures: Each fixture requiring a lens shall be complete with appropriate framed lens 0.125-inch minimum thickness, or as shown on fixture schedule. Florescent fixtures shall have 100 percent virgin acrylic, KSH-12 pattern, or as indicated. For lenses with convex pattern of pyramids or cones, specified minimum thickness refers to distance from flat surface to base of pyramids or cones, or thickness of undisturbed material. For lenses with concave pattern, specified minimum thickness refers to overall thickness of material. Lenses shall essentially eliminate lamp images when viewed from all directions within the 45 degrees to 90 degree angle from the vertical when the ratio of lamp spacing to the distance from lamp underside to top of lens does not exceed 1. Within the viewing angle from zero to 45 degrees the ratio of maximum brightness under a lamp to minimum brightness between lamps shall not exceed 3 to 1.

I. Parabolic Lens: Parabolic lens shall be shipped to the project site with a factory installed protective self-adhering mylar overlay for protection against construction dust. All parabolic lens shall be free from dust and finger prints prior to Owner acceptance. If necessary, Contractor shall be responsible for cleaning fixture and parabolic lens to remove dust and finger prints.

2.2 LIGHTING FIXTURES

A. Lighting fixtures shall be provided in accordance with the schedules. Fixtures shall be furnished complete with all accessories necessary for complete and proper installation. Catalog numbers indicated in schedules do not necessarily include plaster frame, special mounting rails and other fittings which may be required for proper installation, but these devices shall be provided where applicable.

B. Schedule of Fixtures: See drawings.

2.3 EXTERIOR LIGHTING POLES

A. Provide light poles as specified on the lighting fixture schedule.

PART 3 - EXECUTION

3.1 RECESSED FLUORESCENT FIXTURES

A. Fixtures shall be installed in suspended ceiling openings as provided. Load bearing supports independent of the suspended ceiling grid, shall be provided along sides and end of fixture.

3.2 LIGHTING FIXTURES RECESSED IN FIRE RATED CEILINGS, AND PLENUM SPACES

A. Fixture shall be constructed to provide continuous operation when installed in air plenums, or when surrounded with restrictive enclosures.

B. Where space above ceiling is used as an air plenum changer for either supply or return air the fixture shall be factory wired in accordance with Article 300-22(C) of the NEC.

3.3 WIRING

A. For 120 volt fixture wiring, use minimum 300 volt, 150C, type SF-1, SF-2, SFF-1, SFF-2, PF or PFF wire beginning at separately mounted outlet box unless higher temperature wire is required by fixture design.

B. For higher-voltage fixture wiring use 600 volt, Type SF-2 or SFF-2 wire beginning at separately mounted outlet box, unless higher temperature wire is required by fixture design.

C. All wire nuts used in fixtures shall have helical cone shaped live spring to ensure tight pressure connection. Wire nuts without metal spring are not acceptable.

3.4 BLEMISHED, DAMAGED, OR UNSATISFACTORY FIXTURES

A. Fixtures shall be replaced with new fixtures.

B. Fixtures with highly polished reflective surfaces shall NOT be handled with bare hands but with new, clean, grease-free cotton gloves. Surfaces found with finger prints shall be cleaned or replaced with new fixtures.

3.5 TARGETING

A. Target and adjust fixtures immediately before final inspection.

3.6 CLEANING OF FIXTURES

A. Before final acceptance of electrical work, clean fixture bottom, trim and reflecting surfaces of dust, dirt, plaster, paint and foreign matter. Mask trim and bottom of all lighting fixtures if necessary to protect the fixtures. Diffuser cleaning materials and methods shall be in accordance with the manufacturer's instructions. As a minimum, fixtures shall be cleaned with a nonstatic producing solution and air dried.

3.7 MISCELLANEOUS REQUIREMENTS

A. Lighting in equipment rooms and electric closets is diagrammatic, indicating type, quantity and general circuiting of fixtures. Modify locations and mounting to suit conditions, allowing clearances for equipment, piping and ductwork.

B. Verify recessing depths for all lighting fixtures, and where required, provide matching "modified" units of decreased depth for fixture installation. Verify horizontal clearances and provide units of proper length.

C. Plaster Frames shall be provided for all recessed fixtures including those located in lath and plaster, gypsum board and similar material.

D. Light fixtures installed in stair construction shall have clearances verified and coordinated for conduit feeds, concealed conduit systems, recess depths, and other obstructions.

E. Provide fixture support bars spanning structural T-bar ceiling channels for surface mounting type fixtures. Support bars and fittings shall allow vertical and horizontal positioning of the fixture.

F. Provide a proper ceiling grid hanger for fixtures that are mounted or suspended from exposed "T-Grid" ceilings. Grid hanger shall be secured to main support channels of the ceiling and shall have provisions for locking in place. Grid hangers shall accept stem canopy or surface fixtures.

G. Fixtures that are located in acoustical tile ceilings shall be located as indicated on reflected ceiling plans. Fixtures shall be fastened to the ceiling framing member per the requirements on NEC Article 410-16(c).

H. Fluorescent fixtures in mechanical spaces shall be hung on heavy chain. In areas where exposed ductwork, pipes, and similar obstructions cross locations for light fixture supports, provide Unistrut or approved equal framing supports to span obstruction.

I. Verify roughing heights of "under-cabinet" type fixture installations to conceal rough-in and provide control by standard wall switch located below fixture and ganged with receptacle where applicable, unless otherwise shown.

J. EMT shall not be used to support suspended fixtures of any type. Suspension shall be by standard hangers, where available and applicable; by rigid threaded conduit and fittings, or by approved rods.

K. Where fixtures are to be mounted on, or suspended from, concrete ceilings, cast-in inserts shall be provided. Tamped or drilled inserts will not be acceptable.

L. Fixtures shall not be supported by outlet box cover screws alone, a fixture stud or "hickey" shall be provided for added support.

M. Fixtures located in Fire Underwriters rated ceiling shall have an equal fire enclosure around fixture. Enclosure shall contain 10 percent maximum free area in ventilation openings.

N. Direct embedded exterior lighting poles with 35 feet overall length shall be set to a depth of 5 feet. Pole installation shall comply with manufacturer's suggested installation procedures.

3.8 TESTS

A. Each support for fixtures shall be tested with a weight of not less than 50 pounds or three times the weight of the installed fixture, whichever is greater.

END OF SECTION 265100

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SECTION 16152 – LAMPS

PART 1 - GENERAL

0.1 SUMMARY

A. Provide lamps for all lighting fixtures furnished as work of this contract.

0.2 DELIVERY AND STORAGE

A. Lamps shall be delivered in manufacturer's packing in undamaged condition.

B. Lamp containers shall be stored where protected from the elements in dry and heated area.

C. Installation shall not be made until approved by Architect-Engineer. Lamps used during construction shall be replaced with new lamps prior to final inspection.

PART 1 - PRODUCTS

1.1 FLUORESCENT LAMPS

A. F32T8/3550X: For all new fluorescent fixtures except where specifically indicated otherwise use "OCTRON" T8 rapid start type rated at 32 watts. Minimum rated light output shall be 2,850 lumens. Triphosphors inside lamps shall produce a neutral color spectrum (3,500 K) with 85 CRI or higher. Rated average lamp life shall not be less than 20,000 hours based on 3 hours per start.

B. Compact Fluorescent (CF): Use for down lights and wall washers. Compact twin-tube or quad-tube lamp with color temperature 3,500 K and 10,000-hour lamp life.

C. Acceptable Manufacturers:
1. General Electric.
2. OSRAM-Sylvania.
3. Phillips.

2.2 INCANDESCENT LAMPS

A. Incandescent lamps shall be furnished in the style, size and performance characteristics as required or as indicated on drawings for the proper operation of the fixture specified. All lamps shall be energy saving, extended life type, rated for 130 volts.

B. In certain areas, "under-lamping" may be indicated on the drawings and socket extender shall be provided for proper position of lamp in relation to lamp reflector.

C. Lamps shall be General Electric Watt Miser Plus or equal.

D. Where specified fixture design uses reflector type lamps, such type lamp shall be furnished in "spot" or "flood" type as correct for this installation, and shall have same socket arrangement.

1.2 HIGH-PRESSURE SODIUM LAMPS (NOT USED)

A. Provide high-pressure sodium lamps of wattage indicated in Fixture Schedule for use with ballast designed for this lamp, and for correct burning position.

1.3 METAL HALIDE LAMPS

A. Metal halide lamps shall be 100W to 1500W as scheduled, of identical color rendition, and selected for burning position and enclosure restrictions in accordance with the manufacturer's lamp application data. Ballast design shall be properly selected for each specific lamp application.

1.4 QUARTZLINE LAMPS

A. Provide type as required by specified fixture design and as shown in Fixture Schedule.

1.5 MANUFACTURERS

A. Acceptable lamp manufacturers are: General Electric, Phillips and OSRAM-Sylvania.

PART 2 - EXECUTION

2.1 INSTALLATION

A. Refer to Section 265100 - LIGHTING.

END OF SECTION 265110

SECTION 265119 – LED INTERIOR LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Interior solid-state luminaires that use LED technology.
2. Lighting fixture supports.

B. Related Requirements:

1. Listed with and comply with: Design Light Consortium, Lighting Facts, Energy Star, IESNA - LM-79 & LM-80.

1.3 DEFINITIONS

A. CCT: Correlated color temperature.

B. CRI: Color Rendering Index.

C. Fixture: See "Luminaire."

D. IP: International Protection or Ingress Protection Rating.

E. LED: Light-emitting diode.

F. Lumen: Measured output of lamp and luminaire, or both.

G. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Arrange in order of luminaire designation.
2. Include data on features, accessories, and finishes.
3. Include physical description and dimensions of luminaires.
4. Include emergency lighting units, including batteries and chargers.
5. Include life, output (lumens, CCT, and CRI), and energy efficiency data.
6. Photometric data and adjustment factors based on laboratory tests[, complying with IESNA Lighting Measurements Testing and Calculation Guides, of each lighting fixture

type. The adjustment factors shall be for lamps and accessories identical to those indicated for the lighting fixture as applied in this Project IES LM-79 and IES LM-80.

a. Manufacturers' Certified Data: Photometric data certified by manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.
b. Testing Agency Certified Data: For indicated luminaires, photometric data certified by a qualified independent testing agency. Photometric data for remaining luminaires shall be certified by manufacturer.

B. Shop Drawings: For nonstandard or custom luminaires.

1. Include plans, elevations, sections, and mounting and attachment details.
2. Include details of luminaire assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include diagrams for power, signal, and control wiring.

C. LEED Submittals:

1. Product Data for Credit IEQ 4.2: For paints and coatings, documentation including printed statement of VOC content.
2. Laboratory Test Reports for Credit IEQ 4.2: For paints and coatings, documentation indicating that products comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

D. Product Schedule: For luminaires and lamps. Use same designations indicated on Drawings.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Lighting luminaires.
2. Suspended ceiling components.
3. Partitions and millwork that penetrate the ceiling or extend to within 12 inches (300 mm) of the plane of the luminaires.
4. Structural members to which equipment and or luminaires will be attached.
5. Initial access modules for acoustical tile, including size and locations.
6. Items penetrating finished ceiling, including the following:

a. Other luminaires.
b. Air outlets and inlets.
c. Speakers.
d. Sprinklers.
e. Access panels.
f. Ceiling-mounted projectors.

7. Moldings.

B. Qualification Data: For testing laboratory providing photometric data for luminaires.

D. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

E. Product Certificates: For each type of luminaire.

F. Product Test Reports: For each luminaire, for tests performed by manufacturer and witnessed by a qualified testing agency.

G. Sample warranty.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For luminaires and lighting systems to include in operation and maintenance manuals.

1. Provide a list of all lamp types used on Project; use ANSI and manufacturers' codes.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Luminaires: Ten 10% of each type and rating installed. Furnish at least one of each type.
2. Diffusers and Lenses: One (1) for every 100 of each type and rating installed. Furnish at least one of each type.
3. Globes and Guards: One (1) for every 20 of each type and rating installed. Furnish at least one of each type.

1.8 QUALITY ASSURANCE

A. Luminaire Photometric Data Testing Laboratory Qualifications: Luminaire manufacturer's laboratory that is accredited under the NVLAP for Energy Efficient Lighting Products.

B. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by an independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7, accredited under the NVLAP for Energy Efficient Lighting Products, and complying with the applicable IES testing standards.

C. Provide luminaires from a single manufacturer for each luminaire type.

D. Each luminaire type shall be binned within a three-step MacAdam Ellipse to ensure color consistency among luminaires.

E. Mockups (where indicated on plans or notes): For interior lighting luminaires in room or module mockups, complete with power and control connections.

1. Obtain Architect's approval of luminaires in mockups before starting installations.
2. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.

3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.9 MOCKUPS

A. The specific design requirements of several building conditions will mandate the necessity of full scale on site mockups prior to final authorization (release) to fabricate. The Contractor shall include as part of his bid provision for complete on site mockups of the following conditions:

TYPE	LOCATION	MAGNITUDE (extent)
C1	Concourse	(1) One 8’-0” Run
C2	Concourse	(2) Two 8’-0” Runs
H1	Holdroom	(1) One 8’-0” Run
H2	Holdroom	(1) One 8’-0” Run
H3	Holdroom	(2) Two Fixtures
H4	Holdroom	(1) One 8’-0” Run

1.10 DELIVERY, STORAGE, AND HANDLING

A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering before shipping.

1.11 WARRANTY

A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.

B. Warranty Period: Five (5) years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Seismic Performance not used

2.2 LUMINAIRE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. NRTL Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by an NRTL.

C. FM Global Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.

D. Recessed Fixtures: Comply with NEMA LE 4.

E. Bulb shape complying with ANSI C79.1.

F. Lamp base complying with ANSI C81.61 or IEC 60061-1.

G. CRI of minimum 82. CCT of 3500 K (See Luminaire Schedule). Rated lamp life of 50,000 hours.

H. Luminaires dimmable from 100 percent to 0 percent of maximum light output. See Luminaire Schedule for dimming per luminaire type.

I. Internal driver.

J. Nominal Service Voltage: 277 VAC.

K. Lens Thickness: At least 0.15 inch (3.175mm) minimum unless otherwise indicated.

L. Housings:

1. As specified in Luminaire Schedule

2.3 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Cooper Lighting.
2. Hubbell Lighting.
3. Lithonia Lighting; Acuity Brands Lighting, Inc.
4. Phillips

B. Minimum lumens see Luminaire Schedule. Minimum allowable efficacy of 80 lumens per watt.

C. With integral mounting provisions.

2.4 MATERIALS

A. Metal Parts:

1. Free of burrs and sharp corners and edges.
2. Sheet metal components shall be steel unless otherwise indicated.
3. Form and support to prevent warping and sagging.

B. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.

C. Housings:

1. Extruded-aluminum housing and heat sink.
2. Powder-coat painted finish.

D. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps. Locate labels where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.

1. Label shall include the following lamp characteristics:

a. "USE ONLY" and include specific lamp type.
b. Lamp diameter, shape, size, wattage, and coating.
c. CCT and CRI for all luminaires.

2.5 METAL FINISHES

A. Variations in finishes are unacceptable in the same piece. Variations in finishes of adjoining components are acceptable if they are within the range of approved Samples and if they can be and are assembled or installed to minimize contrast.

2.6 LUMINAIRE FIXTURE SUPPORT COMPONENTS

A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.

B. Single-Stem Hangers: 1/2-inch (13-mm) steel tubing with swivel ball fittings and ceiling canopy. Finish same as luminaire.

C. Wires: ASTM A 641/A 641 M, Class 3, soft temper, zinc-coated steel, 12 gage (2.68 mm) .

D. Rod Hangers: 3/16-inch (5-mm) minimum diameter, cadmium-plated, threaded steel rod.

E. Hook Hangers: Integrated assembly matched to luminaire, line voltage, and equipment with threaded attachment, cord, and locking-type plug.

PART 3 - INTELLIGENT LED ILLUMINATION SYSTEM

3.1 COLORGRAZE POWERCORE

A. MANUFACTURER GENERAL

The Contractor shall furnish the complete LED-based lighting system as described in the architectural details. It shall be manufactured by Philips Color Kinetics. All products associated with installation and control of the LED system, including peripheral devices and software, are to be provided by a single manufacturer. Manufacturer shall provide mechanical, electrical, network communication, and environmental specifications along with system wiring diagrams and installation instructions. Manufacturer shall provide the option of a factory-trained applications engineer for on-site supervision of start-up and/or programming and shall provide 24-hour technical support. Manufacturer shall have at least ten years of experience designing, selling, and supporting intelligent LED systems, and shall be able provide a reference listing installations using its intelligent LED-based systems. LED fixtures must have a minimum 5 year manufacturer's warranty.

B. LED LIGHT CHARACTERISTICS AND PHOTOMETRICS

All LEDs used in the LED fixture shall be high brightness and of proven quality from established and reputable LED manufacturers.

Manufacturer shall utilize an advanced production LED binning process such as Optibin® from Philips Color Kinetics to deliver a common and repeatable color point to maintain color consistency from fixture to fixture and project to project over time, while ensuring a reliable supply of LEDs from the supplier.

Manufacturer shall provide optical performance, polar diagrams, and photometric data in various formats including IES file format in accordance with IES LM-79-08. Photometric data shall be based on test results from an independent NIST traceable testing lab. IES data must be available and downloadable from manufacturer's Web Site.

Fixture shall provide a lumen output equal to **X** (see data sheet or spec sheet), and be capable of 8-bit and 16-bit control of red, green, blue and 4000K white LEDs to produce 16.7 million colors.

C. LED FIXTURE AND TECHNOLOGY

Fixture shall be available in 3 lengths and consume 18 W @ 2-ft, 27 W @ 3-ft and 36 W @ 4-ft maximum at full output.

Fixture shall have auto-switching input voltage for 100 – 277 VAC.

Fixture shall be a Class 2 LED product.

Fixture housing shall be IP66-rated extruded anodized aluminum housing with a clear polycarbonate lens.

Fixture shall have standard beam angle options. Custom BTO beam angle options shall also be available.

Fixture shall have multi-positional, constant torque, locking hinges for mounting.

The LED system should be digitally driven using noise-shaping pulse width modulation (PWM) techniques, and use integral and differential nonlinear control.

Fixture shall use Chromacore® technology, and able to receive an individual light address per one foot segments controllable via DMX 512 or KiNET Ethernet protocol, which is compatible with standard Ethernet hardware.

LED fixture shall integrate Powercore® technology to merge line voltage with control data and deliver them to the fixture over a single standard cable from the Philips Color Kinetics Data Enabler. A single microprocessor-controlled SSL driver that efficiently and accurately will condition and manage power output to LED systems directly from line voltage is required.

The system should achieve an efficiency of 80%+ for controllable color fixtures. Power factor correction of at least 0.99 into every fixture.
LED fixtures shall have the technology to allow long runs of fixtures on a single trunk line and installation using standard wiring and conventional installation methods to eliminate the need for external transformers or power supplies.

D. COMPLIANCE
Manufacturer shall ensure that products undergo and successfully meet appropriate design and manufacturability testing, including Design FMEA, Process FMEA, environmental engineering considerations, and laboratory tests. Manufacturer shall be able to provide documentation supporting the product's compliance with third-party regulations.
All LED fixtures shall undergo a minimum 24-hour burn-in test during manufacturing.
The LED fixture shall be operated at constant and carefully regulated current levels.
LEDs shall not be designed to be driven beyond their specified nominal voltage and current.

E. High-power LED fixtures shall be thermally protected using metal core board, gap pad, and/or internal monitoring firmware thermal management techniques. LED fixture housing shall be designed to transfer heat from the LED board to the outside environment. All hardwired connections to LED fixture shall be reverse-polarity protected and shall provide high-voltage protection in the event that connections are reversed or shorted during installation.
Outdoor LED fixtures shall comply with Random Vibration MIL-STD 810 Category 24, pass temperature range operational testing from –40° C to 50° C, pass high-temperature storage testing up to 85° C, pass high-temperature operating testing up to 50° C, meet lumen maintenance standards as defined in IESNA LM-80-08, pass water ingress testing, and pass general endurance
testing.

F. LED fixture shall be UL listed or UL/cUL classified, CE certified, PSE marked, RoHS compliant, FCC compliant and WEEE certified.

3.2 DATA ENABLER PRO

A. Data Enabler Pro delivers integrated data and power to intelligent color and tunable white LED lighting fixtures employing Powercore® technology from Philips Color Kinetics.

B. MANUFACTURER GENERAL
The Contractor shall furnish the complete LED-based lighting system as described in the architectural details. The lighting system shall be manufactured by Philips Color Kinetics. All products associated with the LED system installation and control, including peripheral devices and software, are to be provided by a single manufacturer. Manufacturer shall provide mechanical, electrical, network communication, and environmental specifications along with system wiring diagrams and installation instructions. Manufacturer shall provide the option of a factory-trained applications engineer for on-site supervision of start-up and/or programming and shall provide 24-hour technical support. Manufacturer shall have at least fifteen years of experience designing, selling, and supporting intelligent LED systems, and shall provide a reference listing installations using its intelligent LED-based systems upon request. LED fixtures must have a minimum 5 year manufacturer's warranty.

C. PHYSICAL CHARACTERISTICS
Power Data Interface shall support Powercore technology
Power Data Interface shall merge line voltage and control data and deliver them to the LED luminaire over a single 4-conductor cable.

Power Data Interface shall include accessible, clearly labeled terminal block connectors for DMX512, Ethernet, line voltage
Power Data Interface shall support DMX512 and Ethernet data communications —providing inputs and outputs for both DMX512 and Ethernet, allowing the user to connect multiple Power Data Interfaces in series.
Power Data Interface shall include a tethered cover with captive screws to ensure convenient removal and replacement
Power Data Interface shall incorporate double-pair, double-entry IDC connectors for all data connections, which accept unstripped cable wire strands.
Power Data Interface shall weight ≤ 5.4 lbs and incorporate an outdoor-rated, cast aluminum housing with slots for surface mounting for use in damp and wet environments,
(IP66-rated enclosure.)
Power Data Interface shall include multiple conduit entries to accommodate NPT conduit in US trade sizes of 1/2 in and 3/4 in, or metric sizes of PG13.5 and PG21.
Power Data Interface shall have an operating Temperature Range of -40° – 122° F
(-40° – 50° C)
Dimensions for Power Data Interface shall be ≤ (Height x Width x Depth) 3.4 x 10.5 x 5.4 inches.
Product packaging for each Power Data Interface shall include 8 mm hex wrench, 3 mm hex wrench and installation Instructions.

D. TECHNOLOGY
Power Data Interface shall automatically senses mains voltages ranging from 100 VAC to 277 VAC, and passes mains voltages through to all connected LED lights.
Power Data Interface shall have a maximum input current of 16.5 Amps
Maximum idle power consumption for Power Data Interface shall be ≤ 5 Watts.
Power Data Interface shall include optional power-saving modes which can be remotely configured and automatically cut power to attached lights when they do not receive data for a configurable number of minutes
Power Data Interface shall include on-board indicator LEDs providing visual feedback for normal operation, Ethernet connection detection, and Ethernet and DMX512 data transmission
Manufacture shall provide software free of charge which allows the Power Data Interface to be remote configured including:
Interface name
Interface IP address
Interface universe
The Power Data Interface shall have a firmware image which can be updated to improve system performance and functionality. The Manufacture shall provide software free of charge that allows the firmware for the Power Data Interface to be updated remotely over an Ethernet network.

Power Data Interface shall allow long runs of fixtures on a single trunk line and installation using standard wiring and conventional installation methods to eliminate the need for external transformers or power supplies.

E. The maximum individual run length from the Power Data Interface shall be ≤ 175 feet and the total cable length per Power Data Interface shall be ≤ 400 feet.

PART 4 - **EXEC**UTION

4.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for luminaire to verify actual locations of luminaire and electrical connections before fixture installation. Proceed with installation only after unsatisfactory conditions have been corrected.

4.2 TEMPORARY LIGHTING

A. If approved by the Architect, use selected permanent luminaires for temporary lighting. When construction is sufficiently complete, clean luminaires used for temporary lighting and install new lamps.

4.3 INSTALLATION

A. Comply with NECA 1.

B. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.

C. Install lamps in each luminaire.

D. Supports:

1. Sized and rated for luminaire weight.
2. Able to maintain luminaire position after cleaning and relamping.
3. Provide support for luminaire without causing deflection of ceiling or wall.
4. Luminaire mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and vertical force of 400 percent of luminaire weight.

E. Flush-Mounted Luminaire Support:

1. Secured to outlet box.
2. Attached to ceiling structural members at four points equally spaced around circumference of luminaire.
3. Trim ring flush with finished surface.

F. Wall-Mounted Luminaire Support:

1. Attached to structural members in walls; attached to a minimum 20 gauge backing plate attached to wall structural members; attached using through bolts and backing plates on either side of wall.
2. Do not attach luminaires directly to gypsum board.

G. Ceiling-Mounted Luminaire Support:

1. Ceiling mount with two 5/32-inch- (4-mm-) diameter aircraft cable supports adjustable to 120 inches (6 m) in length.
2. Ceiling mount with pendant mount with 5/32-inch- (4-mm-) diameter aircraft cable supports adjustable to 120 inches (6 m) in length.
3. Ceiling mount with hook mount.

H. Suspended Luminaire Support:

1. Pendants and Rods: Where longer than 48 inches (1200 mm), brace to limit swinging.
2. Stem-Mounted, Single-Unit Luminaires: Suspend with twin-stem hangers. Support with approved outlet box and accessories that hold stem and provide damping of luminaire oscillations. Support outlet box vertically to building structure using approved devices.
3. Continuous Rows of Luminaires: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of luminaire chassis, including one at each end.
4. Do not use ceiling grid as support for pendant luminaires. Connect support wires or rods to building structure.

I. Ceiling-Grid-Mounted Luminaires:

1. Secure to any required outlet box.
2. Secure luminaire to the luminaire opening using approved fasteners in a minimum of four locations, spaced near corners of luminaire.
3. Use approved devices and support components to connect luminaire to ceiling grid and building structure in a minimum of four locations, spaced near corners of luminaire.

J. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" for wiring connections.

4.4 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

4.5 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
2. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal.

B. Luminaire will be considered defective if it does not pass operation tests and inspections.

C. Prepare test and inspection reports.

4.6 STARTUP SERVICE

A. Comply with requirements for startup specified in Section 260943.16 "Addressable-Fixture Lighting Controls."

B. Comply with requirements for startup specified in Section 260943.23 "Relay-Based Lighting Controls."

4.7 ADJUSTING

A. Occupancy Adjustments: When requested within **12** months of date of Substantial Completion, provide on-site assistance in adjusting the direction of aim of luminaires to suit occupied conditions. Make up to **two** visits to Project during other-than-normal hours for this purpose. Some of this work may be required during hours of darkness.

1. During adjustment visits, inspect all luminaires. Replace lamps or luminaires that are defective.
2. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
3. Adjust the aim of luminaires in the presence of the Architect.

END OF SECTION 265119

SECTION L-101 AIRPORT ROTATING BEACONS

DESCRIPTION

101-1.1 This item shall consist of furnishing and installing the new airport rotating beacon. The work shall also include support frame, mounting, leveling, wiring, painting, servicing, and testing of the beacon. In addition, this item also includes all materials and incidentals necessary to place the beacon in an operating condition (as a completed unit) to the satisfaction of the Engineer. This item shall include a mounting platform if specified in the plans.

101-1.2 Prior to demolition of the existing air traffic control tower, the Contractor shall remove the existing airport rotation beacon and supply to the owner.

EQUIPMENT AND MATERIALS

101-2.1 General.

a. Airport lighting equipment and materials covered by advisory circulars (ACs) must be certified and listed in AC 150/5345-53, Airport Lighting Equipment Certification Program, ***current version***.

b. All other equipment and materials covered by other referenced specifications shall be subject to acceptance through manufacturer's certification of compliance with the applicable specification when requested by the Engineer.

c. Manufacturer's certifications shall not relieve the Contractor of the responsibility to provide materials that are per these specifications. Materials supplied and/or installed that do not comply with these specifications shall be removed (when directed by the Engineer and replaced with materials, that are per these specifications, at the Contractor's cost.

d. All materials and equipment used to construct this item shall be submitted to the Engineer for approval prior to ordering the equipment. Submittals consisting of marked catalog sheets or shop drawings shall be provided. Submittal data shall be presented in a clear, precise and thorough manner. Original catalog sheets are preferred. Photocopies are acceptable provided they are as good a quality as the original. Clearly mark each copy to identify the products or models applicable to this project. Indicate all optional equipment and delete any non-pertinent data. Submittals for components or electrical equipment and systems shall identify the equipment to which they apply on each submittal sheet. Markings shall be made bold and clear with arrows or circles (highlighting is not acceptable). The Contractor is solely responsible for delays in the project that accrue directly or indirectly from late submissions or resubmissions of submittals.

e. The data submitted shall be sufficient, in the opinion of the Engineer, to determine compliance with the Contract Documents plans and specifications. The Contractor's submittals shall be neatly bound in a properly sized 3-ring binder, tabbed by specification section. The Engineer reserves the right to reject any and all equipment, materials or procedures that do not meet the system design and the standards and codes, specified in this document.

f. Only Third Party certified manufacturers, listed in AC 150/5345-53, Appendix 3 Addendum (as required) and meeting the BUY AMERICAN preference requirements can provide equipment and materials specified in the Contract Documents. Documentation certifying compliance with the BUY AMERICAN preference rules for Airport Improvement Program (AIP) cited in 49 USC §50101) shall be included with each equipment and material submittal.

g. All equipment and materials furnished and installed in this section shall be guaranteed against defects in materials and workmanship for at least twelve (12) months from the date of final acceptance by the

Owner. The defective materials and/or equipment shall be repaired or replaced, at the Owner's discretion, with no additional cost to the Owner.

101-2.2 Beacon. The beacon shall be a Type L-802A Class 1 beacon meeting the requirements of AC 150/5345-12, Specification for Airport and Heliport Beacons***, current version***.

101-2.3 Beacon installation. See AC 150/5340-30, Design and Installation Details for Airport Visual Aids, ***current version*** for beacon installation details. Provide two lamp sets as spares.

101-2.4 Panel boards and breakers. Panel boards and breakers shall conform to the requirements of Federal Specification W-P-115, Panel, Power Distribution.

101-2.5 Weatherproof cabinets. The weatherproof cabinets shall conform to National Electrical Manufacturers Association Standards (NEMA) and shall be constructed of steel not less than No. 16 United States Standard (USS) gauge.

101-2.6 Electrical wire. For ratings up to 600 volts, moisture and heat resistant thermoplastic wire conforming to Commercial Item Description A-A-59544A Type THWN-2 shall be used. The wires shall be the type, size, number of conductors, and voltage shown in the plans or in the proposal.

101-2.7 Conduit. Rigid steel conduit and fittings shall be per Underwriters Laboratories Standards 6, 514B, and 1242.

101-2.8 Paint.

a. Priming paint for non-galvanized metal surfaces shall be a high solids alkyd primer per Society for Protective Coatings (SSPC) Paint 25.

b. Priming paint for galvanized metal surfaces shall be a zinc-rich epoxy primer paint per MIL-DTL-24441/19B, Formula 159, Type III. Use MIL-24441 thinner per paint manufacturer's recommendations.

c. Orange paint for the body and the finish coats on metal and wood surfaces shall consist of a ready-mixed non-fading paint meeting the requirements of Master Painter's Institute (MPI) Reference #9 (gloss). The color shall be per Federal Standard 595, International Orange Number 12197.

d. White paint for body and finish coats on metal and wood surfaces shall be ready-mixed paint per the Master Painter's Institute, Reference #9, Exterior Alkyd, Gloss, volatile organic content (VOC) Range E2.

e. Priming paint for wood surfaces shall be mixed on the job by thinning the above-specified orange or white paint with 1/2 pint (0.24 liter (l)) of raw linseed oil to each gallon (liter).

CONSTRUCTION METHODS

101-3.1. Placing the beacon. The beacon shall be mounted on a beacon tower, platform, or building roof as shown in the plans.

101-3.2 Hoisting and mounting. The beacon shall be hoisted to the mounting platform by using suitable slings and hoisting tackle. Before fastening the beacon to the mounting platform, the mounting holes shall be checked for correct spacing. Beacon base or mounting legs shall not be strained or forced out of position to fit incorrect spacing of mounting holes. The beacon base shall be raised first, set in position, and bolted in place. The drum shall then be raised and assembled to the base.

101-3.3 Leveling. After the beacon has been mounted, it shall be accurately leveled following the manufacturer's instructions. The leveling shall be checked in the presence of the Engineer and shall be to the Engineer's satisfaction.

101-3.4 Servicing. Before placing the beacon in operation, the Contractor shall check the manufacturer's manual for proper servicing requirements. Follow the manufacturer's servicing instructions for each size of beacon.

101-3.5 Beam adjustment. After the beacon has been mounted and leveled, the elevation of the beam shall be adjusted. The final beam adjustments shall be made at night so that results can be readily observed. The beams shall be adjusted to the elevation directed by the Engineer or as shown in the plans. See AC 150/5340-30 for additional information about airport beacon beam adjustment.

101-3.6 Beacon mounting platform. Where the beacon is to be mounted at a location other than the beacon tower and where a special mounting platform is required, the construction of the mounting platform and any necessary lightning protection equipment shall be per the details shown in the plans.

101-3.7 Wiring. The Contractor shall furnish all necessary labor and materials and shall make complete above ground electrical connections per the wiring diagram furnished with the project plans. The electrical installation shall conform to the requirements of the latest edition of National Fire Protection Association, NFPA-70, National Electrical Code (NEC). Copies of the National Electric Code may be obtained from the NFPA website: http://www.nfpa.org/aboutthecodes/list_of_codes_and_standards.asp

If underground cable for the power feed from the transformer vault to the beacon site and duct for this cable installation is required, the cable, ground rods and duct shall be installed per and paid for as described in Item L-108, Underground Power Cable for Airports, and Item L-110, Airport Underground Electrical Duct Banks and Conduit.

Unless otherwise specified, the Contractor shall connect the tell-tale relay mechanism in the beacon to energize the tower obstruction light circuit when failure of the beacon service (primary) lamp occurs.

If lightning protection is specified in the plans or proposal as a part of this item, it shall be installed per paragraph 103-2.3 in Item L-103, Airport Beacon Towers.

101-3.8 Panel and cabinet. Unless otherwise specified, the Contractor shall furnish and install at the top of the beacon tower or mounting platform a circuit-breaker panel consisting of four 15-ampere breakers mounted in a weather-proof cabinet to provide separate protection for the circuits to the beacon lamps, motor, obstruction lights, and other equipment. The cabinet shall be located on the side of the beacon platform, as directed by the Engineer.

101-3.9 Conduit. All exposed wiring shall be run in not less than 3/4 inch (19 mm) galvanized rigid steel conduit. Outdoor rated, liquid-tight, flexible metal conduit may be used for final connection at the beacon equipment. No conduit shall be installed on top of a beacon platform floor. All conduits shall be installed to provide for drainage. If mounted on a steel beacon tower, the conduit shall be fastened to the tower members with Wraplock® straps (or equivalent), clamps, or approved fasteners, spaced approximately 5 feet (1.5 m) apart. The conduit shall be fastened to wooden structures with galvanized pipe straps and with galvanized wood screws not less than No. 8 or less than 1-1/4 inches (32 mm) long. There shall be at least two fastenings for each 10 feet (3 m) length.

101-3.10 Booster transformer. If shown in the plans or specified in job specifications, a booster transformer to compensate for voltage drop to the beacon shall be installed in a suitable weatherproof housing under or on the tower platform or at the base of the tower. The installation shall be as indicated in the plans and described in the proposal. If the booster transformer is required for installation remote from the beacon, it shall be installed per and paid for as part of the beacon installation.

101-3.11 Photoelectric control. If shown in the plans or specified in the job specifications, the Contractor shall furnish and install an automatic control switch at the location indicated in the plans. The switch shall be a photoelectric type. It shall be a standard commercially available unit that will energize when the illumination on a vertical surface facing North decreases to 25 to 35 foot-candles (269 to 377 lux). The photoelectric switch should de-energize when the illumination rises to 50 to 60 foot-candles (538 to 646 lux). The photoelectronic switch shall be installed, connected, and adjusted per the manufacturer's instructions.

101-3.12 Obstruction lights. Unless otherwise specified, the Contractor shall install on the top of the beacon tower or mounting platform two L-810 obstruction lights on opposite corners. These lights shall be mounted on conduit extensions to a height of not less than 4 inches (100 mm) above the top of the beacon.

101-3.13 Painting. If construction of a wooden mounting platform is stipulated in the proposal as part of this item, all wooden parts of the platform shall be given one priming coat of white or aviation-orange paint after fabrication but before erection and one body and one finish coat of international-orange paint after erection. Steel mounting platforms shall be given one priming coat of corrosion-inhibiting primer before erection and one body and one finish coat of international-orange paint after erection. All equipment installed under this contract and exposed to the weather shall be given one body and one finish coat of international-orange (per Federal Standard 595, Number 12197) or white paint as required. This shall include the beacon (except glass surfaces), beacon base, breaker cabinet, all conduit, and transformer cases. It shall not include lightning protection system air terminals or obstruction light globes.

Skilled painters must apply the paint uniformly at the proper consistency. The finished paint shall be free from sags, holidays, and smears. Each coat of paint shall be given ample time to dry and harden before the next coat of paint is applied. A minimum of three (3) days shall be allowed for drying on wood surfaces, and a minimum of four (4) days shall be allowed for drying on metal surfaces. Painting shall not be performed in cold, damp, foggy, dusty, or frosty atmospheres, or when the air temperature is below 40°F (4°C), nor started when the weather forecast indicates such conditions for the day.

All surfaces shall be cleaned before painting. The surfaces shall be dry and free from scale, grease, rust, dust, and dirt. All knots in wood surfaces shall be covered with shellac immediately before applying the priming coat of paint. Nail holes and permissible imperfections shall be filled with putty. The ready-mixed paint shall be thinned for the priming and body coats per the manufacturer's recommendations. In the absence of such recommendations, the following shall apply:

a. Body coats (for both wood and steel surfaces) - add 1/2 pint (0.24 liter) of turpentine to each gallon (liter) of ready-mixed paint for body coats.

b. Finish coats (for both wood and steel surfaces) the ready-mixed paint shall be used as it comes from the container for finish coats.

101-3.14 Testing. The beacon installation shall be fully tested as a completed unit prior to acceptance. These tests shall include operation of the lamp-changer and performing insulation resistance and voltage readings. The insulation resistance to ground of the beacon power supply circuit shall be not less than 100 megohms when measured ungrounded. The Contractor must furnish testing equipment. Tests shall be conducted in the presence of the Engineer and shall be to the Engineer's satisfaction.

METHOD OF MEASUREMENT

101-4.1 The quantity to be paid for shall be the number of beacons installed as completed units in place, accepted, and ready for operation.

BASIS OF PAYMENT

101-5.1 Payment will be made at the contract unit price for each completed and accepted job. This price shall be full compensation for furnishing all materials and for all preparation, assembly, and installation of these materials, and for all labor, equipment, tools, and incidentals necessary to complete this item.

Payment will be made under:

Item L-101-5.1	Airport Rotating Beacon, in place - per each

MATERIAL REQUIREMENTS

AC 150/5345-7	Specification for L-824 Underground Cable for Airport Lighting Circuits
AC 150/5345-12	Specification for Airport and Heliport Beacons
AC 150/5340-30	Design and Installation Details for Airport Visual Aids
AC 150/5345-53	Airport Lighting Equipment Certification Program
FED SPEC A-A-59544	Cable and Wire, Electrical (Power, Fixed Installation)
FED SPEC W-P-115	Panel, Power Distribution
FED STD 595	Colors Used in Government Procurement
MPI Reference #9	Alkyd, Exterior, Gloss (MPI Gloss Level 6)
MIL-DTL-24441C/19B	Paint, Epoxy-Polyamide, Zinc Primer, Formula 159, Type III
NFPA-70	National Electric Code (NEC)
NFPA-780	Standard for the Installation of Lightning Protection Systems
SSPC Paint 25 BCS	Zinc Oxide, Alkyd, Linseed Oil, Primer for
Underwriters Laboratories Standard 6	Electrical Rigid Metal Conduit – Steel
Underwriters Laboratories Standard 514B	Conduit, Tubing, and Cable Fittings
Underwriters Laboratories Standard 1242	Electrical Intermediate Metal Conduit - Steel

END OF ITEM L-101

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SECTION L-105 ALTERATIONS, REMOVAL, AND DEMOLITION

GENERAL

105-1.1 DEFINITIONS.

Removal shall mean the dismantling of existing materials, components, equipment, and utilities. Removed items shall be handled, prepared for storage, transported to storage areas as specified.

All items to be turned over to the Owner shall be properly enclosed or boxed to protect the items from damage and transported by the Contractor to a location on the Owner's property, designated by the Engineer and/or the Owner.

The installation and/or removal of lighting equipment may be critical to airport operations; therefore, the Contractor shall follow the work schedule established in the plans and specifications or as directed by the Engineer. The system shall be installed in accordance with the National Electrical Code and/or local code requirements.

105-1.2 CONDITION OF EXISTING FACILITIES. The Contractor shall verify the areas, conditions, and features necessary to tie into existing construction. This verification shall be done prior to submittal of shop drawings, fabrication or erection, construction or installation. Special attention is called to the fact that there may be piping, fixtures or other items in the existing systems which must be removed or relocated in order to perform the alteration work.

105-1.3 OCCUPANCY AND USE OF EXISTING FACILITIES. The Contractor shall be required to plan and coordinate his activities with the Owner in order to provide all necessary controls for the abatement of dust, noise, and inconvenience to the Owner personnel during all phases of the work.

The Owner will remove all portable items of furniture, equipment, and vehicles prior to the start of work.

105-1.4 SAFETY REQUIREMENTS. The Contractor shall conduct alterations and removal operations in a manner that will ensure the safety of persons in accordance with the requirements of CFR 29 PART 1926 and 1910.

105-1.5 TEMPORARY PROTECTION. The Contractor shall protect persons and property throughout the progress of the work in accordance with these specifications. Provide temporary exits, entrances, and protected passages where work prevents the use of existing facilities.

EXECUTION

105-2.1 DISCONNECTING UTILITIES. Prior to the start of work, the necessary utilities serving each area of alteration or removal will be shut off by the Owner and shall be disconnected and sealed by the Contractor, as required. Lockout/Tag/Try procedures shall be utilized in accordance with all Contract specifications.

105-2.2 REMOVAL WORK. The Contractor shall not disturb the existing construction beyond that indicated or necessary for installation of new work.

The Contractor shall provide protective measures to control accumulation and migration of dust and dirt in all areas of work, particularly those adjacent to occupied areas. The Contractor shall remove dust, dirt, and debris from the areas of work daily.

105-2.3 SALVAGEABLE MATERIALS AND EQUIPMENT. The Contractor shall remove all salvageable materials and equipment in a manner that will cause the least possible damage thereto. Removed items which are to be retained by the Owner shall be carefully handled, stored, and protected.

105-2.4 BUILDINGS AND STRUCTURES. The Contractor shall perform removal operations in existing buildings and structures as indicated and as otherwise required to complete the work.

The Contractor shall dismantle steel components at field connections and in a manner that will prevent bending or damage. The use of flame-cutting torches will be permitted only when other methods of dismantling are not practical, and when approved in writing by the Owner and/or Engineer.

105-2.5 ELECTRICAL EQUIPMENT AND FIXTURES. Wiring systems and components shall be salvaged. Loose items shall be boxed and tagged for identification.

All unused conduit not removed shall have a pull string installed and shall be noted on the record drawings.

Primary, secondary, control, communication, and signal circuits shall be disconnected at the point of attachment to their distribution system.

The Contractor shall remove and salvage electrical fixtures. Incandescent lamps, mercury-vapor lamps, and fluorescent lamps shall be salvaged, boxed and tagged for identification, and protected from breakage.

The Contractor shall remove and salvage switches, receptacles, fixtures, transformers, constant current regulators, meters, instruments, plates, circuit breakers, panelboards, outlet boxes, and similar items. These items shall be boxed, and tagged for identification according to type and size.

The Contractor shall remove and dispose of conductors and conduits not used in the finished work and shown to be demolished on the plans.

DEMOLITION

105-3.1 DEMOLITION OPERATIONS. Demolition operations shall be conducted to ensure the safe passage of persons to and from facilities occupied and used by the Owner and to prevent damage by falling debris or other cause to adjacent buildings, structures, and other facilities.

The sequence of operations shall be such that maximum protection from inclement weather will be provided for materials and equipment located in partially dismantled structures.

105-3.2 MAINTAINING TRAFFIC. Demolition operations and removal of debris to disposal areas shall be conducted to ensure minimum interference with runways, taxiways, aprons, roads, streets, walks, and other facilities occupied and used by the Owner.

Streets, walks, runways, taxiways and other facilities occupied and used by the Owner shall not be closed or obstructed without written permission from the Owner.

105-3.3 REFERENCE STANDARDS REQUIREMENTS. Demolition operations shall be conducted to ensure the safety of persons in accordance with ANSI A 10.6 Safety Requirements for Demolition.

Demolition shall be conducted in accordance with OSHA, State and local requirements.

DISPOSAL OF DEMOLISHED MATERIALS

105-4.1 GENERAL. The Contractor shall dispose of debris, rubbish, scrap, and other non-salvageable materials resulting from demolition operations. Demolished materials shall not be stored or disposed of on Airport property.

105-4.2 REMOVAL FROM OWNER PROPERTY. Materials classified as debris shall be transported from Owner property and legally disposed of at no additional cost to the Owner. Permits and fees for disposal shall be paid by the Contractor.

ALTERATION WORK

105-5.1 GENERAL. Cutting, patching, repairing, and other alteration work shall be done by tradesman skilled in the particular trade or work required.

Where required to patch or extend existing construction, or both, such alteration work shall match existing exposed surface materials in finish, color, texture, and pattern.

Salvaged items for reuse shall be as approved by the Engineer and Owner.

METHOD OF MEASUREMENT

105-6.1 Payment will be made on a lump sum basis.

BASIS OF PAYMENT

105-7.1 Payment will be made at the lump sum price for required removal of existing airport beacon tower/mast and cables. Rotating beacon concrete foundation and existing conduit below the beacon foundation shall be abandoned in place. Existing conduit below the foundation level shall be protected. All other equipment shall be protected, including but not limited to the airfield lighting/beacon cabinet, transformer, meter rack, power/ASOS disconnects, transfer switch, transformer, and fuel tanks. This item includes all materials, labor, transportation, incidentals and services required for the demolition as shown on the plans. This item includes any temporary wiring, fixtures, etc. required to maintain the existing airfield lighting systems to the satisfaction of the Owner and Engineer. It is the intent of the demolition pay item that all equipment, devices, fixtures, wiring, materials, systems and appurtenances, etc. which are no longer required as a result of the beacon removal be removed.

Payment will be made under:

Item L-105-7.1 Remove and Relocate Beacon -- per Lump Sum.

END OF ITEM L-105

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ITEM L-108 UNDERGROUND POWER CABLE FOR AIRPORTS

DESCRIPTION

108-1.1 This item shall consist of furnishing and installing power cables that are direct buried and furnishing and/or installing power cables within conduit or duct banks per these specifications at the locations shown on the plans. It includes excavation and backfill of trench for direct-buried cables only. Also included are the installation of counterpoise wires, ground wires, ground rods and connections, cable splicing, cable marking, cable testing, and all incidentals necessary to place the cable in operating condition as a completed unit to the satisfaction of the Engineer. This item shall not include the installation of duct banks or conduit, trenching and backfilling for duct banks or conduit, or furnishing or installation of cable for FAA owned/operated facilities. Requirements and payment for trenching and backfilling for the installation of underground conduit and duct banks is in Item L-110, Airport Underground Electrical Duct Banks and Conduits.

EQUIPMENT AND MATERIALS

108-2.1 General.

a. Airport lighting equipment and materials covered by advisory circulars (AC) shall be approved under the Airport Lighting Equipment Certification Program per AC 150/5345-53, current version.

b. All other equipment and materials covered by other referenced specifications shall be subject to acceptance through manufacturer's certification of compliance with the applicable specification, when requested by the Engineer.

c. Manufacturer's certifications shall not relieve the Contractor of the responsibility to provide materials per these specifications. Materials supplied and/or installed that do not comply with these specifications shall be removed (when directed by the Engineer) and replaced with materials that comply with these specifications at the Contractor's cost.

d. All materials and equipment used to construct this item shall be submitted to the Engineer for approval prior to ordering the equipment. Submittals consisting of marked catalog sheets or shop drawings shall be provided. Submittal data shall be presented in a clear, precise and thorough manner. Original catalog sheets are preferred. Photocopies are acceptable provided they are as good a quality as the original. Clearly and boldly mark each copy to identify products or models applicable to this project. Indicate all optional equipment and delete any non-pertinent data. Submittals for components of electrical equipment and systems shall identify the equipment to which they apply on each submittal sheet. Markings shall be made bold and clear with arrows or circles (highlighting is not acceptable). The Contractor is solely responsible for delays in the project that may accrue directly or indirectly from late submissions or resubmissions of submittals.

e. The data submitted shall be sufficient, in the opinion of the Engineer, to determine compliance with the plans and specifications. The Contractor's submittals shall be neatly bound in a properly sized 3-ring binder, tabbed by specification section. The Engineer reserves the right to reject any and all equipment, materials, or procedures that do not meet the system design and the standards and codes, specified in this document.

f. All equipment and materials furnished and installed under this section shall be guaranteed against defects in materials and workmanship for at least twelve (12) months from the date of final acceptance by the Owner. The defective materials and/or equipment shall be repaired or replaced, at the Owner's discretion, with no additional cost to the Owner. The Contractor shall be responsible to maintain a minimum insulation resistance per AC 150/5340-26~~B~~, Maintenance Airport Visual aid Facilities, ***current version,*** Table 5-1 and paragraph 5.1.3.1, with isolation transformers connected in new circuits and new segments of existing circuits through the end of the contract warranty period.

g. Only Third Party certified manufacturers, listed in AC 150/5345-53, Appendix 3 Addendum (as required) and meeting the BUY AMERICAN preference requirements can provide equipment and materials specified in the Contract Documents. Documentation certifying compliance with the BUY AMERICAN preference rules for Airport Improvement Program (AIP) cited in 49 USC §50101) shall be included with each equipment and material submittal.

108-2.2 Cable. Underground cable for airfield lighting facilities (runway and taxiway lights and signs) shall conform to the requirements of AC 150/5345-7, Specification for L-824 Underground Electrical Cable for Airport Lighting Circuits latest edition. Conductors for use on 6.6 ampere primary airfield lighting series circuits shall be single conductor, seven strand, #6 American wire gauge AWG, L-824 Type C, 5,000 volts, nonshielded, with cross-linked polyethylene insulation. L-824 conductors for use on the L-830 secondary of airfield lighting series circuits shall be sized in accordance with the manufacturer's recommendations. All other conductors shall comply with FAA and National Electric Code (NEC) requirements. Conductor sizes noted above shall not apply to leads furnished by manufacturers on airfield lighting transformers and fixtures.

Airfield lighting fixtures shall be connected into the series circuit as shown in the Contract Documents. The "return" conductor shall not be connected to any airfield lighting fixtures.

Wire for electrical circuits up to 600 volts shall comply with ***AC 150/5345-7, current version*** ~~Specification L-824~~ and/or Federal Specification A-A-59544 and shall be type THWN-2, 75°C. Conductors for parallel (voltage) circuits shall be sized and installed in accordance with NFPA-70, National Electrical Code.

Unless noted otherwise, all 600-volt and less non-airfield lighting conductor sizes are based on a 75°C, THWN-2, 600 volt insulation, copper conductors, not more than three single insulated conductors, in raceway, in free air. The conduit/duct sizes are based on the use of THWN-2, 600 volt insulated conductors. The Contractor shall make the necessary increase in conduit/duct sizes for other types of wire insulation. In no case shall the conduit/duct size be reduced. The minimum power circuit wire size shall be #12 AWG.

Conductor sizes may have been adjusted due to voltage drop or other engineering considerations. Equipment provided by the Contractor shall be capable of accepting the quantity and sizes of conductors shown in the Contract Documents. All conductors, pigtails, cable step-down adapters, cable step-up adapters, terminal blocks and splicing materials necessary to complete the cable termination/splice shall be considered incidental to the respective pay items provided.

Cable type, size, number of conductors, strand and service voltage shall be as specified in the Contract Document.

108-2.3 Bare copper wire (counterpoise, bare copper wire ground and ground rods). Wire for counterpoise or ground installations for airfield lighting systems shall be No. 6 AWG bare solid copper wire for counterpoise and/or No. 6 AWG insulated stranded for ground wire per ASTM B3 and ASTM B8, and shall be bare copper wire per ASTM B33. See AC 150/5340-30 for additional details about counterpoise and ground wire types and installation. For voltage powered circuits,

the equipment ground conductor shall be minimum No. 6 AWG, 600V rated, Type XHHW insulated, green color, stranded copper equipment ground conductor.

Each fixture shall be individually bonded to the light base with a No. 6 AWG stranded copper, green THWN-2 insulated bonding jumper. The wire shall conform to ASTM B3, ASTM B8, and ASTM B33.

Ground rods shall be copper-clad steel. The ground rods shall be of the length and diameter specified on the plans, but in no case be less than 10 feet (2.54 m) long and 3/4 inch (19 mm) in diameter. The ground rod assembly shall include exothermic connections and minimum 1/C No. 6 AWG bare copper wire. The resistance to ground of the counterpoise system shall not exceed 25 OHMs. Each rod shall be tested individually.

108-2.4 Cable connections. In-line connections or splices of underground primary cables shall be of the type called for on the plans, and shall be one of the types listed below. No separate payment will be made for cable connections.

a. The cast splice. A cast splice, employing a plastic mold and using epoxy resin equivalent to that manufactured by 3M™ Company, “Scotchcast” Kit No. 82-B, or as manufactured by Hysol® Corporation, “Hyseal Epoxy Splice” Kit No. E1135, or an approved equivalent, used for potting the splice is acceptable.

b. The field-attached plug-in splice. Figure 3 of AC 150/5345-26, Specification for L-823 Plug and Receptacle, Cable Connectors, employing connector kits, is acceptable for field attachment to single conductor cable. It shall be the Contractor’s responsibility to determine the outside diameter of the cable to be spliced and to furnish appropriately sized connector kits and/or adapters and heat shrink tubing with integral sealant.

c. The factory-molded plug-in splice. Specification for L-823 Connectors, Factory-Molded to Individual Conductors, is acceptable.

d. The taped or heat-shrink splice. Taped splices employing field-applied rubber, or synthetic rubber tape covered with plastic tape is acceptable. The rubber tape should meet the requirements of ASTM D4388 and the plastic tape should comply with Military Specification MIL-I-24391 or Commercial Item Description A-A-55809. Heat shrinkable tubing shall be heavy-wall, self-sealing tubing rated for the voltage of the wire being spliced and suitable for direct-buried installations. The tubing shall be factory coated with a thermoplastic adhesive-sealant that will adhere to the insulation of the wire being spliced forming a moisture- and dirt-proof seal. Additionally, heat shrinkable tubing for multi-conductor cables, shielded cables, and armored cables shall be factory kits that are designed for the application. Heat shrinkable tubing and tubing kits shall be manufactured by Tyco Electronics/ Raychem Corporation, Energy Division, or approved equivalent. ***The taped or heat-shrink splice shall not be used for splicing airfield lighting circuits. This splice may be used in combination with L-823 connectors in item b or c above.***

In all the above cases, connections of cable conductors shall be made using crimp connectors using a crimping tool designed to make a complete crimp before the tool can be removed. All L-823/L-824 splices and terminations shall be made per the manufacturer’s recommendations and listings.

All connections of counterpoise, grounding conductors and ground rods shall be made by the exothermic process or approved equivalent, except that a light base ground clamp connector shall be used for attachment to the light base. See AC 150/5340-30 for additional information about methods of attaching a ground to a galvanized light base. All exothermic connections shall be made per the manufacturer’s recommendations and listings.

108-2.5 Splicer qualifications. Every airfield lighting cable splicer shall be qualified in making airport cable splices and terminations on cables rated at or above 5,000 volts AC. The Contractor shall submit to the Engineer proof of the qualifications of each proposed cable splicer for the airport cable type and voltage level to be worked on. Cable splicing/terminating personnel shall have a minimum of three (3) years continuous experience in terminating/splicing medium voltage cable.

108-2.6 Concrete. Concrete for cable markers shall be per Specification Item P-610, Structural Portland Cement Concrete.

108-2.7 Flowable backfill. Flowable material used to backfill trenches for power cable trenches shall conform to the requirements of Item P-153, Controlled Low Strength Material.

108-2.8 Cable identification tags. Cable identification tags shall be made from a non-corrosive material with the circuit identification stamped or etched onto the tag. The tags shall be of the type as detailed on the plans.

108-2.9 Tape. Electrical tapes shall be Scotch™ Electrical Tapes –Scotch™ 88 (1-1/2 inch (38 mm) wide) and Scotch™ 130C® linerless rubber splicing tape (2-inch (50 mm) wide), as manufactured by the Minnesota Mining and Manufacturing Company (3M™), or an approved equivalent.

108-2.10 Electrical coating. Electrical coating shall be Scotchkote™ as manufactured by 3M™, or an approved equivalent.

108-2.11 Existing circuits. Whenever the scope of work requires connection to an existing circuit, the circuit's insulation resistance shall be tested, in the presence of the Engineer. The test shall be performed per this item and prior to any activity that will affect the respective circuit. The Contractor shall record the results on forms acceptable to the Engineer. When the work affecting the circuit is complete, the circuit's insulation resistance shall be checked again, in the presence of the Engineer. The Contractor shall record the results on forms acceptable to the Engineer. The second reading shall be equal to or greater than the first reading or the Contractor shall make the necessary repairs to the circuit to bring the second reading above the first reading. All repair costs including a complete replacement of the L-823 connectors, L-830 transformers and L-824 cable, if necessary, shall be borne by the Contractor. All test results shall be submitted in the Operation and Maintenance (O&M) Manual.

108-2.12 Detectable warning tape. Plastic, detectable, American Wood Preservers Association (AWPA) Red (electrical power lines, cables, conduit and lighting cable) with continuous legend magnetic tape shall be polyethylene film with a metalized foil core and shall be 3-6 inches (75-150 mm) wide. Detectable tape is incidental to the respective bid item.

CONSTRUCTION METHODS

108-3.1 General. The Contractor shall install the specified cable at the approximate locations indicated on the plans. Unless otherwise shown on the plans, all cable required to cross under pavements expected to carry aircraft loads shall be installed in concrete encased duct banks. Wherever possible, cable shall be run without splices, from connection to connection.

Cable connections between lights will be permitted only at the light locations for connecting the underground cable to the primary leads of the individual isolation transformers. The Contractor shall be responsible for providing cable in continuous lengths for home runs or other long cable runs without connections unless otherwise authorized in writing by the Engineer or shown on the plans.

In addition to connectors being installed at individual isolation transformers, L-823 cable connectors for maintenance and test points shall be installed at locations shown on the plans. Cable circuit identification markers shall be installed on both sides of the L-823 connectors installed or at least once in each access point where L-823 connectors are not installed.

Provide not less than 3 feet (1 m) of cable slack on each side of all connections, isolation transformers, light units, and at points where cable is connected to field equipment. Where provisions must be made for testing or for future above grade connections, provide enough slack to allow the cable to be extended at least one foot (30 cm) vertically above the top of the access structure. This requirement also applies where primary cable passes through empty light bases, junction boxes, and access structures to allow for future connections, or as designated by the Engineer.

Primary airfield lighting cables installed shall have cable circuit identification markers attached on both sides of each L-823 connector and on each airport lighting cable entering or leaving cable access points, such as manholes, hand holes, pull boxes, junction boxes, etc. Markers shall be of sufficient length for imprinting the cable circuit identification legend on one line, using letters not less than 1/4 inch (6 mm) in size. The cable circuit identification shall match the circuits noted on the construction plans.

108-3.2 Installation in duct banks or conduits. This item includes the installation of the cable in duct banks or conduit per the following paragraphs. The maximum number and voltage ratings of cables installed in each single duct or conduit, and the current-carrying capacity of each cable shall be per the latest version of the National Electric Code, or the code of the local agency or authority having jurisdiction.

The Contractor shall make no connections or splices of any kind in cables installed in conduits or duct banks.

Unless otherwise designated in the plans, where ducts are in tiers, use the lowest ducts to receive the cable first, with spare ducts left in the upper levels. Check duct routes prior to construction to obtain assurance that the shortest routes are selected and that any potential interference is avoided.

Duct banks or conduits shall be installed as a separate item per Item L-110, Airport Underground Electrical Duct Banks and Conduit. The Contractor shall run a mandrel through duct banks or conduit prior to installation of cable to ensure that the duct bank or conduit is open, continuous and clear of debris. The mandrel size shall be compatible with the conduit size. The Contractor shall swab out all conduits/ducts and clean light bases, manholes, etc., interiors immediately prior to pulling cable. Once cleaned and swabbed, the light bases and all accessible points of entry to the duct/conduit system shall be kept closed except when installing cables. Cleaning of ducts, light bases, manholes, etc., is incidental to the pay item of the item being cleaned. All raceway systems left open, after initial cleaning, for any reason shall be re-cleaned at the Contractor's expense. The Contractor shall verify existing ducts proposed for use in this project as clear and open. The Contractor shall notify the Engineer of any blockage in the existing ducts.

The cable shall be installed in a manner that prevents harmful stretching of the conductor, damage to the insulation, or damage to the outer protective covering. The ends of all cables shall be sealed with moisture-seal tape providing moisture-tight mechanical protection with minimum bulk, or alternately, heat shrinkable tubing before pulling into the conduit and it shall be left sealed until connections are made. Where more than one cable is to be installed in a conduit, all cable shall be pulled in the conduit at the same time. The pulling of a cable through duct banks or conduits may be accomplished by hand winch or power winch with the use of cable grips or pulling eyes. Maximum pulling tensions shall not exceed the cable manufacturer's recommendations. A non-

hardening cable-pulling lubricant recommended for the type of cable being installed shall be used where required.

The Contractor shall submit the recommended pulling tension values to the Engineer prior to any cable installation. If required by the Engineer, pulling tension values for cable pulls shall be monitored by a dynamometer in the presence of the Engineer. Cable pull tensions shall be recorded by the Contractor and reviewed by the Engineer. Cables exceeding the maximum allowable pulling tension values shall be removed and replaced by the Contractor at the Contractor's expense.

The manufacturer's minimum bend radius or NEC requirements (whichever is more restrictive) shall apply. Cable installation, handling and storage shall be per manufacturer's recommendations. During cold weather, particular attention shall be paid to the manufacturer's minimum installation temperature. Cable shall not be installed when the temperature is at or below the manufacturer's minimum installation temperature. At the Contractor's option, the Contractor may submit a plan, for review by the Engineer, for heated storage of the cable and maintenance of an acceptable cable temperature during installation when temperatures are below the manufacturer's minimum cable installation temperature.

Cable shall not be dragged across base can or manhole edges, pavement or earth. When cable must be coiled, lay cable out on a canvas tarp or use other appropriate means to prevent abrasion to the cable jacket.

108-3.3 Installation of direct-buried cable in trenches. Unless otherwise specified, the Contractor shall not use a cable plow for installing the cable. Cable shall be unreeled uniformly in place alongside or in the trench and shall be carefully placed along the bottom of the trench. The cable shall not be unreeled and pulled into the trench from one end. Slack cable sufficient to provide strain relief shall be placed in the trench in a series of S curves. Sharp bends or kinks in the cable shall not be permitted.

Where cables must cross over each other, a minimum of 3 inches (75 mm) vertical displacement shall be provided with the topmost cable depth at or below the minimum required depth below finished grade.

a. Trenching. Where turf is well established and the sod can be removed, it shall be carefully stripped and properly stored. Trenches for cables may be excavated manually or with mechanical trenching equipment. Walls of trenches shall be essentially vertical so that a minimum of surface is disturbed. Graders shall not be used to excavate the trench with their blades. The bottom surface of trenches shall be essentially smooth and free from coarse aggregate. Unless otherwise specified, cable trenches shall be excavated to a minimum depth of 18 inches (0.5 m) below finished grade per NEC Table 300.5, except as follows:

(1) When off the airport or crossing under a roadway or driveway, the minimum depth shall be 36 inches (91 cm) unless otherwise specified.

(2) Minimum cable depth when crossing under a railroad track, shall be 42 inches (1 m) unless otherwise specified.

Dewatering necessary for cable installation, erosion and turbidity control, per Federal, state, and local requirements is incidental to its respective pay items as part of Item L-108. The cost of all excavation regardless of type of material encountered, shall be included in the unit price bid for the L-108 Item.

The Contractor shall excavate all cable trenches to a width not less than 6 inches (150 mm). Unless otherwise specified on the plans, all cables in the same location and running in the same general direction shall be installed in the same trench.

When rock is encountered, the rock shall be removed to a depth of at least 3 inches (75 mm) below the required cable depth and it shall be replaced with bedding material of earth or sand containing no mineral aggregate particles that would be retained on a 1/4 inch (6 mm) sieve. Flowable backfill material may alternatively be used. The Contractor shall ascertain the type of soil or rock to be excavated before bidding. All such rock removal shall be performed and paid for under Item P-152.

Duct bank or conduit markers temporarily removed for trench excavations shall be replaced as required.

It is the Contractor's responsibility to locate existing utilities within the work area prior to excavation. Where existing active cables cross proposed installations, the Contractor shall ensure that these cables are adequately protected. Where crossings are unavoidable, no splices will be allowed in the existing cables, except as specified on the plans. Installation of new cable where such crossings must occur shall proceed as follows:

(1) Existing cables shall be located manually. Unearthed cables shall be inspected to assure absolutely no damage has occurred.

(2) Trenching, etc., in cable areas shall then proceed, with approval of the Engineer, with care taken to minimize possible damage or disruption of existing cable, including careful backfilling in area of cable.

In the event that any previously identified cable is damaged during the course of construction, the Contractor shall be responsible for the complete repair or replacement.

b. Backfilling. After the cable has been installed, the trench shall be backfilled. The first layer of backfill in the trench shall be 3 inches (75 mm) deep, loose measurement, and shall be either earth or sand containing no mineral aggregate particles that would be retained on a 1/4 inch (6 mm) sieve. This layer shall not be compacted. The second layer shall be 5 inches (125 mm) deep, loose measurement, and shall contain no particles that would be retained on a one inch (25 mm) sieve. The remaining third and subsequent layers of backfill shall not exceed 8 inches (20 cm) of loose measurement and be excavated or imported material and shall not contain stone or aggregate larger than 4 inches (100 mm) maximum diameter.

The second and subsequent layers shall be thoroughly tamped and compacted to at least the density of the adjacent undisturbed soil, and to the satisfaction of the Engineer. If necessary to obtain the desired compaction, the backfill material shall be moistened or aerated as required.

If the cable is to be installed in locations or areas where other compaction requirements are specified (under pavements, embankments, etc.) the compaction requirements per Item P-152 for that area shall be followed.

Trenches shall not contain pools of water during backfilling operations. The trench shall be completely backfilled and tamped level with the adjacent surface, except that when turf is to be established over the trench, the backfilling shall be stopped at an appropriate depth consistent with the type of turfing operation to be accommodated. A proper allowance for settlement shall also be provided. Any excess excavated material shall be removed and disposed of per the plans and specifications.

Underground electrical warning (caution) tape shall be installed in the trench above all direct-buried cable. Contractor shall submit a sample of the proposed warning tape for acceptance by the Engineer. If not shown on the plans, the warning tape shall be located 6 inches (150 mm) above the direct-buried cable or the counterpoise wire if present. A 4-6 inch (100 - 150 mm) wide polyethylene film detectable tape, with a metalized foil core, shall be installed above all direct

buried cable or counterpoise. The tape shall be of the color and have a continuous legend as indicated on the plans. The tape shall be installed 8 inch (200 mm) minimum below finished grade.

c. Restoration. Following restoration of all trenching near airport movement surfaces, the Contractor shall visually inspect the area for foreign object debris (FOD) and remove any that is found. Where soil and sod has been removed, it shall be replaced as soon as possible after the backfilling is completed. All areas disturbed by work shall be restored to its original condition. The restoration shall include the topsoiling, seeding, and mulching as shown on the plans. The Contractor shall be held responsible for maintaining all disturbed surfaces and replacements until final acceptance. When trenching is through paved areas, restoration shall be equal to existing conditions and compaction shall meet the requirements of Item P-152. Restoration shall be considered incidental to the pay item of which it is a component part.

108-3.4 Cable markers for direct-buried cable. The location of direct buried circuits shall be marked by a concrete slab marker, 2 feet (60 cm) square and 4-6 inch (10 - 15 cm) thick, extending approximately one inch (25 mm) above the surface. Each cable run from a line of lights and signs to the equipment vault shall be marked at approximately every 200 feet (61 m) along the cable run, with an additional marker at each change of direction of cable run. All other direct-buried cable shall be marked in the same manner. Cable markers shall be installed directly above the cable. The Contractor shall impress the word “CABLE” and directional arrows on each cable marking slab. The letters shall be approximately 4 inches (100 mm) high and 3 inches (75 mm) wide, with width of stroke 1/2 inch (12 mm) and 1/4 inch (6 mm) deep.

At the location of each underground cable connection, except at lighting units, or isolation transformers, or power a concrete marker slab must mark adapters placed above the connection. The Contractor shall impress the word “SPLICE” on each slab. The Contractor also shall impress additional circuit identification symbols on each slab as directed by the Engineer. All cable markers and splice markers shall be painted international orange. Paint shall be specifically manufactured for uncured exterior concrete. After placement, all cable or splice markers shall be given one coat of high-visibility aviation orange paint as approved by the Engineer. Furnishing and installation of cable markers is incidental to the respective cable pay item.

108-3.5 Splicing. Connections of the type shown on the plans shall be made by experienced personnel regularly engaged in this type of work and shall be made as follows:

a. Cast splices. These shall be made by using crimp connectors for jointing conductors. Molds shall be assembled, and the compound shall be mixed and poured per the manufacturer’s instructions and to the satisfaction of the Engineer.

b. Field-attached plug-in splices. These shall be assembled per the manufacturer’s instructions. These splices shall be made by plugging directly into mating connectors. In all cases the joint where the connectors come together shall be wrapped with at least one layer of rubber or synthetic rubber tape and one layer of plastic tape, one-half lapped, extending at least 1-1/2 inches (38 mm) on each side of the joint.

c. Factory-molded plug-in splices. These shall be made by plugging directly into mating connectors. In all cases, the joint where the connectors come together shall be wrapped with at least one layer of rubber or synthetic rubber tape and one layer of plastic tape, one-half lapped, extending at least 1-1/2 inches (38 mm) on each side of the joint.

d. Taped or heat-shrink splices. A taped splice shall be made in the following manner:

Bring the cables to their final position and cut so that the conductors will butt. Remove insulation and jacket allowing for bare conductor of proper length to fit compression sleeve connector with 1/4 inch (6 mm) of bare conductor on each side of the connector. Prior to splicing, the two ends

of the cable insulation shall be penciled using a tool designed specifically for this purpose and for cable size and type. Do not use emery paper on splicing operation since it contains metallic particles. The copper conductors shall be thoroughly cleaned. Join the conductors by inserting them equidistant into the compression connection sleeve. Crimp conductors firmly in place with crimping tool that requires a complete crimp before tool can be removed. Test the crimped connection by pulling on the cable. Scrape the insulation to assure that the entire surface over which the tape will be applied (plus 3 inches (75 mm) on each end) is clean. After scraping wipe the entire area with a clean lint-free cloth. Do not use solvents.

Apply high-voltage rubber tape one-half lapped over bare conductor. This tape should be tensioned as recommended by the manufacturer. Voids in the connector area may be eliminated by highly elongating the tape, stretching it just short of its breaking point. Throughout the rest of the splice less tension should be used. Always attempt to exactly half-lap to produce a uniform buildup. Continue buildup to 1-1/2 times cable diameter over the body of the splice with ends tapered a distance of approximately one inch (25 mm) over the original jacket. Cover rubber tape with two layers of vinyl pressure-sensitive tape one-half lapped. Do not use glyptol or lacquer over vinyl tape as they react as solvents to the tape. No further cable covering or splice boxes are required.

Heat shrinkable tubing shall be installed following manufacturer's instructions. Direct flame heating shall not be permitted unless recommended by the manufacturer. Cable surfaces within the limits of the heat-shrink application shall be clean and free of contaminates prior to application.

Surfaces of equipment or conductors being terminated or connected shall be prepared in accordance with industry standard practice and manufacturer's recommendations. All surfaces to be connected shall be thoroughly cleaned to remove all dirt, grease, oxides, nonconductive films, or other foreign material. Paints and other nonconductive coatings shall be removed to expose base metal. Clean all surfaces at least 1/4 inch (6.4 mm) beyond all sides of the larger bonded area on all mating surfaces. Use a joint compound suitable for the materials used in the connection. Repair painted/coated surface to original condition after completing the connection.

108-3.6 Bare counterpoise wire installation for lightning protection and grounding. If shown on the plans or included in the job specifications, bare solid #6 AWG copper counterpoise wire shall be installed for lightning protection of the underground cables.

Counterpoise wire shall be installed in the same trench for the entire length of buried cable, conduits and duct banks that are installed to contain airfield cables.

For edge light fixtures installed in turf (stabilized soils) and for raceways or cables adjacent to the full strength pavement edge, the counterpoise conductor shall be installed halfway between the pavement edge and the light base, mounting stake, raceway, or cable.

The counterpoise conductor shall be installed 8 inches (203 mm) minimum below grade.

Each light base or mounting stake shall be provided with a grounding electrode.

When a metallic light base is used, the grounding electrode shall be bonded to the metallic light base or mounting stake with a No. 6 AWG bare, annealed or soft drawn, solid copper conductor.

When a nonmetallic light base is used, the grounding electrode shall be bonded to the metallic light fixture or metallic base plate with a No. 6 AWG bare, annealed or soft drawn, solid copper conductor. **]**

[For raceways installed under pavement; for raceways and cables not installed adjacent to the full strength pavement edge; for fixtures installed in full strength pavement and shoulder pavement

and for optional method of edge lights installed in turf (stabilized soils); and for raceways or cables adjacent to the full strength pavement edge, the counterpoise conductor shall be centered over the raceway or cable to be protected as described below.

The counterpoise conductor shall be installed no less than 8 inches (203 mm) above the raceway or cable to be protected, except as permitted below.

The minimum counterpoise conductor height above the raceway or cable to be protected shall be permitted to be adjusted subject to coordination with the airfield lighting and pavement designs.

Where raceway is installed by the directional bore, jack and bore, or other drilling method, the counterpoise conductor shall be permitted to be installed concurrently with the directional bore, jack and bore, or other drilling method raceway, external to the raceway or sleeve.

The counterpoise conductor shall be installed no more than 12 inches (305 mm) above the raceway or cable to be protected.

The counterpoise conductor height above the protected raceway(s) or cable(s) shall be calculated to ensure that the raceway or cable is within a 45-degree area of protection.

The counterpoise conductor shall be bonded to each metallic light base, mounting stake, and metallic airfield lighting component.

All metallic airfield lighting components in the field circuit on the output side of the constant current regulator (CCR) or other power source shall be bonded to the airfield lighting counterpoise system. **]**

The counterpoise wire shall also be exothermically welded to ground rods installed as shown on the plans but not more than 500 feet (150 m) apart around the entire circuit. The counterpoise system shall be continuous and terminate at the transformer vault or at the power source. It shall be securely attached to the vault or equipment external ground ring or other made electrode-grounding system. The connections shall be made as shown on the plans and in the specifications.

If shown on the plans or in the specifications, a separate equipment (safety) ground system shall be provided in addition to the counterpoise wire using one of the following methods:

c. A ground rod installed at and securely attached to each light fixture base, mounting stake, and to all metal surfaces at junction/access structures via #6 AWG wire.

d. For parallel voltage systems only, install a #6 AWG green insulated equipment ground conductor internal to the conduit system and securely attached it to each light fixture base internal grounding lug and to all metal surfaces at junction/access structures. Dedicated ground rods shall be installed and exothermically welded to the counterpoise wires at each end of a duct bank crossing under pavement.

Where an existing airfield lighting system is being extended or modified, the new counterpoise conductors shall be interconnected to existing counterpoise conductors at each intersection of the new and existing airfield lighting counterpoise systems.

108-3.7 Counterpoise installation above multiple conduits and duct banks. Counterpoise wires shall be installed above multiple conduits/duct banks for airfield lighting cables, with the intent being to provide a complete area of protection over the airfield lighting cables. When multiple conduits and/or duct banks for airfield cable are installed in the same trench, the number and location of counterpoise wires above the conduits shall be adequate to provide a complete cone of protection measured 22-1/2 degrees each side of vertical.

Where duct banks pass under pavement to be constructed in the project, the counterpoise shall be placed above the duct bank. Reference details on the construction plans.

108-3.8 Counterpoise installation at existing duct banks. When airfield lighting cables are indicated on the plans to be routed through existing duct banks, the new counterpoise wiring shall be terminated at ground rods at each end of the existing duct bank where the cables being protected enter and exit the duct bank. The new counterpoise conductor shall be bonded to the existing counterpoise system.

108-3.9 Exothermic bonding. Bonding of counterpoise wire shall be by the exothermic welding process. Only personnel experienced in and regularly engaged in this type of work shall make these connections.

Contractor shall demonstrate to the satisfaction of the Engineer, the welding kits, materials and procedures to be used for welded connections prior to any installations in the field. The installations shall comply with the manufacturer's recommendations and the following:

a. All slag shall be removed from welds.

b. Using an exothermic weld to bond the counterpoise to a lug on a galvanized light base is not recommended unless the base has been specially modified. Consult the manufacturer's installation directions for proper methods of bonding copper wire to the light base. See also AC 150/5340-30 for galvanized light base exception.

c. If called for in the plans, all buried copper and weld material at weld connections shall be thoroughly coated with 6 mm of 3M™ Scotchkote™, or approved equivalent, or coated with coal tar Bitumastic® material to prevent surface exposure to corrosive soil or moisture.

108-3.10 Testing. The Contractor shall furnish all necessary equipment and appliances for testing the airport electrical systems and underground cable circuits before and after installation. The Contractor shall perform all tests in the presence of the Engineer. The Contractor shall demonstrate the electrical characteristics to the satisfaction of the Engineer. All costs for testing are incidental to the respective item being tested. For phased projects, the tests must be completed by phase. The Contractor must maintain the test results throughout the entire project as well as during the warranty period that meet the following:

a. Earth resistance testing methods shall be submitted to the Engineer for approval. Earth resistance testing results shall be recorded on an approved form and testing shall be performed in the presence of the Engineer. All such testing shall be at the sole expense of the Contractor.

b. Should the counterpoise or ground grid conductors be damaged or suspected of being damaged by construction activities the Contractor shall test the conductors for continuity with a low resistance ohmmeter. The conductors shall be isolated such that no parallel path exists and tested for continuity. The Engineer shall approve of the test method selected. All such testing shall be at the sole expense of the Contractor.

After installation, the Contractor shall test and demonstrate to the satisfaction of the Engineer the following:

c. That all affected lighting power and control circuits (existing and new) are continuous and free from short circuits.

d. That all affected circuits (existing and new) are free from unspecified grounds.

e. That the insulation resistance to ground of all new non-grounded high voltage series circuits or cable segments is not less than **50** megohms.

f. That the insulation resistance to ground of all new non-grounded conductors of new multiple circuits or circuit segments is not less than 100 megohms.

g. That all affected circuits (existing and new) are properly connected per applicable wiring diagrams.

h. That all affected circuits (existing and new) are operable. Tests shall be conducted that include operating each control not less than 10 times and the continuous operation of each lighting and power circuit for not less than 1/2 hour.

i. That the impedance to ground of each ground rod does not exceed 25 ohms prior to establishing connections to other ground electrodes. The fall-of-potential ground impedance test shall be used, as described by American National Standards Institute/Institute of Electrical and Electronic Engineers (ANSI/IEEE) Standard 81, to verify this requirement. As an alternate, clamp-on style ground impedance test meters may be used to satisfy the impedance testing requirement. Test equipment and its calibration sheets shall be submitted for review and approval by the Engineer prior to performing the testing.

Two copies of tabulated results of all cable tests performed shall be supplied by the Contractor to the Engineer. Where connecting new cable to existing cable, ground resistance tests shall be performed on the new cable prior to connection to the existing circuit.

There are no approved “repair” procedures for items that have failed testing other than complete replacement.

METHOD OF MEASUREMENT

108-4.1 Cable or counterpoise wire installed in trench, duct bank or conduit shall be measured by the number of linear feet (meters) installed and grounding connectors, and trench marking tape ready for operation, and accepted as satisfactory. Separate measurement shall be made for each cable or counterpoise wire installed in trench, duct bank or conduit. The measurement for this item shall include additional quantities required for slack. Any trenching required for installation of counterpoise wire shall be incidental to the wire itself and will not be measured for payment.

BASIS OF PAYMENT

108-5.1 Payment will be made at the contract unit price for trenching, cable and bare counterpoise wire installed in trench (direct-buried), or cable and equipment ground installed in duct bank or conduit, in place by the Contractor and accepted by the Engineer. This price shall be full compensation for furnishing all materials and for all preparation and installation of these materials, and for all labor, equipment, tools, and incidentals, including ground rods and ground connectors and trench marking tape, necessary to complete this item. ***The No. 6 AWG stranded copper bonding jumper shall be considered incidental to the item being installed and shall not be measured separately for payment.***

Payment will be made under:

Item L-108-5.1	3-1/C No. 6 AWG**,** L-824, Type C Cable, Installed in Trench, Duct Bank or Conduit - per liner foot (meter)
Item L-108-5.2	Airfield Lighting Control Cable, 25pr - per linear foot (meter)

MATERIAL REQUIREMENTS

AC 150/5340-26	Maintenance of Airport Visual Aid Facilities
AC 150/5340-30	Design and Installation Details for Airport Visual Aids
AC 150/5345-7	Specification for L-824 Underground Electrical Cable for Airport Lighting Circuits
AC 150/5345-26	Specification for L-823 Plug and Receptacle, Cable Connectors
AC 150/5345-53	Airport Lighting Equipment Certification Program
Commercial Item Description A-A-59544	Cable and Wire, Electrical (Power, Fixed Installation)
Commercial Item Description A-A-55809	Insulation Tape, Electrical, Pressure-Sensitive Adhesive, Plastic
ASTM B3	Standard Specification for Soft or Annealed Copper Wire
ASTM B8	Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
ASTM B33	Standard Specification for Tin-Coated Soft or Annealed Copper Wire for Electrical Purposes
ASTM D4388	Standard Specification for Nonmetallic Semi-Conducting and Electrically Insulating Rubber Tapes
FED SPEC J-C-30	Cable and Wire, Electrical (Power, Fixed Installation)
MIL-I-24391	Insulation Tape, Electrical, Plastic, Pressure Sensitive

REFERENCE DOCUMENTS

NFPA-70	National Electrical Code (NEC)
NFPA-780	Standard for the Installation of Lightning Protection Systems
MIL-S-23586F	Performance Specification: Sealing Compound (with Accelerator), Silicone Rubber, Electrical
ANSI/IEEE STD 81	IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System

END OF ITEM L-108

SECTION L-110 AIRPORT UNDERGROUND ELECTRICAL DUCT BANKS AND CONDUITS

DESCRIPTION

110-1.1 This item shall consist of underground electrical conduits and duct banks (single or multiple conduits encased in concrete) installed in accordance with this specification at the locations and in accordance with the dimensions, designs, and details shown on the plans. This item shall include furnishing and installing of all underground electrical duct banks and individual and multiple underground conduits. It shall also include all turfing trenching, backfilling, removal, and restoration of any paved or turfed areas; concrete encasement, mandreling, pulling lines, duct markers, plugging of conduits, and the testing of the installation as a completed system ready for installation of cables in accordance with the plans and specifications. This item shall also include furnishing and installing conduits and all incidentals for providing positive drainage of the system. Verification of existing ducts is incidental to the pay items provided in this specification.

EQUIPMENT AND MATERIALS

110-2.1 GENERAL.

a. All equipment and materials covered by referenced specifications shall be subject to acceptance through manufacturer's certification of compliance with the applicable specification when so requested by the Engineer.

b. Manufacturer's certifications shall not relieve the Contractor of the Contractor's responsibility to provide materials in accordance with these specifications and acceptable to the Engineer. Materials supplied and/or installed that do not materially comply with these specifications shall be removed, when directed by the Engineer and replaced with materials, that comply with these specifications, at the Contractor's cost.

c. All materials and equipment used to construct this item shall be submitted to the Engineer for approval prior to ordering the equipment. Submittals consisting of marked catalog sheets or shop drawings shall be provided. Submittal data shall be presented in a clear, precise and thorough manner. Original catalog sheets are preferred. Photocopies are acceptable provided they are as good a quality as the original. Clearly and boldly mark each copy to identify pertinent products or models applicable to this project. Indicate all optional equipment and delete non-pertinent data. Submittals for components of electrical equipment and systems shall identify the equipment for which they apply on each submittal sheet. Markings shall be boldly and clearly made with arrows or circles (highlighting is not acceptable). Contractor is solely responsible for delays in project accruing directly or indirectly from late submissions or resubmissions of submittals.

d. The data submitted shall be sufficient, in the opinion of the Engineer, to determine compliance with the plans and specifications. The Contractor's submittals shall be neatly bound in a properly sized 3-ring binder, tabbed by specification section. The Engineer reserves the right to reject any and all equipment, materials or procedures, which, in the Engineer's opinion, does not meet the system design and the standards and codes, specified herein.

e. All equipment and materials furnished and installed under this section shall be guaranteed against defects in materials and workmanship for a period of at least twelve (12) months from final acceptance by the Owner. The defective materials and/or equipment shall be repaired or replaced, at the Owner's discretion, with no additional cost to the Owner.

110-2.2 STEEL CONDUIT. Rigid galvanized steel conduit and fittings shall be hot dipped galvanized inside and out and conform to the requirements of Underwriters Laboratories Standard 6, 514B, and 1242.

110-2.3 PLASTIC CONDUIT. Plastic conduit and fittings shall conform to the requirements of Fed. Spec. W--C-1094, Underwriters Laboratories Standards UL 651 and Article 352 of the current National Electrical Code shall be one of the following, as shown on the plans:

a. Type I - Schedule 40 PVC suitable for underground use either direct-buried or encased in concrete.

b. Type II - Schedule 40 PVC suitable for either above ground or underground use.

c. Type III - Schedule 80 PVC suitable for either above ground or underground use either direct-buried or encased in concrete.

d. High Density Polyethylene (HDPE) meeting the requirements of ASTM D 3035 SDR 11. HDPE may be used under pavements when conduit placed with directional boring.

The type of adhesive shall be as recommended by the conduit/fitting manufacturer.

110-2.4 SPLIT CONDUIT. Split conduit shall be pre-manufactured for the intended purpose and shall be made of steel or plastic.

110-2.5 CONDUIT SPACERS. Conduit spacers shall be prefabricated interlocking units manufactured for the intended purpose. They shall be of double wall construction made of high grade, high density polyethylene complete with interlocking cap and base pads, They shall be designed to accept No. 4 reinforcing bars installed vertically.

110-2.6 CONCRETE. Concrete shall conform to Item P-610, Structural Portland Cement Concrete, using 1 inch maximum size coarse aggregate with a minimum 28 day compressive strength of 4000 psi. Where reinforced duct banks are specified, reinforcing steel shall conform to ASTM A615 Grade 60. Concrete and reinforcing steel are incidental to the respective pay item of which they are a component part.

110-2.7 FLOWABLE BACKFILL. Flowable material used to back fill conduit and duct bank trenches shall conform to the requirements of Item P-153, Controlled Low Strength Material. Fill shall be designed to achieve a 28-day compressive strength of 200 psi under pavement.

110-2.8 DETECTABLE WARNING TAPE. Plastic, detectable, AWPA orange (communication lines, fiber cables, telephone cable) with continuous legend. Magnetic tape shall be polyethylene film with a metalized foil core and shall be 3-6 inches wide. Detectable tape is incidental to the respective bid item. Color shall be orange with legend “CAUTION – FIBER OPTIC LINE BELOW”.

CONSTRUCTION METHODS

110-3.1 GENERAL. The Contractor shall install underground duct banks and conduits at the approximate locations indicated on the plans. The Engineer shall indicate specific locations as the work progresses, if required to differ from the plans. Duct banks and conduits shall be of the size, material, and type indicated on the plans or specifications. Where no size is indicated on the plans or in the specifications, conduits shall be not less than 2 inches (50 mm) inside diameter or comply with the National Electrical Code based on cable to be installed, whichever is larger. All duct bank and conduit lines shall be laid so as to grade toward access points and duct or conduit ends for drainage. Unless shown otherwise on the plans, grades shall be at least 3 inches (75 mm) per 100 feet (30 m). On runs where it is not practicable to maintain the grade all one way, the duct bank and conduit lines shall be graded from the center in both directions toward access points or conduit ends, with a drain into the storm drainage system. Pockets or traps where moisture may accumulate shall be avoided. No duct bank or underground conduit shall be

less than 18 inches below finished grade. Where under pavement, the top of the duct bank shall not be less than 18 inches below the subgrade.

The Contractor shall mandrel each individual conduit whether the conduit is direct-buried or part of a duct bank. An iron-shod mandrel, not more than 1/4 inch (6 mm) smaller than the bore of the conduit shall be pulled or pushed through each conduit. The mandrel shall have a leather or rubber gasket slightly larger than the conduit hole.

The Contractor shall swab out all conduits/ducts and clean base can, manhole, pull boxes, etc. interiors IMMEDIATELY prior to pulling cable. Once cleaned and swabbed the base cans, manhole, pull boxes, etc. and all accessible points of entry to the duct/conduit system shall be kept closed except when installing cables. Cleaning of ducts, base cans, manholes, etc. is incidental to the pay item of the item being cleaned. All raceway systems left open, after initial cleaning, for any reason shall be re-cleaned at the Contractor's expense. All accessible points shall be kept closed when not installing cable. The Contractor shall verify existing ducts proposed for use in this project as clear and open. The Contractor shall notify the Engineer of any blockage in the existing ducts.

For pulling the permanent wiring, each individual conduit, whether the conduit is direct-buried or part of a duct bank, shall be provided with a 200 pound test polypropylene pull rope. The ends shall be secured and sufficient length shall be left in access points to prevent it from slipping back into the conduit. Where spare conduits are installed, as indicated on the plans, the open ends shall be plugged with removable tapered plugs, designed for this purpose.

All conduits shall be securely fastened in place during construction and shall be plugged to prevent contaminate from entering the conduits. Any conduit section having a defective joint shall not be installed. Ducts shall be supported and spaced apart using approved spacers at intervals not to exceed 5 feet.

Unless otherwise shown on the plans, concrete encased duct banks shall be used when crossing under pavements expected to carry aircraft loads, such as runways, taxiways, taxilanes, ramps and aprons. When under paved shoulders and other paved areas, conduit and duct banks shall be encased using flowable fill for protection.

All conduits within concrete encasement shall terminate with female ends for ease in current and future use. Install factory plugs in all unused ends, do not cover the ends or plugs with concrete.

Where turf is well established and the sod can be removed, it shall be carefully stripped and properly stored.

Trenches for conduits and duct banks may be excavated manually or with mechanical trenching equipment unless in pavement, in which case they shall be excavated with mechanical trenching equipment. Walls of trenches shall be essentially vertical so that a minimum of shoulder surface is disturbed. Blades of graders shall not be used to excavate the trench.

When rock is encountered, the rock shall be removed to a depth of at least 3 inches below the required conduit or duct bank depth and it shall be replaced with bedding material of earth or sand containing no mineral aggregate particles that would be retained on a 1/4 inch sieve. Flowable backfill may alternatively be used. The Contractor shall ascertain the type of soil or rock to be excavated before bidding. All such rock removal shall be performed and paid for under Item P-152.

Underground electrical warning (Caution) tape shall be installed in the trench above all underground duct banks and conduits in unpaved areas. Contractor shall submit a sample of the proposed warning tape for approval by the Engineer. If not shown on the plans, the warning tape shall be located 6 inches above the duct/conduit or the counterpoise wire if present.

Joints in plastic conduit shall be prepared in accordance with the manufacturer's recommendations for the particular type of conduit. Plastic conduit shall be prepared by application of a plastic cleaner and brushing a plastic solvent on the outside of the conduit ends and on the inside of the couplings. The conduit fitting shall then be slipped together with a quick one-quarter turn twist to set the joint tightly. Where more than one conduit is placed in a single trench, or in duct banks, joints in the conduit shall be staggered a minimum of 2 feet.

Changes in direction of runs exceeding 10 degrees, either vertical or horizontal, shall be accomplished using manufactured sweep bends.

Whether or not specifically indicated on the drawings, where the soil encountered at established duct bank grade is an unsuitable material, as determined by the Engineer, the unsuitable material shall be removed in accordance with Item P-152 and replaced with suitable material. Alternatively, additional duct bank supports that are adequate and stable shall be installed, as approved by the Engineer.

All excavation shall be unclassified and shall be considered incidental to the respective L-110 pay item of which it is a component part. Dewatering necessary for duct installation, erosion and turbidity control, in accordance with Federal, State, and Local requirements is incidental to its respective pay item as a part of Item L-110. The cost of all excavation regardless of type of material encountered, shall be included in the unit price bid for the L-110 Item.

Unless otherwise specified, excavated materials that are deemed by the Engineer to be unsuitable for use in backfill or embankments shall be removed and disposed of offsite.

Any excess excavation shall be filled with suitable material approved by the Engineer and compacted in accordance with item P-152.

It is the Contractor's responsibility to locate existing utilities within the work area prior to excavation. Where existing active cables cross proposed installations, the Contractor shall insure that these cables are adequately protected. Where crossings are unavoidable, no splices will be allowed in the existing cables, except as specified on the plans. Installation of new cable where such crossings must occur shall proceed as follows:

1) Existing cables shall be located manually. Unearthed cables shall be inspected to assure absolutely no damage has occurred

2) Trenching, etc., in cable areas shall then proceed with approval of the Engineer, with care taken to minimize possible damage or disruption of existing cable, including careful backfilling in area of cable.

In the event that any previously identified cable is damaged during the course of construction, the Contractor shall be responsible for the complete repair.

110-3.2 DUCT BANKS. Unless otherwise shown in the plans, duct banks shall be installed so that the top of the concrete envelope is not less than 18 inches (45 cm) below the bottom of the base or stabilized base course layers where installed under runways, taxiways, aprons, or other paved areas, and not less than 18 inches (45 cm) below finished grade where installed in unpaved areas.

Unless otherwise shown on the plans, duct banks under paved areas shall extend at least 3 feet (90 cm) beyond the edges of the pavement or 3 feet (90 cm) beyond any underdrains that may be installed alongside the paved area. Trenches for duct banks shall be opened the complete length before concrete is placed so that if any obstructions are encountered, proper provisions can be made to avoid them. Unless otherwise shown on the plans, all duct banks shall be placed on a layer of concrete not less than 3 inches (75 mm) thick prior to its initial set. The Contractor shall space the conduits not less than 3 inches apart (measured from outside wall to outside wall). All such multiple conduits shall be placed using

conduit spacers applicable to the type of conduit. As the conduit laying progresses, concrete shall be placed around and on top of the conduits not less than 3 inches (75 mm) thick unless otherwise shown on the plans.

Conduits forming the duct bank shall be installed using conduit spacers. No. 4 reinforcing bars shall be driven vertically into the soil a minimum of 6 inches to anchor the assembly into the earth prior to placing the concrete encasement. For this purpose, the spacers shall be fastened down with locking collars attached to the vertical bars. Spacers shall be installed at 5 foot intervals. Spacers shall be in the proper sizes and configurations to fit the conduits. Locking collars and spacers shall be submitted to the Engineer for review prior to use.

When specified, the Contractor shall reinforce the bottom side and top of encasements with steel reinforcing mesh or fabric or other approved metal reinforcement. When directed, the Contractor shall supply additional supports where the ground is soft and boggy, where ducts cross under roadways, or where shown on the plans. Under such conditions, the complete duct structure shall be supported on reinforced concrete footings, piers, or piles located at approximately 5 foot (150 cm) intervals.

All pavement surfaces that are to have ducts installed therein shall be neatly saw cut to form a vertical face. All excavation shall be included in the contract with price for the duct.

Install a plastic, detectable, color as noted, 3 - 6 inch (75 – 150 mm) wide tape 8 inches (200 mm) minimum below grade above all underground conduit or duct lines not installed under pavement. Utilize the 3 inch wide tape only for single conduit runs. Utilize the 6 inch wide tape for multiple conduits and duct banks. For duct banks equal to or greater than 24 inches in width, utilize more than one tape for sufficient coverage and identification of the duct bank as required.

When existing cables are to be placed in split duct, encased in concrete, the cable shall be carefully located and exposed by hand tools. Prior to being placed in duct, the Engineer shall be notified so that he may inspect the cable and determine that it is in good condition. Where required, split duct shall be installed as shown on the drawings or as required by the Engineer.

110-3.3 CONDUITS WITHOUT CONCRETE ENCASEMENT. Trenches for single-conduit lines shall be not less than 6 inches (150 mm) nor more than 12 inches (300 mm) wide, and the trench for 2 or more conduits installed at the same level shall be proportionately wider. Trench bottoms for conduits without concrete encasement shall be made to conform accurately to grade so as to provide uniform support for the conduit along its entire length.

Unless otherwise shown on the plans, a layer of fine earth material, at least 4 inches (100 mm) thick (loose measurement) shall be placed in the bottom of the trench as bedding for the conduit. The bedding material shall consist of soft dirt, sand or other fine fill, and it shall contain no particles that would be retained on a 1/4 inch (6 mm) sieve. The bedding material shall be tamped until firm. Flowable backfill may alternatively be used.

Unless otherwise shown on plans, conduits shall be installed so that the tops of all conduits are at least 18 inches (45 cm) below the finished grade.

When two or more individual conduits intended to carry conductors of equivalent voltage insulation rating are installed in the same trench without concrete encasement, they shall be spaced not less than 3 inches apart (measured from outside wall to outside wall) in a horizontal direction and not less than 6 inches (150 mm) apart in a vertical direction. Where two or more individual conduits intended to carry conductors of differing voltage insulation rating are installed in the same trench without concrete encasement, they shall be spaced not less than 3 inches (75 mm) apart (measured from outside wall to outside wall) in a horizontal direction and lot less than 6 inches (150 mm) apart in a vertical direction.

Trenches shall be opened the complete length between normal termination points before conduit is installed so that if any unforeseen obstructions are encountered, proper provisions can be made to avoid them.

Conduits shall be installed using conduit spacers. No. 4 reinforcing bars shall be driven vertically into the soil a minimum of 6 inches to anchor the assembly into the earth while backfilling. For this purpose, the spacers shall be fastened down with locking collars attached to the vertical bars. Spacers shall be installed at 5 foot intervals. Spacers shall be in the proper sizes and configurations to fit the conduits. Locking collars and spacers shall be submitted to the Engineer for review prior to use.

110-3.4 MARKERS. The location of each end and of each change of direction of conduits and duct banks shall be marked by a concrete slab marker 2 feet (60 cm) square and 4 - 6 inches (100 - 150 mm) thick extending approximately 1 inch (25 mm) above the surface. The markers shall also be located directly above the ends of all conduits or duct banks, except where they terminate in a junction/access structure or building.

The Contractor shall impress the word “DUCT” or “CONDUIT” on each marker slab. The Contractor shall also impress on the slab the number and size of conduits beneath the marker along with all other necessary information as determined by the Engineer. The letters shall be 4 inches (100 mm) high and 3 inches (75 mm) wide with width of stroke 1/2 inch (12 mm) and 1/4 inch (6 mm) deep or as large as the available space permits. Furnishing and installation of duct markers is incidental to the respective duct pay item.

110-3.5 BACKFILLING FOR CONDUITS. For conduits, 8 inches (200 cm) of sand, soft earth, or other fine fill (loose measurement) shall be placed around the conduits ducts and carefully tamped around and over them with hand tampers. The remaining trench shall then be backfilled and compacted in accordance with Item P-152, Excavation and Embankment, except that material used for back fill shall be select material not larger than 4 in in diameter.

Flowable backfill may alternatively be used.

Trenches shall not contain pools of water during back, filling operations.

The trench shall be completely backfilled and tamped level with the adjacent surface: except that, where sod is to be placed over the trench, the backfilling shall be stopped at a depth equal to the thickness of the sod to be used, with proper allowance for settlement.

Any excess excavated material shall be removed and disposed of in accordance with instructions issued by the Engineer.

110-3.6 BACKFILLING FOR DUCT BANKS. After the concrete has cured, the remaining trench shall be backfilled and compacted in accordance with Item P-152, Excavation and Embankment, except that the material used for backfill shall be select material not larger than 4 in in diameter. In addition to the requirements of P-152, where duct banks are installed under pavement, one moisture/density test per lift shall be made for each 250 linear feet of duct bank or one work period’s construction, whichever is less.

Flowable backfill may alternatively be used.

Trenches shall not contain pools of water during backfilling operations.

The trench shall be completely backfilled and tamped level with the adjacent surface: except that, where sod is to be placed over the trench, the backfilling shall be stopped at a depth equal to the thickness of the sod to be used, with proper allowance for settlement.

Any excess excavated material shall be removed and disposed of in accordance with instructions issued by the Engineer.

110-3.7 RESTORATION. Where sod has been removed, it shall be replaced as soon as possible after the backfilling is completed. All areas disturbed by the work shall be restored to its original condition. The restoration shall include seeding and mulching shown on the plans. The Contractor shall be held responsible for maintaining all disturbed surfaces and replacements until final acceptance. All restoration shall be considered incidental to the respective L-110 pay item.

110-3.8 DIRECTIONAL BORE. Conduit shall be installed with the use of an auger. Conduit shall extend a minimum of 10 feet beyond the edge of pavement and shall be placed a minimum of 24” deep under pavement. Ensure adequate removal of soil cutting and stability of the bore hole by monitoring the drilling fluids such as the pumping rate, pressures, viscosity, and density during the pilot bore, back reaming, and pipe installation. Use a mixture of bentonite clay or other approved stabilizing agent mixed with potable water with a minimum pH of 6.0 to create drilling fluid for lubrication and soil stabilization. Do not use any other chemical or polymer surfactants in the drilling fluid without written consent from the Engineer. If an obstruction is encountered during the boring process which prevents completion of the installation in accordance with the design location and specification, the pipe may be taken out of service and left in place at the discretion of the Engineer. Immediately fill the product left in place with flowable fill.

METHOD OF MEASUREMENT

110-4.1 Underground conduits and duct banks shall be measured by the linear feet (meter) of conduits and duct banks installed, including encasement, locator tape, trenching and backfill with designated, resolution, and for drain lines, the termination at the drainage structure, all measured in place, completed, and accepted. Separate measurement shall be made for the various types and sizes. Failed borings will not be measured for payment and shall be considered incidental to a successful boring.

BASIS OF PAYMENT

110-5.1 Payment will be made at the contract unit price per linear foot for each type and size of conduit and duct bank completed and accepted, including trench and backfill with the designated material, and, for drain lines, the termination at the drainage structure. This price shall be full compensation for furnishing all materials and for all preparation, assembly, and installation of these materials, and for all labor, equipment, tools, and incidentals necessary to complete this item in accordance with the provisions and intent of the plans and specifications.

Payment will be made under:

Item L-110-5.1 Electrical Conduit, 2-2” Schedule 40 PVC - per linear foot

Item L-110-5.2 Electrical Conduit, 2-3” Schedule 40 PVC - per linear foot

Item L-110-5.3 Electrical Conduit, 2-4” Schedule 40 PVC – per linear foot

MATERIAL REQUIREMENTS

Fed. Spec. W-C-1094	Conduit and Conduit Fittings; Plastic, Rigid (cancelled; replaced by UL 514 Boxes, Nonmetallic Outlet, Flush Device Boxes, & Covers, and UL 651 Standard for Conduit & Hope Conduit, Type EB & A Rigid PVC)
Underwriters Laboratories Standard 6	Rigid Metal Conduit
Underwriters Laboratories Standard 514B	Fittings for Cable and Conduit
Underwriters Laboratories Standard 1242	Intermediate Metal Conduit
Underwriters Laboratories Standard 651	Schedule 40 and 80 Rigid PVC Conduit (for Direct Burial)
Underwriters Laboratories Standard 651A	Type EB and A Rigid PVC Conduit and HDPE Conduit (for concrete encasement)
AC 150/5340-30	Design and Installation Details for Airport Visual Aids
AC 150/5345-53	Airport Lighting Equipment Certification Program
ASTM A615	Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
ASTM D1556	Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method
ASTM D1557	Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort
ASTM D2167	Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method
ASTM D2922	Standard Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)

END OF ITEM L-110

SECTION L-112 DIRECTIONAL BORE

DESCRIPTION

112-1.1 GENERAL. This item shall consist of furnishing and installing underground utilities using the method of installation commonly referred to as directional boring. This item shall include all services, equipment, materials, and labor for the complete and proper installation, testing, restoration of underground utilities and environmental protection and restoration. A No. 4 AWG Copper Counterpoise Conductor shall be installed with and external to the directional bore duct. Quantity of counterpoise shall be per the details. The No. 4 AWG counterpoise shall be paid for by the linear foot in accordance with L-108, Installation of Underground Cable for Airports.

SUBMITTALS

112-2.1 WORK PLAN. Prior to beginning work, the Contractor must submit to the Engineer a general work plan outlining the procedure and schedule to be used to execute the work. The work plan shall define the procedures for accomplishing the directional boring, locating existing underground utilities and cables of any type, protection of all existing utilities and cables and procedures for installing base cans at various locations along the directional bore. The Contractor shall also provide documentation of the depth of the directional bore along its entire length.

112-2.2 EQUIPMENT. The Contractor shall submit specifications on directional drilling equipment to be used to the Engineer to ensure that the equipment will be adequate to complete the project.

112-2.3 MATERIAL. Specifications on the material to be used in the directional bore shall be submitted to the Engineer. The material shall include the pipe, conduit, fittings and any other items which are to be an installed component of the project.

EQUIPMENT/CONSTRUCTION

112-3.1 GENERAL. The directional drilling equipment shall consist of a directional drilling rig of sufficient capacity to perform the bore and pullback the pipe, a drilling fluid mixing and delivery system of sufficient capacity to successfully complete the crossing, a guidance system to accurately guide boring operations and trained and competent personnel to operate the system. All equipment shall be in good, safe operating condition with sufficient supplies, materials and spare parts on hand to maintain the system in good working order for the duration of the project.

112-3.2 GUIDANCE SYSTEM. The guidance system shall be of a proven type and shall be setup and operated by personnel trained and experienced with this system. The operator shall be aware of any magnetic anomalies and shall consider such influences in the operation of the guidance system if using a magnetic system.

112-3.3 CONDUIT/DUCT. The conduit duct shall be Schedule 80 PVC conduit. HDPE conduit shall not be used. Conduit shall be Carlon Plus 80 Rigid PVC nonmetallic conduit, or approved equivalent. The Contractor is responsible for selection of Schedule 80 PVC raceway that is compatible with the proposed directional bore method and equipment.

112-3.4 EXECUTION. The Engineer must be notified 48 hours in advance of starting work. The directional bore shall not begin until the Engineer is present at the job site and agrees that proper preparations for the operation have been made. The Engineer's approval for beginning the installation shall in no way relieve the Contractor of the ultimate responsibility for the satisfactory completion of the work as authorized under the Contract.

The Contractor shall provide documentation that all underground utilities and cable systems have been located, staked and depths confirmed. No work shall begin until the Engineer and Owner are assured that the directional boring operation will not result in any utilities or cable system being cut or damaged.

The Contractor shall perform hand digging of the existing underground utilities and/or cable systems to accurately establish their depths at no additional cost to the Owner. Any damage done to the existing underground utilities and/or cable systems shall be promptly repaired by the Contractor at no additional cost to the Owner.

METHOD OF MEASUREMENT

112-4.1 The items described in this section are incidental to other sections and shall not be measured for payment.

END OF ITEM L-112

SECTION L-115 ELECTRICAL MANHOLES AND JUNCTION STRUCTURES

DESCRIPTION

115-1.1 This item shall consist of electrical manholes and junction structures (handholes, pull boxes, junction cans, etc.) installed in accordance with this specification, at the indicated locations and conforming to the lines, grades and dimensions shown on the plans or as required by the Engineer. This item shall include the installation of each electrical manhole and/or junction structures with all associated excavation, backfilling, sheeting and bracing, concrete, reinforcing steel, ladders, appurtenances, testing, dewatering and restoration of surfaces to the satisfaction of the Engineer.

EQUIPMENT AND MATERIALS

115-2.1 GENERAL.

a. All equipment and materials covered by referenced specifications shall be subject to acceptance through manufacturer's certification of compliance with the applicable specification when so requested by the Engineer.

b. Manufacturer's certifications shall not relieve the Contractor of the Contractor's responsibility to provide materials in accordance with these specifications and acceptable to the Engineer. Materials supplied and/or installed that do not materially comply with these specifications shall be removed, when directed by the Engineer and replaced with materials that comply with these specifications at the Contractor's cost.

c. All materials and equipment used to construct this item shall be submitted to the Engineer for approval prior to ordering the equipment. Submittals consisting of marked catalog sheets or shop drawings shall be provided. Submittal data shall be presented in a clear, precise and thorough manner. Original catalog sheets are preferred. Photocopies are acceptable provided they are as good a quality as the original. Clearly and boldly mark each copy to identify pertinent products or models applicable to this project. Indicate all optional equipment and delete non-pertinent data. Submittals for components of electrical equipment and systems shall identify the equipment for which they apply on each submittal sheet. Markings shall be boldly and clearly made with arrows or circles (highlighting is not acceptable). Contractor is solely responsible for delays in project accruing directly or indirectly from late submissions or resubmissions of submittals.

d. The data submitted shall be sufficient, in the opinion of the Engineer, to determine compliance with the plans and specifications. The Contractor's submittals shall be neatly bound in a properly sized 3-ring binder, tabbed by specification section. The Engineer reserves the right to reject any and all equipment, materials or procedures, which, in the Engineer's opinion, does not meet the system design and the standards and codes, specified herein.

e. All equipment and materials furnished and installed under this section shall be guaranteed against defects in materials and workmanship for a period of at least twelve (12) months from final acceptance by the Owner. The defective materials and/or equipment shall be repaired or replaced, at the Owner's discretion, with no additional cost to the Owner.

115-2.2 CONCRETE STRUCTURES. Cast-in-place concrete structures shall conform to the details and dimensions shown on the plans.

Provide precast concrete structures where shown on the plans. Precast concrete structures shall be an approved standard design of the manufacturer. Precast units shall have mortar or Bitumastic sealer placed between all joints to make them watertight. The structure shall be designed to withstand 36,300 lb

aircraft loads, unless otherwise shown on the plans. Openings or knockouts shall be provided in the structure as detailed on the plans.

Threaded inserts and pulling eyes shall be cast in as shown.

If the Contractor chooses to propose a different structural design, signed and sealed shop drawings, design calculations, and other information requested by the Engineer shall be submitted by the Contractor to allow for a full evaluation by the Engineer. The Engineer shall review in accordance with the process defined in the General Provisions.

115-2.3 JUNCTION CANS. Junction Cans shall be L-867 Class 1 (non-load bearing) or L-868 Class 1 (load bearing) cans encased in concrete. The cans shall have a galvanized steel blank cover, gasket, and stainless steel or coated steel hardware per FAA Engineering Brief #83. Covers shall be 3/8 inch thickness for L-867 and 3/4 inch thickness for L-868.

115-2.4 MORTAR. The mortar shall be composed of one part of Portland cement and two parts of mortar sand, by volume. The Portland cement shall conform to the requirements of ASTM C150, Type I. The sand shall conform to the requirements of ASTM C144. Hydrated lime may be added to the mixture of sand and cement in an amount not to exceed 15 percent of the weight of cement used. The hydrated lime shall meet the requirements of ASTM C6. The water shall be clean and free of deleterious amounts of acid, alkalis or organic material. If the water is of questionable quality, it shall be tested in accordance with AASHTO T-26.

115-2.5 CONCRETE. All concrete used in structures shall conform to the requirements of Item P-610, Structural Portland Cement Concrete.

115-2.6 FRAMES AND COVERS. The frames shall conform to one of the following requirements.

a.	ASTM A 48	Gray iron castings
b.	ASTM A 47	Malleable iron castings
c.	ASTM A 27	Steel castings
d.	ASTM A 283, Grade D	Structural steel for grates and frames
e.	ASTM A 536	Ductile iron castings
f.	ASTM A 897	Austempered ductile iron castings

All castings specified shall withstand a maximum tire pressure of 125 psi and maximum load of 30,000 lb.

All castings or structural steel units shall conform to the dimensions shown on the plans and shall be designed to support the loadings specified.

Each frame and cover unit shall be provided with fastening members to prevent it from being dislodged by traffic, but which will allow easy removal for access to the structure.

All castings shall be thoroughly cleaned. After fabrication, structural steel units shall be galvanized to meet the requirements of ASTM A123.

Each cover shall have the word “ELECTRIC” or other approved designation cast on it. Each frame and cover shall be as shown on the plans or approved equivalent. No cable notches are required.

115-2.7 LADDERS. Ladders, if specified, shall be galvanized steel or as shown on the plans.

115-2.8 REINFORCING STEEL. All reinforcing steel shall be deformed bars of new billet steel meeting the requirements of ASTM A615, Grade 60.

115-2.9 BEDDING/SPECIAL BACKFILL. Bedding or special backfill shall be as shown on the plans.

115-2.10 FLOWABLE BACKFILL. Flowable material used to backfill shall conform to the requirements of Item P-153, Controlled Low Strength Material.

115-2.11 CABLE TRAYS. Cable trays shall be of galvanized steel, plastic, or aluminum. Cable trays shall be located as shown on the plans.

115-2.12 PLASTIC CONDUIT. Plastic conduit shall comply with Item L-110, Airport Underground Electrical Duct Banks and Conduits.

115-2.13 CONDUIT TERMINATORS. Conduit terminators shall be pre-manufactured for the specific purpose and sized as required or as shown on the plans.

115-2.14 PULLING-IN IRONS. Pulling-in irons shall be manufactured with 7/8 inch (22 mm) diameter hot-dipped galvanized steel or stress-relieved carbon steel roping designed for concrete applications (7 strand, 1/2 inch diameter with an ultimate strength of 270,000 psi). Where stress-relieved carbon steel roping is used, a rustproof sleeve shall be installed at the hooking point and all exposed surfaces shall be encapsulated with a polyester coating to prevent corrosion.

115-2.15 GROUND RODS. Ground rods shall be one piece, copper clad**.** The ground rods shall be of the length and diameter specified on the plans, but in no case shall they be less than 8 feet (240 cm) long nor less than 5/8 inches (15 mm) in diameter.

CONSTRUCTION METHODS

115-3.1 UNCLASSIFIED EXCAVATION. It is the Contractor's responsibility to locate existing utilities within the work area prior to excavation. Damage to utility lines, through lack of care in excavating, shall be repaired or replaced to the satisfaction of the Engineer without additional expense to the Owner.

The Contractor shall perform excavation for structures and structure footings to the lines and grades or elevations shown on the plans or as staked by the Engineer. The excavation shall be of sufficient size to permit the placing of the full width and length of the structure or structure footings shown.

All excavation shall be unclassified and shall be considered incidental to the respective L-115 pay item of which it is a component part. Dewatering necessary for L-115 structure installation, erosion and turbidity control, in accordance with Federal, State, and Local requirements is incidental to its respective pay item as a part of Item L-115. The cost of all excavation regardless of type of material encountered, shall be included in the unit price bid for the L-115 Item.

Boulders, logs and all other objectionable material encountered in excavation shall be removed. All rock and other hard foundation material shall be cleaned of all loose material and cut to a firm surface either level, stepped or serrated, as directed by the Engineer. All seams, crevices, disintegrated rock and thin strata shall be removed. When concrete is to rest on a surface other than rock, special care shall be taken not to disturb the bottom of the excavation. Excavation to final grade shall not be made until just before the concrete or reinforcing is to be placed.

The Contractor shall provide all bracing, sheeting and shoring necessary to implement and protect the excavation and the structure as required for safety or conformance to governing laws. The cost of bracing, sheeting and shoring shall be included in the unit price bid for the structure.

Unless otherwise provided, bracing, sheeting and shoring involved in the construction of this item shall be removed by the Contractor after the completion of the structure. Removal shall be effected in a manner that will not disturb or mar finished masonry. The cost of removal shall be included in the unit price bid for the structure.

After each excavation is completed, the Contractor shall notify the Engineer. Structures shall be placed after the Engineer has approved the depth of the excavation and the suitability of the foundation material.

Prior to installation the Contractor shall provide a minimum of 6 in of sand or a material approved by the Engineer as a suitable base to receive the structure. The base material shall be compacted and graded level and at proper elevation to receive the structure in proper relation to the conduit grade or ground cover requirements, as indicated on the plans.

115-3.2 CONCRETE STRUCTURES. Concrete structures shall be built on prepared foundations conforming to the dimensions and form indicated on the plans. The concrete and construction methods shall conform to the requirements specified in Item P-610. Any reinforcement required shall be placed as indicated on the plans and shall be approved by the Engineer before the concrete is placed.

115-3.3 PRECAST UNIT INSTALLATIONS. Precast units shall be installed plumb and true. Joints shall be made watertight by use of sealant at each tongue-and-groove joint and at roof of manhole. Excess sealant shall be removed and severe surface projections on exterior of neck shall be removed.

115-3.4 PLACEMENT AND TREATMENT OF CASTINGS, FRAMES AND FITTINGS. All castings, frames and fittings shall be placed in the positions indicated on the Plans or as directed by the Engineer and shall be set true to line and to correct elevation. If frames or fittings are to be set in concrete or cement mortar, all anchors or bolts shall be in place and position before the concrete or mortar is placed. The unit shall not be disturbed until the mortar or concrete has set.

Field connections shall be made with bolts, unless indicated otherwise. Welding will not be permitted unless shown otherwise on the approved shop drawings and written permission is granted by the casting manufacturer. Erection equipment shall be suitable and safe for the workman. Errors in shop fabrication or deformation resulting from handling and transportation that prevent the proper assembly and fitting of parts shall be reported immediately to the Engineer and approval of the method of correction shall be obtained. Approved corrections shall be made at Contractor's expense.

Anchor bolts and anchors shall be properly located and built into connection work. Bolts and anchors shall be preset by the use of templates or such other methods as may be required to locate the anchors and anchor bolts accurately.

Pulling-in irons shall be located opposite all conduit entrances into structures to provide a strong, convenient attachment for pulling-in blocks when installing cables. Pulling-in irons shall be set directly into the concrete walls of the structure.

115-3.5 INSTALLATION OF LADDERS. Ladders shall be installed such that they may be removed if necessary. Mounting brackets shall be supplied top and bottom and shall be cast in place during fabrication of the structure or drilled and grouted in place after erection of the structure.

115-3.6 REMOVAL OF SHEETING AND BRACING. In general, all sheeting and bracing used to support the sides of trenches or other open excavations shall be withdrawn as the trenches or other open excavations are being refilled. That portion of the sheeting extending below the top of a structure shall be withdrawn, unless otherwise directed, before more than 6 inches of material is placed above the top of the structure and before any bracing is removed. Voids left by the sheeting shall be carefully refilled with selected material and rammed tight with tools especially adapted for the purpose or otherwise as may be approved.

The Engineer may order the Contractor to delay the removal of sheeting and bracing if, in his judgment, the installed work has not attained the necessary strength to permit placing of backfill.

115-3.7 BACKFILLING. After a structure has been completed, the area around it shall be backfilled in horizontal layers not to exceed 6 inches in thickness measured after compaction to the density requirements in Item P-152. Each layer shall be deposited all around the structure to approximately the same elevation. The top of the fill shall meet the elevation shown on the plans or as directed by the Engineer.

Backfill shall not be placed against any structure until permission is given by the Engineer. In the case of concrete, such permission shall not be given until tests made by the laboratory under supervision of the Engineer establish that the concrete has attained sufficient strength to provide a factor of safety against damage or strain in withstanding any pressure created by the backfill or the methods used in placing it.

Where required, the Engineer may direct the Contractor to add, at his own expense, sufficient water during compaction to assure a complete consolidation of the backfill. The Contractor shall be responsible for all damage or injury done to conduits, duct banks, structures, property or persons due to improper placing or compacting of backfill.

115-3.8 CONNECTION OF DUCT BANKS. To relieve stress of joint between concrete-encased duct banks and structure walls, reinforcement rods shall be placed in the structure wall and shall be formed and tied into duct bank reinforcement at the time the duct bank is installed.

115-3.9 GROUNDING. A ground rod shall be installed in the floor of all concrete structures so that the top of rod extends 6 inches (154 mm) above the floor. The ground rod shall be installed within 1 foot of a corner of the concrete structure. Ground rods shall be installed prior to casting the bottom slab. Where the soil condition does not permit driving the ground rod into the earth without damage to the ground rod, the Contractor shall drill a 4 inch diameter hole into the earth to receive the ground rod. The hole around the ground rod shall be filled throughout its length, below slab, with Portland cement grout. Ground rods shall be installed in precast bottom slab of structures by drilling a hole through bottom slab and installing the ground rod. Bottom slab penetration shall be sealed watertight with Portland cement grout around the ground rod.

A grounding bus of 4/0 bare stranded copper shall be exothermically bonded to the ground rod and loop the concrete structure walls. The ground bus shall be a minimum of 1 foot above the floor of the structure and separate from other cables. No. 2 AWG bare copper pigtails shall bond the grounding bus to all cable trays and other metal hardware within the concrete structure. Connections to the grounding bus shall be exothermic. Hardware connections may be mechanical, using a lug designed for that purpose.

115-3.10 CLEANUP AND REPAIR. After erection of all galvanized items, damaged areas shall be repaired by applying a liquid cold-galvanizing compound conforming MIL-P-21035. Surfaces shall be prepared and compound applied in accordance with manufacturer's recommendations.

Prior to acceptance, the entire structure shall be cleaned of all dirt and debris.

115-3.11 RESTORATION. After the backfill is completed, the Contractor shall dispose of all surplus material, dirt and rubbish from the site. The Contractor shall restore all disturbed areas equivalent to or better than their original condition. All sodding, grading and restoration shall be considered incidental to the respective L-115 pay item.

The Contractor shall grade around structures as required to provide positive drainage away from the structure.

Areas with special surface treatment, such as roads, sidewalks, or other paved areas shall have backfill compacted to match surrounding areas, and surfaces shall be repaired using materials comparable to original materials.

After all work is completed, the Contractor shall remove all tools and other equipment, leaving the entire site free, clear and in good condition.

115-3.12 INSPECTION. Prior to final approval, the electrical structures shall be thoroughly inspected for conformance with the plans and this specification. Any indication of defects in materials or workmanship shall be further investigated and corrected. The earth resistance to ground of each ground rod shall not exceed 25 ohms. Each ground rod shall be tested using the fall-of-potential ground impedance test as described by ANSI IEEE Standard 81. This test shall be performed prior to establishing connections to other ground electrodes.

115-3.13 MANHOLE ELEVATION ADJUSTMENTS. The Contractor shall adjust the tops of existing manholes in areas designated in the Contract Documents to the new elevations shown. The Contractor shall be responsible for determining the exact height adjustment required to raise the top of each manhole to the new elevations. The existing top elevation of each manhole to be adjusted shall be determined in the field and subtracted/added from the proposed top elevation.

The Contractor shall remove/extend the existing top section or ring and cover on the manhole structure or manhole access. The Contractor shall then install precast concrete sections or grade rings of the required dimensions to adjust the manhole top to the new proposed elevation or shall cut the existing manhole walls to shorten the existing structure, as required by final grades. Finally, the Contractor shall reinstall the manhole top section or ring and cover on top and check the new top elevation.

The Contractor shall construct a concrete slab around the top of adjusted structures located in graded areas that are not to be paved. The concrete slab shall conform to the dimensions shown on the plans.

115-3.14 DUCT EXTENSION TO EXISTING DUCTS. Where existing concrete encased ducts are to be extended, the duct extension shall be concrete encased plastic conduit. The fittings to connect the ducts together shall be standard manufactured connectors designed and approved for the purpose. The duct extensions shall be installed according to the concrete encased duct detail and as shown on the plans.

METHOD OF MEASUREMENT

115-4.1 Electrical manholes and junction structures shall be measured by each unit completed in place and accepted. The following additional items are specifically included in each unit.

All Required Excavation, Dewatering

Sheeting and Bracing

All Required Backfilling with On-Site Materials

Restoration of All Surfaces and Finished Grading, Sodding

All Required Connections

Dewatering If Required

Temporary Cables and Connections

Ground Rod Testing

115-4.2 MANHOLE ELEVATION ADJUSTMENTS shall be measured by the completed unit installed, in place, completed, and accepted. Separate measurement shall not be made for the various types and sizes.

BASIS OF PAYMENT

115-5.1 The accepted quantity of electrical manholes and junction structures will be paid for at the Contract unit price per each, complete and in place. This price shall be full compensation for furnishing all materials and for all preparation, excavation, backfilling and placing of the materials, furnishing and installation of appurtenances and connections to duct banks and other structures as may be required to complete the item as shown on the plans and for all labor, equipment, tools and incidentals necessary to complete the structure.

115-5.2 Payment shall be made at the contract unit price for manhole elevation adjustments. This price shall be full compensation for furnishing all materials and for all preparation, assembly, and installation of these materials, and for all labor, equipment, tools, and incidentals necessary, including but not limited to, spacers, concrete, rebar, dewatering, excavating, backfill, topsoil, sodding and pavement restoration, where required, to complete this item as shown in the plans and to the satisfaction of the Engineer.

Payment will be made under:

Item L-115-5.1 Electrical Handhole - Vehicle-Rated – per each

MATERIAL REQUIREMENTS

ANSI/IEEE Std 81	IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System
AC 150/5345-7	Specification for L-824 Underground Electrical Cable for Airport Lighting Circuits
AC 150/5345-26	Specification for L-823 Plug and Receptacle Cable Connectors
FED SPEC J-C-30	Cable and Wire, Electrical Power, Fixed Installation (cancelled; replaced by AA-59544 Cable and Wire, Electrical (Power, Fixed Installation))
ASTM B3	Soft or Annealed Copper Wire
ASTM B8	Concentric-Lay-Stranded Copper Conductor, Hard, Medium-Hard, or Soft

END OF ITEM L-115

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SECTION L-127 AIRFIELD LIGHTING CONTROL AND MONITORING SYSTEM

127-1.1 DESCRIPTION

A. It is the intention of this Specification to describe an Airfield Lighting Control and Monitoring System (ALCMS) using industrial grade Programmable Logic Controllers (PLCs). Systems using personal or industrial grade computers to control regulators, circuit selectors or other input / output (I/O) devices, or to provide functions other than Graphical User Interface (GUI) are not acceptable.

127-1.2 SCOPE OF WORK

A. Provide all labor, materials, tools and equipment, whether or not directly specified in this Section or shown on the plans, required for the design, supply, installation, testing, commissioning and training of a complete functioning ALCMS, unless it is specifically mentioned that the work or a portion thereof shall not be included, or shall be by others.

B. This project shall include hardware, software, programming, computers, manuals, factory testing, on-site testing & commissioning, on-site training and any other materials, tools and equipment to provide a fully functional system to the satisfaction of the Owner and Engineer.

127-1.3 SYSTEM OVERVIEW

A. Refer to the drawings to view the overall topology of the system. The primary function of the ALCMS is to provide the remote control and monitoring capability of the equipment in the airfield lighting vault. The primary location for the user interface to the system is at the cab of the Air Traffic Control Tower (ATCT). Secondary control for the system, protected by an authentication process, is from the vault location.

B. The major elements of the ALCMS, described further in these specifications shall be comprised of:

1. ATCT Graphical User Interface (GUI): One graphical user interface panel shall be provided. It shall comprise of a LCD monitor with touch-screen for input of control commands and graphic display of the airfield lighting status. Coordinate location of the lighting control panel with the Owner.
2. ATCT Control Panel: A wall mounted cabinet shall be provided in the transfer level equipment room to house the fiber optic and/or radio communication equipment, Ethernet switch, power supplies, PLC processor, I/O, rotating beacon and additional control and monitoring components, as applicable.
3. Vault Control Panel: A wall mounted cabinet shall be provided in the electrical vault containing the fiber optic equipment, Ethernet switch, PLC control processors, I/O, power supplies, and other components necessary for control and monitoring of the airfield lighting, constant current regulators, and non-regulated feeder circuits.
4. Vault GUI: A graphical user interface panel identical to the tower shall be provided in the electrical vault, mounted in the door or on the side of the vault control panel. The vault GUI shall include the tower graphics and be capable of controlling the lights if required.
5. ALCMS Fiber Communications Network: Fiber optic cable shall be provided between the ATCT and the lighting vault. The fiber shall be connected between locations the drawings indicate general configuration of the ALCMS and routing of the fiber optic cables.

127-1.4 DEFINITIONS

A. Abbreviations

1.	AC	Advisory Circular
2.	AGL	Airport Ground Lighting
3.	ATCT	Airport traffic control tower
4.	ALCMS	Airfield Lighting Control and Monitoring System
5.	CCR	Constant Current Regulator
6.	CPU	Central Processing Unit
7.	CSR	Current Sensing Relay
8.	FAA	Federal Aviation Administration
9.	FAT	Factory Acceptance Test
10.	FO	Fiber Optic
11.	GUI	Graphical User Interface
12.	I/O	Input / Output
13.	LED	Light Emitting Diode
14.	NEC	National Electrical Code
15.	NRTL	Nationally Recognized Testing Laboratory
16.	OSHA	Occupational Safety and Health Administration
17.	PAPI	Precision Approach Path Indicator
18.	PC	Personal Computer
19.	PLC	Programmable Logic Controller
20.	SAT	System Acceptance Test
21.	UPS	Uninterruptable Power Supply
22.	VAC	Volts, Alternating Current
23.	VDC	Volts, Direct Current

127-1.5 REFERENCES

A. Codes and standards referred to in this section:

1.	NFPA 70	National Electrical Code
2.	L-890	FAA AC 150/5345-56

127-1.6 QUALITY ASSURANCE

A. Airport lighting equipment and materials covered by FAA specifications shall have prior approval of the Federal Aviation Administration, Airports Service, Washington, D.C. 20591, and shall be listed in Advisory Circular 150/5345-53, latest edition, Airport Lighting Equipment Certification Program.

B. The ALCMS shall be certified to the requirements of FAA Specification L-890 Airport Lighting Control and Monitoring System AC 150/5345-56. Equipment shall be certified to level L-890BB (last state failsafe and basic monitoring) as defined in Section 1.2.1 of the Advisory Circular 150/5345-56.

C. Manufacturers shall have demonstrated ALCMS experience at a minimum of 5 (five) airports where PLC based Control and Monitoring systems have been installed. The PLC shall have communicated to the GUI stations using serial or Ethernet protocols. Systems shall have been operational at other airports for at least a period of 5 (five) years.

D. The ALCMS Manufacturer shall provide an experienced and qualified Engineering, Sales and Service staff to support the contractor and airport throughout the installation and life of the system.

E. A detailed summary of qualifications and experience shall be submitted for approval by the Owner / Engineer as part of the submission and shall include the following information: location of airport, date of final acceptance, and a description of the hardware and software used in the control system.

F. The ALCMS shall be listed and labeled by a NRTL for electrical safety.

G. The installation of the ALCMS shall comply with NFPA 70 "National Electrical Code (NEC)", latest edition, for components and installation.

127-1.7 PROJECT COORDINATION

A. The installation of the ALCMS shall have the following basic sequence of events:

1. Submittal
2. Hardware approval and production release
3. Graphics and software coordination meeting and approval
4. Production
5. Factory acceptance testing and approval
6. Shipment
7. Installation
8. Commissioning
9. Cutover
10. System acceptance testing
11. Training
12. O&M manuals
13. Warranty period

EQUIPMENT AND MATERIALS

127-2.1 L-890 ALCMS

A. The ALCMS shall be based on an "open architecture" concept to allow simple integration and interfacing of all system components. It shall be possible to add additional off-the-shelf discrete monitoring and control hardware without requiring the services of the original manufacturer.

B. The system shall be a non-distributed type design

C. The main control panel shall be pre-wired to handle all CCRs shown (active and spare) for a total of 4. All CCR I/O shall be sized to handle 5 step regulators.

D. Any hardware or software changes required in the future as a result of airport expansions or changes shall be possible without contacting the original equipment manufacturer or supplier. The equipment and software supplied shall be upgradeable by the Owner, consultants or other systems integrators. No programming knowledge other than relay ladder logic shall be necessary to make changes to the system.

E. All hardware and software shall be commercially available off-the-shelf products and be available from various suppliers. The PLC manufacturer must have a distributor within 50 miles of the airport.

F. The software application running on the GUI shall be by the same manufacturer of the PLC.

G. The PLC shall be an industrial grade PLC. The PLC shall be a rack style chassis with separate power supply module, CPU module, communications modules, I/O modules.

H. In general, all components of the ALCMS must be provided, assembled and tested by one manufacturer. The ALCMS shall be provided as per the plans and consist of the following:

1. Touch-screen GUI (ATCT and vault)

   a. This panel shall contain integrated CPU's capable of providing all graphics processing and Ethernet network support. Only power and Ethernet connections shall be required. The operator panel shall not contain any mechanical hard drives, fans or other moving parts. No video extender or tower equipment room PC's are permitted. Keyboard, mouse or other input device shall not be required.

   b. Graphical User Interface (GUI) shall consist of:

      1) 15" Active Matrix TFT LCD color display
      2) Black Monitor bezel
      3) touch-screen
      4) Resolution: 1280 x 1024
      5) Brightness: 230 cd/m^2 (with touch-screen)
      6) Contrast: 350:1
      7) Viewing Angle – Horizontal: 160° Minimum
      8) Viewing Angle – Vertical: 160° Minimum
      9) Touch-screen Connection: Serial or USB
      10) Video Connection: DB15 VGA
      11) Backlight Lamp Life: 30,000 hours minimum
      12) Non-glare, non-reflective viewing surface

   c. Integrated industrial computer, as a minimum, shall consist of:

      1) Dedicated Pentium based control processor
      2) No Moving parts, no enclosure or CPU fans, no hard drives
      3) Celeron Processor, 400 MHz minimum
      4) 256MB SDRAM
      5) 512K Battery Backed RAM
      6) Compact Flash Solid State Drive, 1GB Minimum
      7) 1 Serial Port, 1 parallel port
      8) 10/100 MBit Ethernet Port
      9) USB Port
      10) DB15 VGA Connector
      11) PS/2 Mouse and Keyboard connectors
      12) Power: 9 to 36VDC
      13) Operating Temperature: -10°C to +50 ^{o}C

2. The ALCMS control panels (vault and ATCT) shall include the following:

   a. NEMA 12, single door, front access complete with door locking system
   b. Ventilation and filters.
   c. Terminal blocks, clips, rails, ducts, and other material as required to provide properly terminated and supported wire and cable routing
   d. Grounding straps as required
   e. Minimum dimensions: 30" wide x 36" high x 12" deep, wall mounted.
   f. Provision for incoming 120VAC supply.
   g. Lightning / surge protection for 120VAC supply

h. 24VDC power supply, short circuit protected, sized to provide 100% spare capacity
i. All wiring and panel terminal blocks to be rated 600V minimum
j. Nameplates shall be provided for panel and devices
k. PLC Chassis with power supply, PLC processor, I/O modules, communication module.
l. Ethernet Fiber Optic communication module or media converter
m. Ethernet radio modem
n. Ethernet switch
o. Ethernet patch cables
p. I/O for monitoring of panel alarms, battery and UPS status. Monitoring to be provided for each 120VAC supply, each 24VDC supply, and each surge suppressor.
q. Fiber optic patch cables
r. Uninterruptable power supply capable of 2hr battery backup

3. Control and Monitoring Interface

a. The ALCMS shall support 24VDC, 48VDC or 120VAC external or internal CCR control voltages for regulator on/off control and 5 step brightness selections for all CCRs.
b. The IO control signals shall be coordinated with the existing CCR manufacturer.
c. A current sensing relay shall be used to determine if regulator status is on.
d. The ALCMS shall be capable of controlling multiple circuit selectors per regulator.
e. The ALCMS shall be capable of providing the following monitoring functions:

1) CCR Commanded On, commanded brightness step
2) CCR On / off status
3) CCR faulted (On-fault / Off fault)
4) Input power available to CCR
5) CCR Control Switch in Remote Position
6) Circuit selector switch in Remote (for each circuit selector)
7) Circuit selector input power / control power available
8) Elapsed time at each brightness step and total elapsed time
9) Number of times the regulator is energized

f. The ALCMS shall be capable of providing the following alarming capabilities – each alarm shall be configurable by the site.

1) Lamps out monitoring (L829 type CCRs)
2) Fault (CCR plus circuit selectors)
3) Control switch not in remote (CCR plus circuit selectors)
4) Loss of input power (regulators, circuit selectors)

g. System functions and display information shall be configurable on-line by maintenance personnel, without the need to power down any device. The following parameters shall be configurable:

1) Setup information including address, number of circuit selectors, output current, brightness steps, and monitoring features included.
2) Alarms shall be independently enabled or disabled.

3) Control settings including control capability, soft-start increment time, failsafe settings

4. Communications

a. Fiber Optics shall be used as a Primary communications link between the airfield lighting vault and the ATCT.

1) The fiber optic cable shall conform to Item L-128, Fiber Optic Cable.
2) Fiber optic cable shall be terminated with SC Type connectors.
3) The fiber optic modules shall be industrial grade, powered from 24VDC and shall be DIN rail mounted. Fiber modules shall operate at 100 Mbs. Commercial grade Ethernet modems or transceivers are not acceptable.

b. Ethernet Switch

1) The Ethernet switch shall be industrial grade. Hubs or commercial grade switches are not acceptable.
2) The industrial grade switch shall be DIN rail mounted and operate from 24VDC.
3) The industrial grade switch shall be DIN rail mounted and operate from 24VDC.
4) Ethernet devices shall be connected via CAT5e cables.

5. Design Requirements:

a. GUI Operational Requirements

1) Develop custom graphics and control pushbuttons to meet the operational requirements of ATCT. Coordinate software and programming development with the engineer to ensure that user-operated control and maintenance function requirements are provided.
2) Airfield lighting control commands shall be input on the touch-screen displays using on-screen pushbuttons. Separate control pushbuttons shall be provided for each controllable lighting element. Coordinate with Owner for information on each airfield lighting circuit, constant current regulator and specific operational requirements.
3) Custom pushbuttons shall be provided to automate common procedures. These shall be developed in conjunction with the engineer to provide pre-programmed settings the custom pushbuttons shall be site configurable, allowing changes to be made to the basic system operation without the need to contact the original supplier. Refer to Specification L-890 for information on pilot controlled radio, photocell and other pre-programmed operations.
4) Utility functions shall be provided to allow the airport personnel to calibrate the touch-screen and lock the screen for cleaning and demonstrating the system without accidentally changing the current settings.
5) Each operator control station shall display a graphic representation (mimic display) of the airfield lighting installation.

Colors used for indication on the screen shall be reviewed and approved by the engineer.

6) Only circuits that are actually “ON” (current is flowing in circuit) shall be indicated as being “ON” on the mimic display.

7) Indications shall be provided for various alarm conditions including fault (circuit did not come on when requested). Fault conditions shall be indicated in a flashing red color.

8) If a circuit is out of service for maintenance and cannot be controlled by ATCT, the circuit shall be indicated on the mimic display in a solid orange color.

9) Maintenance personnel shall have the ability to enable or disable each monitoring feature (on an individual circuit basis), and specify which locations (ATCT, vault) should receive the alarm indications.

b. Software Design

1) All software required to operate, maintain, analyze, and trouble-shoot the system shall be provided as part of this contract. All control and monitoring software shall be off-the-shelf, non-proprietary and become the property of the Owner. All original program files and source code shall be provided as part of this contract and become property of the Owner.

2) All interlocking, monitoring and control logic shall be programmed in electrical ladder logic format and shall reside in the PLCs provided. A failure of a tower or vault computer that displays the airfield graphics shall not affect the PLC operation and the operation of the rest of the system.

3) The software contained in the graphics computers shall consist solely of graphic generation, touch-screen operator input, configuration utilities and remote access software.

4) System functions and display information shall be completely configurable on-line by maintenance personnel without the need to power down any device. This provides the ability to change the operation of the system without the need to make any program changes. These configuration changes shall be made simply by selecting a checkbox or by entering data into a configuration screen. The following features shall be provided:

a) Enable control capability from each location including ATCT and Vault.

b) Independently enable or disable circuits and each individual monitoring feature for the circuit. Swap spare regulators into service by simply changing field cables and specifying the new regulator number.

c) Configure all custom pushbuttons and provision for unattended operation (photocell, air to ground radio) allowing the site to easily change how the system functions

5) Access to all software shall be provided with suitable security measures to prevent inadvertent access to configuration screens and settings. Any ability to make changes to the software shall be protected using appropriate passwords and security features. These passwords shall be provided to the Owner to allow them to

make future modifications and additions. Security features shall include the following:

a) Site assignable usernames with different security levels, allowing individuals access to different system capabilities (i.e. view only, lighting control only, control and monitoring, configuration, calibration)

6) Backup computer flash drives shall be provided. Upon replacement of the flash drive, the software shall be restored automatically from the backup image. The system shall not require the services of an Information Technology (IT) person or the original manufacturer. Once restored, the system shall be ready to operate.

c. Control Requirements

1) Each operator control station shall operate independently in a fully redundant fashion such that a failure of one station does not impact the operation of the system.
2) Each operator control station shall be capable of independently controlling and displaying the entire airfield lighting installation or any predefined portion as determined by ATCT. Each operator control station shall have independent or simultaneous control.
3) A transfer control procedure shall be provided to ensure that only the appropriate stations have control. Control capability shall be enabled or disabled for each location to prevent unauthorized locations from being able to control the lighting.
4) The control system shall have provision for photocell and air-to-ground radio control of the airfield lighting.
5) The rotating beacon control shall be provided with a re-strike delay feature to prevent the beacon from being switched on or off until full warm-up or cool-down period is completed. The rotating beacon shall be provided with a panel door mounted control switch and indicating light allowing manual on/off and remote control of the beacon.
6) The system shall be provided with a soft start control feature to allow the circuits to be switched on or off without in-rush concerns for the equipment or lamps.
7) The system software shall be supplied with capability to control and monitor 20 circuits per vault. Hardware shall be provided to control the circuits specified on the contract drawings. It shall be possible to add additional circuits by adding additional processors.
8) The system software shall be supplied with capability to control and monitor up to 2 circuit selector controlled circuits per regulator.
9) The system shall provide the ability to flash the airfield circuits to warn or alert ground vehicles in the event of loss of normal radio communication.
10) If the HMI operator stations cannot communicate to the PLC or the PLC fails for any reason, the ALCMS shall switch to failsafe operation as follows:

a) If power is available to the vault PLC panel and the circuit was on, it shall remain in its last state.

b) If power is available to the vault PLC panel and the circuit was off, it shall remain off.
c) If power is not available to the vault PLC panel, the circuit shall switch to a pre-programmed setting (i.e. switch to off or Brightness B1, B2, B3, B4 or B5).
d) The failsafe settings shall be determined by maintenance staff and shall be field adjustable without changing the software.
e) A watchdog timer shall be installed to check the status of the control system and communications and switch to the failsafe mode if malfunction occurs.
f) When the control system returns to normal, control shall automatically be transferred back to the tower.

d. Monitoring Requirements

1) The ALCMS shall include the capability to diagnose and locate system faults from the vault computer.
2) Maintenance personnel shall have the ability to enable or disable each of the monitoring features simply by selecting the various checkboxes from a configuration screen.

e. Alarming

1) The ALCMS shall provide alarming capabilities for each of the monitored data points. Maintenance personnel shall have the ability to filter each alarm independently by circuit for display at vault or ATCT locations.
2) The Alarm screens shall display a list of all current malfunctions and provide:

a) Date and time of the malfunction
b) Type of Failure or Alarm
c) Lighting system, CCR, circuit selector
d) Location, e.g. ATCT, vault
e) Description of malfunction

f. Event Summary
The system shall log all operator commands and system events and display them on an event summary screen. Information shall include:

1) Date and time of the event
2) Operator circuit switching / brightness changes
3) Security information
4) System event information provided by hardware
5) Description of the event

127-2.2 ETHERNET NETWORK CABLES

A. All Ethernet network cables shall be Category 5e (Enhanced) types, suitable for industrial Ethernet applications, including 100 Base TX and 100 Base T systems.

1. Cable jacket shall be heavy duty industrial types, and shall be oil resistant and UV sunlight resistant.
2. All conductors shall be 24 AWG solid copper conductors.
3. Each cable shall contain four (4) twisted pair conductors.

4. Each cable shall be provided with installation stress resistance.
5. All cables shall meet the following standards:

    a. ANSI/TIA/EIA-568-B.2 Category 5e
    b. ISO/IEC 11801 Category 5e
    c. NEMA WC-63.1 Category 5e

B. Cables shall be 4-pair shielded types.

1. Temperature range: -25 to 75° C
2. Insulation material: Polyolefin
3. Jacket Material: PVC
4. Shielding: Aluminum/Mylar Foil, 100% coverage, provided with #24 AWG stranded TC drain wire.
5. Flame Test: UL CMR 1666 Riser, C(UL) CMR FT4, UL CMX Outdoor.
6. Acceptable Manufacturer: Belden 7929A

127-2.3 FIELD INSTALLED FIBER OPTIC PATCH CORDS

A. Fiber Optic patch cords shall be used from the FO patch panel to FO equipment inside the ALCMS control panels.

B. In General, Fiber optic patch cables shall be as follows:

1. Fiber: 62.5/125 µm MM
2. Construction: Duplex
3. Connector: SC
4. Optical, mechanical and environmental performance: Meets TIA/EIA-568-B.3 specification
5. Mating Durability: 500 matings per FOTP-21
6. Cable Retention: >10 lbs. per FOTP-6.
7. Operating/Storage Temperature: 0°C to +75°C
8. Mated pair insertion loss: MM: <0.35 dB (0.15dB typical)
9. Length: As required

127-2.4 FIBER OPTIC PATCH PANEL

A. Patch panels shall be used to provide a point of connection between the fiber optic cables and the ALCMS system.

B. In general, the patch panel shall be of modular design and as follows:

1. Construction: 16ga. Cold rolled steel
2. Finish: black powder coat
3. Mounting: Wall
4. Design: 2 door with field side lockable
5. Capacity: Four adapter panels
6. Adapter Panels: 3 Duplex SC connections, Blue
7. Provide 4 adapter panels

127-2.5 FIELD INSTALLED ALCMS CONTROL CABLE

A. In general, control tray cable shall be as follows:

1. UL Listed subject 1277

2. 600V, 90 deg. F., Type TC Cable, Exposed run rated
3. Industrial Grade PVC Sunlight and oil resistant Jacket w/rip cord
4. 16 AWG, stranded, bare copper conductor, PVC/Nylon insulation
5. 16 conductor, alpha-numeric and color coded, ICEA standard

127-2.6 ALCMS CONTROL CABLE CONNECTORS

A. In general, control cable connectors shall be as follows:

1. UL Recognized
2. Inserts

a. Rated voltage - 600VAC
b. Test Voltage – 3 kV eff.
c. Working current - 16amps
d. Flammability – UL94 V-0
e. Temperature range - -40C to +125C
f. Base Material – Glass filled thermoplastic
g. Contact material – Solid drilled copper alloy
h. Contact surface – Hard silver plated
i. Screw terminal – 20-14AWG
j. Size: - 16 pin

3. Housings – Base & Hood

a. Material - Die cast aluminum alloy
b. Finish - Epoxy powder coat
c. Locking mechanism - Single lever
d. Internal protection – IP65 (locked)
e. Seal gasket – EDPM
f. Entry – ¾” NPT
g. Hood – Side entry
h. Base – Box type w/cover
i. Size – to match inserts

127-2.7 INSTALLATION HARDWARE

A. All hardware for installation shall conform to other sections of the specifications for this project.

CONSTRUCTION METHODS

127-3.1 SUBMITTALS

A. Airfield Lighting Control and Monitoring System

1. Hardware design Submittal

a. Provide drawings showing the following:

1) Bills of materials
2) Identification and location of devices
3) General arrangement of control panels and mounting details of ATCT touch-screen monitors.

4) For control panels, provide as a minimum a plan view, front view with doors removed.
5) Show overall dimensions and component mounting details, cable routings, connections, and terminations.
6) Provide detailed power schematics of ALCMS panels, showing incoming power supplies, breakers and fuses, cooling fan and control, battery charger and control.
7) Provide detailed control schematic and wiring diagrams including all control, monitoring, and communications interconnections and terminations.

b. Letter documenting coordination with the manufacturer of the CCRs.

2. Equipment Data Sheets
All significant equipment to be supplied shall be listed followed by descriptive data sheets. The equipment list shall include the following:

a. Component name
b. Supplier/Manufacturer
c. Model number
d. A description of the operation
e. Quantity supplied
f. Any special setup, operation and maintenance characteristics.

3. Graphical User Interface sample screens
Provide full color sample screen captures of screens to be used on the GUI along with written descriptions

4. Sequence of Control
Provide a written description of the control sequences of the following:

a. Control sequences
b. Alarming sequences
c. Preset sequences

5. After ALCMS system hardware approval, a meeting to coordinate the system graphic screens and software functions shall be held. In this meeting, the airport representative, The FAA representative, the engineer, the ALCMS manufacturer, the installing contractor shall be in attendance for input, review and coordination of the system software and graphics. Approval may occur at this time or it may require an additional submittal by the ALCMS manufacturer.

B. Submit product data sheets for the following field components not supplied as part of the ALCMS:

1. Each type of wire, cable and fiber optic cable used
2. Control circuit connectors
3. Ethernet CAT 5 cables
4. Fiber optic patch panel
5. Fiber Optic patch cables
6. Antenna Coax cable and connectors (as per ALCMS requirements)

C. Faxed documents shall not be included in submittal package and will be rejected.

D. All submittal items shall be subject to approval of the Engineer. Materials and methods identified and described not meeting the requirements of this specification or, in the

opinion of the Engineer, are not suitable for the intended application, may be rejected, in whole or in part. The supplier shall be required to modify the submittal including changes to materials and methods to the satisfaction of the Engineer

127-3.2 FACTORY ACCEPTANCE TEST

A. Before shipment, the ALCMS shall be assembled as an operating system at the ALCMS Manufacturer's test facilities.

B. Tests shall be witnessed by a representative of the engineer and the airport on a date mutually agreed on.

C. The ALCMS Manufacturer shall incur the costs of setting up and performing the test.

D. The Contractor/Manufacture shall cover the airport/owner travel and expenses

E. At a minimum, the FAT shall allow for one (1) day of testing and review, but may require additional time depending on the results of the testing.

F. A complete examination of the product shall be completed to determine compliance with the specifications and drawings with respect to materials, workmanship, dimensions and marking.

G. Perform any tests, consistent with the contract, which the Airport Authority representative may require to satisfy themselves of the adequacy and satisfactory operation of the system.

H. During the FAT, minor software comments shall be finalized and incorporated into the final system.

I. Delivery of the Systems cannot occur until the FAT has been accepted.

127-3.3 DELIVERY, STORAGE AND HANDLING

A. General

1. Deliver panels ten days or less prior to installation
2. Ship panels and equipment in thoroughly clean condition.
3. Cap all panel openings
4. Protected all externally mounted components from damage during shipping.
5. Secure all internally mounted components to prevent them from breaking free of their mounting during shipping.

B. Acceptance at site

1. Inspect all materials and equipment against approved shop drawings at time of delivery.
2. Immediately return for replacement or repair any equipment or materials damaged or not in conformance with the approved shop drawings. Notify engineer of status.

C. Storage and protection

1. Label all equipment and materials after they have been inspected.
2. Store all equipment and materials in dry, covered, ventilated location.

3. Protect from harm in accordance with manufacturer's recommendation and general conditions of the specifications.

127-3.4 EQUIPMENT INSTALLATION

A. The installing contractor shall be responsible for the physical installation of all associated ALCMS components.

B. The installing contractor shall make all necessary electrical connections at each location in accordance with the ALCMS manufacturer's wiring diagrams

C. In the ATCT, the installing contractor shall replace the existing console top to accommodate the GUI screen. The new console top shall match the surrounding surfaces. The contractor shall coordinate with the FAA when the console top is replaced.

D. Unless otherwise indicated, panels shall be installed such that all control devices mounted on them do not exceed 72 inches above floor or grade elevation.

E. Wiring methods

1. Strictly adhere to the following wiring method rules:

a. All wires called out in the drawings associated with equipment that is to be controlled or monitored shall be pulled, terminated and dressed at the appropriate terminal blocks and at the associated equipment.
b. Do not splice wires in conduits. All splices shall be in a conduit body or junction box.
c. Spade lugs shall be used where pressure plates are not furnished.
d. Do not run DC wiring in a common conduit with AC wiring.
e. Ground instrument cable shields only at the power supply end.
f. Install digital network cables in dedicated raceways and conduits.
g. Do not terminate metallic conduit directly to a non-metallic instrument enclosure. Provide appropriate interface adapter.
h. Leave sufficient extra wire length on each control/monitoring lead to make future changes in connections at the terminal block.

F. Wire/cable labeling methods

1. Each conductor or cable shall be provided with a unique number, which shall be secured on each end of the conductor or cable.
2. Label and identify only the outer jacket of a color-coded multi-conductor cable. It is not necessary to label each individual conductor within the cable.
3. Identification shall be printer generated. Handwritten labels will not be permitted and shall not be used.
4. Wire labels, shall be of the self laminating type. Black text on white. Matte finish. Viewable area of .5"W x .375" H
5. Identification markings designated in the plans shall be followed.

G. Hard-wire Data Cable Installation

1. The Contractor shall install, terminate and test all hard-wire communications required for the project. This includes all of the following components:

a. ALCMS manufacturer specified data cable
b. Data cable termination panels
c. Data cable jumper cables

d. Connectors / couplings
e. Junction boxes

2. Installation of the data cable shall be done by a trained and qualified specialist.
3. All associated cabling, splices and jumper cable shall be tested upon completion of the cable installation and termination of connectors.
4. All test data shall be recorded and included in a test report that shall be submitted to the engineer for approval.
5. Commissioning of the system shall not begin until all test reports have been submitted and approved.

127-3.5 TESTING AND COMMISIONING

A. Because the airport is an active airport, careful coordination will be required for the commissioning, cutover and final SAT of the ALCMS.

B. Commissioning

1. Commissioning shall require complete operation of the ALCMS without the field lighting circuits connected to the CCRs and any other active device to be controlled such as the rotating beacon. Their functions and response may need to be simulated until final cutover.
2. The ALCMS manufacturer shall provide a qualified technical specialist to test and commission the system into service. As a minimum, tests shall include:

a. Point-to-point wiring continuity tests.
b. Insulation and grounding tests.
c. Fiber-optic network communications tests
d. Verification of all remote control functions for each controllable element
e. Verification of all remote monitoring functions
f. Touch-screen monitor operations, screen display sections, command select acknowledgment, and action confirmed representations, alarm indications.
g. Maintenance Center computer tests.
h. Remote Access software
i. Access security
j. Data Logging, Alarming and Reporting

3. A commissioning test report shall be provided to the engineer at the completion of the commissioning.
4. Following commissioning, a minimum 2 week “burn-in” will be required before cut-over may occur.

C. Cutover

1. The ALCMS manufacture and the installing contractor shall develop a cutover plan and submit it to the engineer for approval.
2. Following the system’s commissioning and “burn-in” period, and acceptance of the cutover plan, a date mutually acceptable to the airport and engineer shall be decided for the system cutover.
3. The minimum requirement for the day of the cutover shall be that the weather conditions permit operations of the airport without the possibility of the need for the airfield lights, i.e. Clear VFR conditions with no impending weather or possible deterioration of weather conditions.
4. Final approval to proceed on the day of the cutover shall be the airports decision along with coordination with the ATCT.

D. System acceptance test (SAT)

1. The ALCMS Manufacturer shall develop a SAT test plan in accordance with the specifications and issue this to the engineer for approval.
2. Following the final cutover of the system and approval of the SAT, the ALCMS Manufacturer shall perform the SAT. This demonstration shall include, as a minimum, the following:

   a. Lighting control functions
   b. Monitoring functions
   c. Alarm functions
   d. Print and Display functions

3. The SAT shall be witnessed by owner representatives, the contractor and the engineer.

127-3.6 TRAINING

A. The manufacturer shall provide a qualified factory-trained ALCMS technical specialist to conduct on-site familiarization, operation, and maintenance training.

B. Training shall consist of the following:

1. Air Traffic Control personnel

   a. Provide two (2), 2 hour on-site operational training sessions.
   b. Training shall occur at least 60 calendar days prior to cutover.
   c. Training shall consist, as a minimum, of the following:

      1) ALCMS General System
      2) Overview touchscreen Operations
      3) Using the Control System (GUI)
      4) Command and control Sequences
      5) Alarm and Warning Messages
      6) Failsafe Conditions
      7) Granting Local Control to the Vault

2. Maintenance Personnel

   a. Provide two (2), 4 hour on-site maintenance training sessions
   b. Training shall occur after the system is fully operational
   c. Training shall consist of, as a minimum, of the following:

      1) Familiarization with the Operation and Maintenance Manuals.
      2) Review of schematic drawings - how to read them and how to use them to troubleshoot system function and control problems.
      3) Review of software documentation.
      4) Physical check-over of equipment, noting device locations and relationships to schematics.
      5) Equipment functional tests and checks.
      6) Equipment operating instructions.
      7) Equipment routine service requirements.
      8) Equipment troubleshooting instructions and procedures - review equipment self-diagnostic features and indications, define most likely problems, symptoms and corrective action

127-3.7 OPERATIONS & MAINTENANCE MANUAL

A. Owners Operations and Maintenance manual
The ALCMS Manufacturer shall provide three (3) hard copies of the operation and maintenance manuals that are hard-covered and suitable for daily operation and maintenance of the system. Also provide three (3) soft copies of the manuals on CDROM (dated). The manuals shall include the following information

1. System description, Operational overview and instructions
2. Graphical User Interface (GUI) Screen operation and descriptions with full color sample screen captures
3. As-Built system block diagram(1-line drawings)
4. As-Built external wiring diagrams (Electrical Contractor wiring)
5. As-Built input/output terminal diagrams
6. As-Built assembly drawings and wiring diagrams
7. Final
8. Original Equipment Manufacturer (OEM) Manuals

B. FAA Air traffic control operations manual
The ALCMS Manufacturer shall provide three (3) hard copies of the operation manuals for Air Traffic Controller (ATC) use. The manuals shall be hard-covered and suitable for daily operation of the system. At a minimum, the manuals shall include the following information:

1. System description, Operational overview and instructions
2. Graphical User Interface (GUI) Screen operation and descriptions with full color sample screen captures

C. Software

1. Provide full and complete system software on CDROM including off-the-shelf software and custom control and graphics software created for this project. Software shall be complete so that the Airport Authority can modify or change the program or graphics as required without the need to contact the ALCMS manufacturer.

127-3.8 WARRANTY

A. Provide a written warranty that the ALCMS equipment and components supplied and installed are warranted against defects and malfunction for a period of 12 months from date of completion of commissioning.

B. During the warranty time period, the ALCMS manufacturer shall provide all parts, labor and technical support necessary to maintain the complete functionality of the system as it was accepted at time of commissioning.

127-3.9 MAINTENANCE AND SUPPORT

A. The ALCMS Manufacturer shall provide free phone consultation and technical support as required during the warranty period and if necessary shall be on-site within 24 hours.

B. The ALCMS Manufacturer shall provide a 7 day a week / 24 hours a day support phone line and be capable of providing technical support within 4 hours of the initial call.

C. After the warranty period, The ALCMS manufacture shall provide contact information to the owner of a system integrator, within a 150 mile radius and approved by the ALCMS manufacturer, capable of providing onsite support.

D. At the request of the airport/owner, the ALCMS Manufacturer shall provide information about preventative maintenance programs and extended warranty packages.

METHOD OF MEASUREMENT

127-4.1 ALCMS will be measured for payment on a lump sum basis.

BASIS OF PAYMENT

127-5.1 Payment will be made at the contract lump sum price for ALCMS. This price shall be full compensation for furnishing all materials and for all preparation, assembly, and installation of these materials, and for all labor, equipment, tools, and incidentals necessary to complete this item in accordance with the provisions and intent of the plans and specifications.

Payment will be made under:

Item L-127-5.1	Airfield Lighting Control and Monitoring System Modifications - per lump sum

MATERIAL REQUIREMENTS

AC 150/5345-56	Specification for L-890 Airport Lighting Control and Monitoring System (ALCMS)

END OF ITEM L-127

SECTION L-128 FIBER OPTIC CABLE

DESCRIPTION

128-1.1 This item shall consist of fiber optic cable furnished and installed in accordance with this specification at the locations and in accordance with the dimensions, designs, and details shown on the plans. This item shall also include furnishing and installing of innerduct and the testing of the installation as a completed system ready for operation.

EQUIPMENT AND MATERIALS

128-2.1 GENERAL.

a. All equipment and materials covered by referenced specifications shall be subject to acceptance through manufacturer's certification of compliance with the applicable specification when so requested by the Engineer.

b. Manufacturer's certifications shall not relieve the Contractor of the Contractor's responsibility to provide materials in accordance with these specifications and acceptable to the Engineer. Materials supplied and/or installed that do not materially comply with these specifications shall be removed, when directed by the Engineer and replaced with materials, that comply with these specifications, at the Contractor's cost.

c. All materials and equipment used to construct this item shall be submitted to the Engineer for approval prior to ordering the equipment. Submittals consisting of marked catalog sheets or shop drawings shall be provided. Submittal data shall be presented in a clear, precise and thorough manner. Original catalog sheets are preferred. Photocopies are acceptable provided they are as good a quality as the original. Clearly and boldly mark each copy to identify pertinent products or models applicable to this project. Indicate all optional equipment and delete non-pertinent data. Submittals for components of electrical equipment and systems shall identify the equipment for which they apply on each submittal sheet. Markings shall be boldly and clearly made with arrows or circles (highlighting is not acceptable). Contractor is solely responsible for delays in project accruing directly or indirectly from late submissions or resubmissions of submittals.

d. The data submitted shall be sufficient, in the opinion of the Engineer, to determine compliance with the plans and specifications. The Contractor's submittals shall be neatly bound in a properly sized 3-ring binder, tabbed by specification section. The Engineer reserves the right to reject any and all equipment, materials or procedures, which, in the Engineer's opinion, does not meet the system design and the standards and codes, specified herein.

e. All equipment and materials furnished and installed under this section shall be guaranteed against defects in materials and workmanship for a period of at least twelve (12) months from final acceptance by the Owner. The defective materials and/or equipment shall be repaired or replaced, at the Owner's discretion, with no additional cost to the Owner.

128-2.2 FIBER OPTIC CABLE. The fiber optic cable shall conform to the requirements of ANSI/ICEA S-87-640 and shall be 62.5/125 μm Multimode, all-dielectric, loose-tube, gel-free cable suitable for 1300 nm optical wavelength with the number of fibers as indicated on the plans. The fiber optic terminations shall be as indicated in the plans and specifications for the individual system for which it is associated.

128-2.3 INNERDUCT. Innerduct shall conform to the requirements of ASTM D 3035 SDR 11. Innerduct shall have internal longitudinal ribbing and shall be pre-lubricated during the manufacturing process such that the lubricant becomes permanently impregnated in the inner walls of the innerducts. The lubricant

shall be compatible with fiber optic cable. The innerduct shall be solid orange color for duct identification. All innerducts shall be provided with a polypropylene pull rope. The ends shall be secured and sufficient length shall be left in access points to prevent it from slipping back into the conduit. Where spare innerducts are installed, as indicated on the plans, the open ends shall be plugged with removable tapered plugs, designed for this purpose.

CONSTRUCTION METHODS

128-3.1 INSTALLATION. The Contractor shall install the innerducts and fiber optic cable at the locations indicated on the plans as recommended by the manufacturer, utilizing qualified personnel for installing and terminating the fiber optic cable for a complete and operation system.

Two times the inside perimeter of the structure shall be provided in each handhole for slack.

128-3.2 TESTING AND ACCEPTANCE. The fiber optic cable shall be tested using an OTDR on two (2) separate occasions. The first OTDR test shall be performed by the manufacturer prior to shipping. The second OTDR test shall occur after the cable has been completely installed and terminated from patch panel cabinet to patch panel cabinet. The cable shall meet the performance specifications as follows:

a.	Optical wavelength tested	1300nm
b.	Optical Cable Type	Multimode
c.	Max. Avg. attenuation dB/km	3.5dB/km
d.	Max. attenuation per connector	0.3dB
e.	Max. Reflection per connector	-20dB

The OTDR test report for each optical fiber shall include a graphical picture of the OTDR trace with the X-axis containing the distance measure in meters/division and the Y-axis containing the loss in dB/division. The OTDR shall indicate the X and Y axis scale settings for each optical fiber. The OTDR test report shall be clearly marked to indicate the exact fiber tested. The OTDR reports shall cross reference the optical fiber cable by including the following information on the OTDR report:

a. Identify cable reel or installed cable by means of unique reel and cable numbers.

b. Identify the Buffer Tube in which the optical fiber is installed.

c. Identify the optical fiber by its unique color coating.

A summary of the OTDR settings shall be provided for each test report. The summary shall provide the following information:

a. Wavelength tested

b. Pulse Width

c. Range

d. Pt. Space

e. Refraction Index

f. Backscatter (dB)

Each event shall be tabulated on the OTDR with the following information:

a. Event No.

b. Location along the fiber (meters)

c. Loss (dB)

d. Attenuation up to the Event (dB/km)

e. Reflection (dB)

Copies of OTDR reports shall be submitted to the Engineer.

These specifications do not allow for the acceptance of new optical fiber cables with any bad fibers. If any fibers of a particular cable do not meet the above performance specifications, the entire cable shall be removed and replaced at the contractor's expense – splices are not acceptable.

METHOD OF MEASUREMENT

128-4.1 Fiber optic cable shall be measured by the linear feet (meter) of cable installed, measured in place, completed, and accepted. Separate measurement shall be made for the various sizes. Slack is considered incidental to this item and is included in the Contractor's unit price. No separate measurement or payment will be made for fiber optic cable slack.

128-4.2 Innerduct shall be measured by the linear feet (meter) of innerduct installed, measured in place, completed, and accepted.

BASIS OF PAYMENT

128-5.1 Payment will be made at the contract unit price per linear foot for each size of fiber optic cable completed and accepted, including testing and acceptance. This price shall be full compensation for furnishing all materials and for all preparation, assembly, and installation of these materials, and for all labor, equipment, tools, and incidentals necessary to complete this item in accordance with the provisions and intent of the plans and specifications.

128-5.2 Payment will be made at the contract unit price per linear foot for innerduct completed and accepted. This price shall be full compensation for furnishing all materials and for all preparation, assembly, and installation of these materials, and for all labor, equipment, tools, and incidentals necessary to complete this item in accordance with the provisions and intent of the plans and specifications.

Payment will be made under:

Item L-128-5.1	12 Strand Multimode Fiber Optic Cable - per linear foot
Item L-128-5.2	6 Strand Multimode Fiber Optic Cable - per linear foot
Item L-128-5.3	12 Strand Single Mode Fiber Optic Cable - per linear foot
Item L-128-5.4	3 1-1/4-inch Innerduct - per linear foot

END OF ITEM L-128

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SECTION 271000 – PREMISE DISTRIBUTION SYSTEM

PART 1 - GENERAL

0.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract including General and Supplementary Conditions and Division 1 Specification Sections, apply to this section.

B. Refer to Section 260510 – “Basic Electrical Requirements”

C. Refer to Section 271100 - “Communications Equipment Room Fittings.”

D. Refer to Section 271300 - “Communications Backbone Cabling.”

E. Refer to Section 271500 - “Communications Horizontal Cabling.”

0.2 SUMMARY

A. The premise distribution system shall be based on "open system architecture" (OSA) to create state of the art voice and data integrated wiring system to support voice and local area network application up to 1.2 Gbps (Gigabit per Second) data speed.

B. The premise distribution system shall include, but is not limited to the following major components.
1. Communication Equipment Room.
2. Communication Backbone Cabling.
3. Communication Horizontal Cabling
4. Network Electronics.

C. The premise distribution systems shall include all of the individual products certified for use by an approved manufacturer and an installer who is also certified by the same manufacturer to provide a complete system which shall carry a 25-year product and system assurance warranty. All certified components including but not limited to Category 6 and fiber optic cables, patch panels, modular jacks shall be tested and certified for individual applications. The manufacturer shall have design and installation rules for certified end-to-end applications and shall meet the standards as defined in the TIA 568 series industry standards. The manufacturer shall provide a certification or other similar means of assurance that the shop drawings as submitted includes all the components approval for end-to-end application and meets their design guidelines. The final system as installed shall be fully tested and warranted by the manufacturer for 25 years. Upon successful completion of the installation and subsequent inspection, the customer shall be provided with a numbered certificate from the manufacturing company registering the installation.

D. The premise distribution system shall support data rates of 1.2 Gbps (Gigabit per Second).

0.3 INSTRUCTIONS TO OWNER

A. A letter to Owner, for Owner's signature, acknowledging that instruction in system operation has been received. One copy to be retained by Owner and one copy sent to Contractor.

B. Manufacturer's Instruction: Provide copies of manufacturers' installation specifications for the major components of the system, including:
   1. UTP Cabling
      a. UTP Cables.
      b. Closet Termination Hardware and Equipment.
      c. Electrical Protection Hardware.
      d. Splice Hardware.
      e. Cross Connects.
   2. Fiber Optic Cabling System
      a. Fiber Optic Cables.
      b. Closet Termination Hardware and Equipment.
      c. Connectors.
      d. Inner Duct.
      e. Cross-Connect.
   3. Blown fiber tube system for backbone fibers.

0.4 FINAL TESTS AND WARRANTY

A. Final tests and inspection shall be demonstrated to the Architect/Engineer's and Owner's representatives. The Contractor shall supply personnel and required auxiliary equipment for this test without additional cost. Any deficiencies shall be corrected at no additional cost to the owner.

B. The complete distribution wiring system shall be warranted for 1 year against defects in material and workmanship. The warranty period shall begin upon final acceptance of the system.

0.5 QUALIFICATIONS

A. Contractor's Personnel
   1. Project Manager: Provide project manager with a minimum of 15 years communications systems installation experience and a minimum of 5 years experience as project manager. Prior to installation, submit resume and arrange an interview with the Owner, the Architect/Engineer, and the proposed project manager. During the course of the work, the Contractor shall replace project manager if requested by Owner or Architect/Engineer.
   2. Field Supervisor: Provide full-time Field Supervisor with a minimum of ten years communications systems installation experience and a minimum of 5 years experience as installation supervisor. Prior to installation, submit resume and arrange an interview with the Owner, the Architect/Engineer and the proposed field supervisor. The supervisor must be approved by the Owner and the Architect/Engineer. During the course of the work, the Contractor shall replace field supervisor if requested by Owner or Architect/Engineer.
   3. Installation Crews: Use trained, skilled journeyman installers for the installation, termination, and testing of the cabling system. Journeyman shall have a minimum of 5 years experience installing communications cabling.
   4. Fiber Cable and Terminations: Placement, splicing, termination and testing of fiber optic cable shall be done by journeymen technicians specifically trained, certified and experienced in the installation of fiber optic systems. Cable pulling crews and testing crews shall have a minimum of 1 journeyman for each apprentice or helper. Splicing and termination to be done by journeyman only.
   5. Telephone Cables and Terminations: Placement, splicing, termination, cross-connecting and testing of telephone cabling shall be done be journeymen technicians, specifically trained, certified and experienced in the installation of telephone cabling system. Cable pulling crews and testing crews shall have a minimum of 1

journeyman for each apprentice or helper. Splicing and termination to be done by journeymen only.

B. Refer to related sections for additional qualification requirements.

0.6 MAINTENANCE

A. Maintenance Service: The Contractor shall provide maintenance for 1 year. Coordinate work with system vendors as necessary to ensure proper operation of all systems that utilize the cabling system. Maintenance service shall include:
1. Testing: Provide testing as required for system initialization, operation, and trouble resolution.
2. Trouble Resolution: Perform necessary investigations, reports, technical support, modifications and repairs or replacement of nonperforming components of the cabling system, to resolve operational problems. Support all systems that operate on cabling system. Provide service within 24 hours of verbal notification.
3. Repair or Replacement: Repair or replace any nonperforming component of the cabling system. Repair/Replacement schedule shall be approved by Owner. Components that are necessary for the operation of a system will be replaced immediately upon approval by the Owner.

PART 1 - PRODUCTS

1.1 MANUFACTURERS

PART 2 - EXECUTION

2.1 PLANNING

A. Prior to beginning of the work detail planning and lay-out shall be performed to meet schedule and ensure proper installation of cabling system.

B. Verify that the conduit and cable tray systems are properly grounded per NEC.

END OF SECTION 271000

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SECTION 271100 – COMMUNICATIONS EQUIPMENT ROOM FITTINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Telecommunications mounting elements.
2. Backboards.
3. Telecommunications equipment racks and cabinets.
4. Telecommunications service entrance pathways.
5. Grounding.

B. Related Sections:

1. Division 27 Section 271000 “Premise Distribution System.”
2. Division 27 Section 271300 "Communications Backbone Cabling" for voice and data cabling associated with system panels and devices.
3. Division 27 Section 271500 "Communications Horizontal Cabling" for voice and data cabling associated with system panels and devices.

1.3 DEFINITIONS

A. BICSI: Building Industry Consulting Service International.

B. Ladder Cable Tray: A fabricated structure consisting of two longitudinal side rails connected by individual transverse members (rungs).

C. LAN: Local area network.

D. RCDD: Registered Communications Distribution Designer.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and

finishes for equipment racks and cabinets. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: For communications equipment room fittings. Include plans, elevations, sections, details, and attachments to other work.

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
2. Equipment Racks and Cabinets: Include workspace requirements and access for cable connections.
3. Grounding: Indicate location of grounding bus bar and its mounting detail showing standoff insulators and wall mounting brackets.

C. Qualification Data: For Installer, qualified layout technician, installation supervisor, and field inspector.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.

1. Layout Responsibility: Preparation of Shop Drawings shall be under the direct supervision of RCDD.
2. Installation Supervision: Installation shall be under the direct supervision of Registered Technician, who shall be present at all times when Work of this Section is performed at Project site.
3. Field Inspector: Currently registered by BICSI as RCDD to perform the on-site inspection.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Telecommunications Pathways and Spaces: Comply with TIA/EIA-569-A.

D. Grounding: Comply with ANSI-J-STD-607-A.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install equipment frames and cable trays until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and work above ceilings is complete.

1.7 COORDINATION

A. Coordinate layout and installation of communications equipment with Owner's telecommunications and LAN equipment and service suppliers. Coordinate service entrance arrangement with local exchange carrier.

1. Meet jointly with telecommunications and LAN equipment suppliers, local exchange carrier representatives, and Owner to exchange information and agree on details of equipment arrangements and installation interfaces.
2. Record agreements reached in meetings and distribute them to other participants.
3. Adjust arrangements and locations of distribution frames, cross-connects, and patch panels in equipment rooms to accommodate and optimize arrangement and space requirements of telephone switch and LAN equipment.

4. Adjust arrangements and locations of equipment with distribution frames, cross-connects, and patch panels of cabling systems of other communications, electronic safety and security, and related systems that share space in the equipment room.

B. Coordinate location of power raceways and receptacles with locations of communications equipment requiring electrical power to operate.

PART 2 - PRODUCTS

2.1 PATHWAYS

A. General Requirements: Comply with TIA/EIA-569-A.

B. Cable Support: NRTL labeled. Cable support brackets shall be designed to prevent degradation of cable performance and pinch points that could damage cable. Cable tie slots fasten cable ties to brackets.

1. Comply with NFPA 70 and UL 2043 for fire-resistant and low-smoke-producing characteristics.
2. Support brackets with cable tie slots for fastening cable ties to brackets.
3. Lacing bars, spools, J-hooks, and D-rings.
4. Straps and other devices.

C. Cable Trays:

1. Refer to Section 260537 “Cable Trays for Electrical Systems” for specification information.

D. Conduit and Boxes: Comply with requirements in Division 26 Section "Raceways” Flexible metal conduit shall not be used.

1. Outlet boxes shall be no smaller than 2 inches (50 mm) wide, 3 inches (75 mm) high, and 2-1/2 inches (64 mm) deep.

2.2 BACKBOARDS

A. Backboards: Plywood, fire-retardant treated, 3/4 by 48 by 96 inches (19 by 1220 by 2440 mm). Comply with requirements for plywood backing panels specified in Division 6 Section "Rough Carpentry."

B. Provide prefabricated backboard as indicated on the drawings.

2.3 EQUIPMENT FRAMES

A. Manufacturers: Subject to compliance with requirements of paragraph 1.2 C of Section 271000, provide products by one of the following:

1. ADC.
2. Aim Electronics; a brand of Emerson Electric Co.
3. AMP; a Tyco International Ltd. company.

4. Cooper B-Line, Inc.
5. Hubbell Premise Wiring.
6. KRONE Incorporated.
7. Leviton Voice & Data Division.
8. Middle Atlantic Products, Inc.
9. Nordex/CDT; a subsidiary of Cable Design Technologies.
10. Ortronics, Inc.
11. Panduit Corp.
12. Siemon Co. (The).

B. General Frame Requirements:

1. Distribution Frames: Freestanding and wall-mounting, modular-steel units designed for telecommunications terminal support and coordinated with dimensions of units to be supported.
2. Module Dimension: Width compatible with EIA 310 standard, 19-inch (480-mm) panel mounting.
3. Finish: Manufacturer's standard, baked-polyester powder coat.

C. Floor-Mounted Racks: Modular-type, steel or aluminum construction.

1. Vertical and horizontal cable management channels, top and bottom cable troughs, grounding lug, and a power strip.
2. Baked-polyester powder coat finish.

D. Modular Freestanding Cabinets:

1. Removable and lockable side panels.
2. Hinged and lockable front and rear doors.
3. Adjustable feet for leveling.
4. Screened ventilation openings in the roof and rear door.
5. Cable access provisions in the roof and base.
6. Grounding bus bar.
7. Rack-mounted, 550-cfm (260-L/s) fan with filter.
8. Power strip.
9. Baked-polyester powder coat finish.
10. All cabinets keyed alike.

E. Modular Wall Cabinets:

1. Wall mounting.
2. Steel or aluminum construction.
3. Treated to resist corrosion.
4. Lockable front and rear doors.
5. Louvered side panels.
6. Cable access provisions top and bottom.
7. Grounding lug.
8. Rack-mounted, 250-cfm (118-L/s) fan.
9. Power strip.
10. All cabinets keyed alike.

F. Cable Management for Equipment Frames:

1. Metal, with integral wire retaining fingers.
2. Baked-polyester powder coat finish.

3. Vertical cable management panels shall have front and rear channels, with covers.
4. Provide horizontal crossover cable manager at the top of each relay rack, with a minimum height of two rack units each.

2.4 POWER STRIPS

A. Power Strips: Comply with UL 1363.

1. Rack mounting.
2. Six 20-A, 120-V ac, NEMA WD 6, Configuration 5-20R receptacles.
3. LED indicator lights for power and protection status.
4. LED indicator lights for reverse polarity and open outlet ground.
5. Circuit Breaker and Thermal Fusing: Unit continues to supply power if protection is lost.
6. Close-coupled, direct plug-in line cord.
7. Rocker-type on-off switch, illuminated when in on position.

2.5 GROUNDING

A. Comply with requirements in Division 26 Section "Grounding and Bonding for Electrical Systems" for grounding conductors and connectors.

B. Telecommunications Main Bus Bar:

1. Connectors: Mechanical type, cast silicon bronze, solderless compression-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.
2. Ground Bus Bar: Copper, minimum 1/4 inch thick by 4 inches wide (6 mm thick by 100 mm wide) with 9/32-inch (7.14-mm) holes spaced 1-1/8 inches (28 mm) apart.
3. Stand-Off Insulators: Comply with UL 891 for use in switchboards, 600 V. Lexan or PVC, impulse tested at 5000 V.

C. Comply with ANSI-J-STD-607-A.

2.6 LABELING

A. Comply with TIA/EIA-606-A and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

PART 3 - EXECUTION

3.1 ENTRANCE FACILITIES

A. Contact telecommunications service provider and arrange for installation of demarcation point, protected entrance terminals, and a housing when so directed by service provider.

B. Install underground pathways complying with recommendations in TIA/EIA-569-A, "Entrance Facilities" Article.

1. Install underground entrance pathway complying with Division 26 Section "Raceways".

3.2 INSTALLATION

A. Comply with NECA 1.

B. Comply with BICSI TDMM for layout and installation of communications equipment rooms.

C. Cable Trays: Comply with NEMA VE 2 and TIA/EIA-569-A-7.

D. Bundle, lace, and train conductors and cables to terminal points without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.

3.3 FIRESTOPPING

A. Comply with requirements in Division 7 Section "Penetration Firestopping."

B. Comply with TIA/EIA-569-A, Annex A, "Firestopping."

C. Comply with BICSI TDMM, "Firestopping Systems" Article.

3.4 GROUNDING

A. Install grounding according to BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.

B. Comply with ANSI-J-STD-607-A.

C. Locate grounding bus bar to minimize the length of bonding conductors. Fasten to wall allowing at least 2-inch (50-mm) clearance behind the grounding bus bar. Connect grounding bus bar with a minimum No. 4 AWG grounding electrode conductor from grounding bus bar to suitable electrical building ground.

D. Bond metallic equipment to the grounding bus bar, using not smaller than No. 6 AWG equipment grounding conductor.

1. Bond the shield of shielded cable to the grounding bus bar in communications rooms and spaces.

3.5 IDENTIFICATION

A. Identify system components, wiring, and cabling complying with TIA/EIA-606-A. Comply with requirements in Division 26 Section "Identification for Electrical Systems".

B. Comply with requirements in Division 9 Section "Painting" for painting backboards. For fire-resistant plywood, do not paint over manufacturer's label.

C. Paint and label colors for equipment identification shall comply with TIA/EIA-606-A for Class 3 level of administration including optional identification requirements of this standard.

D. Labels shall be preprinted or computer-printed type.

END OF SECTION 271100

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SECTION 271300 – COMM BACKBONE CABLING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
1. Pathways.
2. UTP cable.
3. Optical fiber cabling.
4. Coaxial cable.
5. Cable connecting hardware, patch panels, and cross-connects.
6. Cabling identification products.

B. Related Sections:
1. Section 280513 "Conductors and Cables for Electronic Safety and Security" for voice and data cabling associated with system panels and devices.

1.3 DEFINITIONS

A. BICSI: Building Industry Consulting Service International.

B. Cross-Connect: A facility enabling the termination of cable elements and their interconnection or cross-connection.

C. EMI: Electromagnetic interference.

D. IDC: Insulation displacement connector.

E. LAN: Local area network.

F. RCDD: Registered Communications Distribution Designer.

G. UTP: Unshielded twisted pair.

1.4 BACKBONE CABLING DESCRIPTION

A. Backbone cabling system shall provide interconnections between communications equipment rooms, main terminal space, and entrance facilities in the telecommunications cabling system structure. Cabling system consists of backbone cables, intermediate and main cross-connects, mechanical terminations, and patch cords or jumpers used for backbone-to-backbone cross-connection.

B. Backbone cabling cross-connects may be located in communications equipment rooms or at entrance facilities. Bridged taps and splitters shall not be used as part of backbone cabling.

1.5 PERFORMANCE REQUIREMENTS

A. General Performance: Backbone cabling system shall comply with transmission standards in TIA/EIA-568-B.1, when tested according to test procedures of this standard.

1.6 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.
   1. For coaxial cable, include the following installation data for each type used:
      a. Nominal OD.
      b. Minimum bending radius.
      c. Maximum pulling tension.

B. Shop Drawings:
   1. System Labeling Schedules: Electronic copy of labeling schedules, in software and format selected by Owner.
   2. System Labeling Schedules: Electronic copy of labeling schedules that are part of the cabling and asset identification system of the software.
   3. Cabling administration drawings and printouts.
   4. Wiring diagrams to show typical wiring schematics including the following:
      a. Cross-connects.
      b. Patch panels.
      c. Patch cords.
   5. Cross-connects and patch panels. Detail mounting assemblies, and show elevations and physical relationship between the installed components.
   6. Cable tray layout, showing cable tray route to scale, with relationship between the tray and adjacent structural, electrical, and mechanical elements. Include the following:
      a. Vertical and horizontal offsets and transitions.
      b. Clearances for access above and to side of cable trays.
      c. Vertical elevation of cable trays above the floor or bottom of ceiling structure.
      d. Load calculations to show dead and live loads as not exceeding manufacturer's rating for tray and its support elements.

1.7 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified layout technician, installation supervisor, and field inspector.

B. Source quality-control reports.

C. Field quality-control reports.

D. Maintenance Data: For splices and connectors to include in maintenance manuals.

1.8 CLOSEOUT SUBMITTALS

A. Software and Firmware Operational Documentation:
   1. Software operating and upgrade manuals.
   2. Program Software Backup: On magnetic media or compact disk, complete with data files.
   3. Device address list.
   4. Printout of software application and graphic screens.

1.9 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Patch-Panel Units: One of each type.
   2. Connecting Blocks: One of each type.

1.10 QUALITY ASSURANCE

A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.
   1. Layout Responsibility: Preparation of Shop Drawings, Cabling Administration Drawings and field testing program development by an RCDD.
   2. Installation Supervision: Installation shall be under the direct supervision of Level 2 Installer, who shall be present at all times when Work of this Section is performed at Project site.
   3. Testing Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing.

B. Testing Agency Qualifications: An NRTL.
   1. Testing Agency's Field Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing.

C. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
   1. Flame-Spread Index: 25 or less.
   2. Smoke-Developed Index: 50 or less.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

E. Telecommunications Pathways and Spaces: Comply with TIA/EIA-569-A.

F. Grounding: Comply with ANSI-J-STD-607-A.

1.11 DELIVERY, STORAGE, AND HANDLING

A. Test cables upon receipt at Project site.
   1. Test optical fiber cable to determine the continuity of the strand end to end. Use optical loss test set.
   2. Test optical fiber cable while on reels. Use an optical time domain reflectometer (OTDR) to verify the cable length and locate cable defects, splices, and connector, including the loss value of each. Retain test data and include the record in maintenance data.
   3. Test each pair of UTP cable for open and short circuits.

1.12 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install cables and connecting materials until wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

1.13 COORDINATION

A. Coordinate layout and installation of telecommunications pathways and cabling with Owner's telecommunications and LAN equipment and service suppliers.

1.14 SOFTWARE SERVICE AGREEMENT

A. Technical Support: Beginning with Substantial Completion, provide software support for two years.

B. Upgrade Service: Update software to latest version at Project completion. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software shall include operating system. Upgrade shall include new or revised licenses for use of software.
   1. Provide 30 days' notice to Owner to allow scheduling and access to system and to allow Owner to upgrade computer equipment if necessary.

PART 2 - PRODUCTS

2.1 PATHWAYS

A. General Requirements: Comply with TIA/EIA-569-A.

B. Cable Support: NRTL labeled for support of Category 6 cabling, designed to prevent degradation of cable performance and pinch points that could damage cable.
   1. Support brackets with cable tie slots for fastening cable ties to brackets.
   2. Lacing bars, spools, J-hooks, and D-rings.
   3. Straps and other devices.

C. Cable Trays:

   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Cable Management Solutions, Inc.
      b. Cablofil Inc.
      c. Cooper B-Line, Inc.
      d. Cope - Tyco/Allied Tube & Conduit.
      e. GS Metals Corp.
   2. Cable Tray Material: Metal, suitable for indoors, and protected against corrosion by electroplated zinc galvanizing, complying with ASTM B 633, Type 1, not less than 0.000472 inches thick or hot-dip galvanizing, complying with ASTM A 123/A 123M, Grade 0.55, not less than 0.002165 inches thick.
      a. Ladder Cable Trays: Nominally 12 inches wide, and a rung spacing of 9 inches.

D. Conduit and Boxes: Comply with requirements in Section 260533 "Raceway and Boxes for Electrical Systems."
   1. Outlet boxes shall be no smaller than 2 inches wide, 3 inches high, and 2-1/2 inches deep.

2.2 BACKBOARDS

A. Backboards: Plywood, fire-retardant treated, 3/4 by 48 by 96 inches. Comply with requirements in Section 061000 "Rough Carpentry" for plywood backing panels.

2.3 UTP CABLE

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Belden CDT Inc.; Electronics Division.
   2. Berk-Tek; a Nexans company.
   3. CommScope, Inc.
   4. Draka USA.
   5. Genesis Cable Products; Honeywell International, Inc.
   6. KRONE Incorporated.
   7. Mohawk; a division of Belden CDT.
   8. Nordex/CDT; a subsidiary of Cable Design Technologies.
   9. Superior Essex Inc.
   10. SYSTIMAX Solutions; a CommScope Inc. brand.
   11. 3M.
   12. Tyco Electronics/AMP Netconnect; Tyco International Ltd.

B. Description: 100-ohm, 100-pair UTP, formed into 25-pair binder groups covered with a gray thermoplastic jacket and overall metallic shield.
   1. Comply with ICEA S-90-661 for mechanical properties.
   2. Comply with TIA/EIA-568-B.1 for performance specifications.
   3. Comply with TIA/EIA-568-B.2, Category 5e.
   4. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444 and NFPA 70 for the following types:
      a. Communications, General Purpose: Type CM or CMG.
      b. Communications, Plenum Rated: Type CMP, complying with NFPA 262.
      c. Communications, Riser Rated: Type CMR, complying with UL 1666.
      d. Communications, Limited Purpose: Type CMX.
      e. Multipurpose: Type MP or MPG.
      f. Multipurpose, Plenum Rated: Type MPP, complying with NFPA 262.
      g. Multipurpose, Riser Rated: Type MPR, complying with UL 1666.

2.4 UTP CABLE HARDWARE

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. American Technology Systems Industries, Inc.
   2. Dynacom Corporation.
   3. Hubbell Premise Wiring.
   4. KRONE Incorporated.
   5. Leviton Voice & Data Division.
   6. Molex Premise Networks; a division of Molex, Inc.
   7. Nordex/CDT; a subsidiary of Cable Design Technologies.
   8. Panduit Corp.
   9. Siemon Co. (The).
   10. Tyco Electronics/AMP Netconnect; Tyco International Ltd.

B. General Requirements for Cable Connecting Hardware: Comply with TIA/EIA-568-B.2, IDC type, with modules designed for punch-down caps or tools. Cables shall be terminated with connecting hardware of same category or higher.

C. Connecting Blocks: 110-style IDC for Category 5e. Provide blocks for the number of cables terminated on the block, plus 25 percent spare. Integral with connector bodies, including plugs and jacks where indicated.

D. Cross-Connect: Modular array of connecting blocks arranged to terminate building cables and permit interconnection between cables.
   1. Number of Terminals per Field: One for each conductor in assigned cables.

E. Patch Panel: Modular panels housing multiple-numbered jack units with IDC-type connectors at each jack for permanent termination of pair groups of installed cables.
   1. Number of Jacks per Field: One for each four-pair UTP cable indicated conductor group of indicated cables, plus spares and blank positions adequate to suit specified expansion criteria.

F. Jacks and Jack Assemblies: Modular, color-coded, eight-position modular receptacle units with integral IDC-type terminals.

G. Patch Cords: Factory-made, 4-pair cables in 72-inch lengths; terminated with 8-position modular plug at each end.
   1. Patch cords shall have bend-relief-compliant boots and color-coded icons to ensure Category 6 performance. Patch cords shall have latch guards to protect against snagging.
   2. Patch cords shall have color-coded boots for circuit identification.

2.5 OPTICAL FIBER CABLE

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Berk-Tek; a Nexans company.
   2. CommScope, Inc.
   3. Corning Cable Systems.
   4. General Cable Technologies Corporation.
   5. Mohawk; a division of Belden CDT.
   6. Nordex/CDT; a subsidiary of Cable Design Technologies.
   7. Optical Connectivity Solutions Division; Emerson Network Power.
   8. Superior Essex Inc.
   9. SYSTIMAX Solutions; a CommScope Inc. brand.
   10. 3M.
   11. Tyco Electronics/AMP Netconnect; Tyco International Ltd.

B. Description: Multimode, 50/125-micrometer OM4 fiber tight buffer, optical fiber cable.
   1. Comply with ICEA S-83-596 for mechanical properties.
   2. Comply with TIA/EIA-568-B.3 for performance specifications.
   3. Comply with TIA/EIA-492AAAA-B or TIA/EIA-492AAAA-A for detailed specifications.
   4. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444, UL 1651, and NFPA 70 for the following types:
      a. General Purpose, Nonconductive: Type OFN or OFNG.
      b. Plenum Rated, Nonconductive: Type OFNP, complying with NFPA 262.
      c. Riser Rated, Nonconductive: Type OFNR, complying with UL 1666.
      d. General Purpose, Conductive: Type OFC or OFCG.

e. Plenum Rated, Conductive: Type OFCP, complying with NFPA 262.
f. Riser Rated, Conductive: Type OFCR, complying with UL 1666.
5. Conductive cable shall be steel or aluminum armored type.
6. Maximum Attenuation: 3.50 dB/km at 850 nm; 1.5 dB/km at 1300 nm.
7. Minimum Modal Bandwidth: 3500 MHz-km at 850 nm; 500 MHz-km at 1300 nm.

C. Description: Singlemode fiber tight buffer, optical fiber cable.
1. Comply with ICEA S-83-596 for mechanical properties.
2. Comply with TIA/EIA-568-B.3 for performance specifications.
3. Comply with TIA/EIA-492AAAA-B or TIA/EIA-492AAAA-A for detailed specifications.
4. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444, UL 1651, and NFPA 70 for the following types:
a. General Purpose, Nonconductive: Type OFN or OFNG.
b. Plenum Rated, Nonconductive: Type OFNP, complying with NFPA 262.
c. Riser Rated, Nonconductive: Type OFNR, complying with UL 1666.
d. General Purpose, Conductive: Type OFC or OFCG.
e. Plenum Rated, Conductive: Type OFCP, complying with NFPA 262.
f. Riser Rated, Conductive: Type OFCR, complying with UL 1666.
5. Conductive cable shall be steel or aluminum armored type.
6. Maximum Attenuation: 1.00 dB/km at 1310 nm; 1.0 dB/km at 1550 nm.

D. Jacket:
1. Jacket Color: Aqua for 50/125-micrometer cable, Yellow for single-mode fiber.
2. Cable cordage jacket, fiber, unit, and group color shall be according to TIA/EIA-598-B.
3. Imprinted with fiber count, fiber type, and aggregate length at regular intervals not to exceed 40 inches.

2.6 OPTICAL FIBER CABLE HARDWARE

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. ADC.
2. American Technology Systems Industries, Inc.
3. Berk-Tek; a Nexans company.
4. Corning Cable Systems.
5. Dynacom Corporation.
6. Hubbell Premise Wiring.
7. Molex Premise Networks; a division of Molex, Inc.
8. Nordex/CDT; a subsidiary of Cable Design Technologies.
9. Optical Connectivity Solutions Division; Emerson Network Power.
10. Siemon Co. (The).

B. Cross-Connects and Patch Panels: Modular panels housing multiple-numbered, duplex cable connectors.
1. Number of Connectors per Field: One for each fiber of cable or cables assigned to field, plus spares and blank positions adequate to suit specified expansion criteria.

C. Patch Cords: Factory-made, dual-fiber cables in 48-inch lengths.

D. Cable Connecting Hardware:
1. Comply with Optical Fiber Connector Intermateability Standards (FOCIS) specifications of TIA/EIA-604-2, TIA/EIA-604-3-A, and TIA/EIA-604-12. Comply with TIA/EIA-568-B.3.
2. Quick-connect, simplex and duplex, Type LC connectors. Insertion loss not more than 0.75 dB.

3. Type SFF connectors may be used in termination racks, panels, and equipment packages.

2.7 COAXIAL CABLE

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Alpha Wire Company.
   2. Belden CDT Inc.; Electronics Division.
   3. Coleman Cable, Inc..
   4. CommScope, Inc.
   5. Draka USA.

B. General Coaxial Cable Requirements: Broadband type, recommended by cable manufacturer specifically for broadband data transmission applications. Coaxial cable and accessories shall have 75-ohm nominal impedance and shall be sweep tested from 5-3000 MHz.

C. RG-11/U (Plenum Rated): NFPA 70, Type CMP.
   1. No. 14 AWG, solid, copper-covered steel conductor.
   2. Foam fluorinated ethylene propylene insulation.
   3. Double shielded with 100 percent aluminum-foil shield and 60 percent aluminum braid.
   4. Copolymer jacket

D. RG-6/U (Plenum Rated): NFPA 70, Type CMP.
   1. No. 16 AWG, solid, copper-covered steel conductor;
   2. Foam fluorinated ethylene propylene insulation.
   3. Double shielded with 100 percent aluminum-foil shield and 60 percent aluminum braid.
   4. Copolymer jacket.

E. RG59/U (Plenum Rated): NFPA 70, Type CMP.
   1. No. 20 AWG, solid, copper-covered steel conductor;
   2. Foam fluorinated ethylene propylene insulation.
   3. Double shielded with 100 percent aluminum-foil shield and 60 percent aluminum braid.
   4. Copolymer jacket.

F. NFPA and UL compliance, listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 1655 and with NFPA 70, "Radio and Television Equipment" and "Community Antenna Television and Radio Distribution" Articles. Types are as follows:
   1. CATV Plenum Rated: Type CATVP, complying with NFPA 262.

2.8 COAXIAL CABLE HARDWARE

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Aim Electronics; a brand of Emerson Electric Co.
   2. Leviton Voice & Data Division.
   3. Siemon Co. (The).

B. Coaxial-Cable Connectors: Type BNC, Type F or Type N as required, 75 ohms.

2.9 GROUNDING

A. Comply with requirements in Section 260526 "Grounding and Bonding for Electrical Systems" for grounding conductors and connectors.

B. Comply with ANSI-J-STD-607-A.

2.10 IDENTIFICATION PRODUCTS

A. Comply with TIA/EIA-606-A and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

2.11 SOURCE QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to evaluate cables.

B. Factory test cables on reels according to TIA/EIA-568-B.1.

C. Factory test UTP cables according to TIA/EIA-568-B.2.

D. Factory test multimode optical fiber cables according to TIA/EIA-526-14-A and TIA/EIA-568-B.3.

E. Cable will be considered defective if it does not pass tests and inspections.

F. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 ENTRANCE FACILITIES

A. Coordinate backbone cabling with the protectors and demarcation point provided by communications service provider.

3.2 WIRING METHODS

A. Wiring Method: Install cables in raceways and cable trays except within consoles, cabinets, desks, and counters. Conceal raceway and cables except in unfinished spaces.
   1. Install plenum cable in environmental air spaces, including plenum ceilings.
   2. Comply with requirements for raceways and boxes specified in Section 260533 "Raceway and Boxes for Electrical Systems."

B. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.

C. Wiring within Enclosures: Bundle, lace, and train cables within enclosures. Connect to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.

3.3 INSTALLATION OF PATHWAYS

A. Cable Trays: Comply with NEMA VE 2 and TIA/EIA-569-A.

B. Comply with requirements for demarcation point, pathways, cabinets, and racks specified in Section 271100 "Communications Equipment Room Fittings." Drawings indicate general arrangement of pathways and fittings.

C. Comply with TIA/EIA-569-A for pull-box sizing and length of conduit and number of bends between pull points.

D. Comply with requirements in Section 260533 "Raceway and Boxes for Electrical Systems" for installation of conduits and wireways.

E. Install manufactured conduit sweeps and long-radius elbows whenever possible.

F. Pathway Installation in Communications Equipment Rooms:
1. Position conduit ends adjacent to a corner on backboard where a single piece of plywood is installed, or in the corner of room where multiple sheets of plywood are installed around perimeter walls of room.
2. Install cable trays to route cables if conduits cannot be located in these positions.
3. Secure conduits to backboard when entering room from overhead.
4. Extend conduits 3 inches above finished floor.
5. Install metal conduits with grounding bushings and connect with grounding conductor to grounding system.

G. Backboards: Install backboards with 96-inch dimension vertical. Butt adjacent sheets tightly, and form smooth gap-free corners and joints.

3.4 INSTALLATION OF CABLES

A. Comply with NECA 1.

B. General Requirements for Cabling:
1. Comply with TIA/EIA-568-B.1.
2. Comply with BICSI ITSIM, Ch. 6, "Cable Termination Practices."
3. Install 110-style IDC termination hardware unless otherwise indicated.
4. Terminate all conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.
5. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches and not more than 6 inches from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
6. Install lacing bars to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer.
7. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIM, "Cabling Termination Practices" Chapter. Use lacing bars and distribution spools.
8. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
9. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.
10. In the communications equipment room, install a 10-foot long service loop on each end of cable.
11. Pulling Cable: Comply with BICSI ITSIM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.

C. UTP Cable Installation:

1. Comply with TIA/EIA-568-B.2.
2. Do not untwist UTP cables more than 1/2 inch from the point of termination to maintain cable geometry.

D. Optical Fiber Cable Installation:
1. Comply with TIA/EIA-568-B.3.
2. Cable may be terminated on connecting hardware that is rack or cabinet mounted.

E. Open-Cable Installation:
1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
2. Suspend UTP cable not in a wireway or pathway, a minimum of 8 inches above ceilings by cable supports not more than 60 inches apart.
3. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.

F. Installation of Cable Routed Exposed under Raised Floors:
1. Install plenum-rated cable only.
2. Install cabling after the flooring system has been installed in raised floor areas.
3. Coil cable 6 feet long not less than 12 inches in diameter below each feed point.

G. Outdoor Coaxial Cable Installation:
1. Install outdoor connections in enclosures complying with NEMA 250, Type 4X. Install corrosion-resistant connectors with properly designed O-rings to keep out moisture.
2. Attach antenna lead-in cable to support structure at intervals not exceeding 36 inches.

H. Group connecting hardware for cables into separate logical fields.

I. Separation from EMI Sources:
1. Comply with BICSI TDMM and TIA/EIA-569-A recommendations for separating unshielded copper voice and data communication cable from potential EMI sources, including electrical power lines and equipment.
2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:
   a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches.
   b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches.
   c. Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches.
3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:
   a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 2-1/2 inches.
   b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches.
   c. Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches.
4. Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:
   a. Electrical Equipment Rating Less Than 2 kVA: No requirement.
   b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches.
   c. Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches.
5. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches.
6. Separation between Communications Cables and Fluorescent Fixtures: A minimum of 5 inches.

3.5 FIRESTOPPING

A. Comply with requirements in Section 078413 "Penetration Firestopping."

B. Comply with TIA/EIA-569-A, Annex A, "Firestopping."

C. Comply with BICSI TDMM, "Firestopping Systems" Article.

3.6 GROUNDING

A. Install grounding according to BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.

B. Comply with ANSI-J-STD-607-A.

C. Locate grounding bus bar to minimize the length of bonding conductors. Fasten to wall allowing at least 2-inch clearance behind the grounding bus bar. Connect grounding bus bar with a minimum No. 4 AWG grounding electrode conductor from grounding bus bar to suitable electrical building ground.

D. Bond metallic equipment to the grounding bus bar, using not smaller than No. 6 AWG equipment grounding conductor.

3.7 IDENTIFICATION

A. Identify system components, wiring, and cabling complying with TIA/EIA-606-A. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
   1. Administration Class: 3.
   2. Color-code cross-connect fields and apply colors to voice and data service backboards, connections, covers, and labels.

B. Comply with requirements in Section 099123 "Interior Painting" for painting backboards. For fire-resistant plywood, do not paint over manufacturer's label.

C. Paint and label colors for equipment identification shall comply with TIA/EIA-606-A for Class 3 level of administration including optional identification requirements of this standard.

D. Comply with requirements in Section 271500 "Communications Horizontal Cabling" for cable and asset management software.

E. Cable Schedule: Install in a prominent location in each equipment room and wiring closet. List incoming and outgoing cables and their designations, origins, and destinations. Protect with rigid frame and clear plastic cover. Furnish an electronic copy of final comprehensive schedules for Project.

F. Cabling Administration Drawings: Show building floor plans with cabling administration-point labeling. Identify labeling convention and show labels for telecommunications closets, backbone pathways and cables, entrance pathways and cables, terminal hardware and positions, horizontal cables, work areas and workstation terminal positions, grounding buses and pathways, and equipment grounding conductors.

G. Cable and Wire Identification:

1. Label each cable within 4 inches of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.
2. Each wire connected to building-mounted devices is not required to be numbered at device if color of wire is consistent with associated wire connected and numbered within panel or cabinet.
3. Exposed Cables and Cables in Cable Trays and Wire Troughs: Label each cable at intervals not exceeding 15 feet.
4. Label each terminal strip and screw terminal in each cabinet, rack, or panel.
   a. Individually number wiring conductors connected to terminal strips and identify each cable or wiring group being extended from a panel or cabinet to a building-mounted device with name and number of particular device as shown.
   b. Label each unit and field within distribution racks and frames.
5. Identification within Connector Fields in Equipment Rooms and Wiring Closets: Label each connector and each discrete unit of cable-terminating and connecting hardware. Where similar jacks and plugs are used for both voice and data communication cabling, use a different color for jacks and plugs of each service.

H. Labels shall be preprinted or computer-printed type with printing area and font color that contrasts with cable jacket color but still complies with requirements in TIA/EIA 606-A, for the following:
   1. Cables use flexible vinyl or polyester that flexes as cables are bent.

3.8 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Perform tests and inspections.

C. Tests and Inspections:
   1. Visually inspect UTP and optical fiber jacket materials for NRTL certification markings. Inspect cabling terminations in communications equipment rooms for compliance with color-coding for pin assignments, and inspect cabling connections for compliance with TIA/EIA-568-B.1.
   2. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
   3. Test UTP copper cabling for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination but not cross-connection.
      a. Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-B.2. Perform tests with a tester that complies with performance requirements in "Test Instruments (Normative)" Annex, complying with measurement accuracy specified in "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
   4. Optical Fiber Cable Tests:
      a. Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-B.1. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
      b. Link End-to-End Attenuation Tests:
         1) Horizontal and multimode backbone link measurements: Test at 850 or 1300 nm in 1 direction according to TIA/EIA-526-14-A, Method B, One Reference Jumper.

2) Attenuation test results for backbone links shall be less than 2.0 dB. Attenuation test results shall be less than that calculated according to equation in TIA/EIA-568-B.1.

D. Data for each measurement shall be documented. Data for submittals shall be printed in a summary report that is formatted similar to Table 10.1 in BICSI TDMM, or transferred from the instrument to the computer, saved as text files, and printed and submitted.

E. Remove and replace cabling where test results indicate that they do not comply with specified requirements.

F. End-to-end cabling will be considered defective if it does not pass tests and inspections.

G. Prepare test and inspection reports.

END OF SECTION 271300

SECTION 271500 – COMMUNICATIONS HORIZONTAL CABLING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Pathways.
2. UTP cabling.
3. Multi-user telecommunications outlet assemblies.
4. Cable connecting hardware, patch panels, and cross-connects.
5. Telecommunications outlet/connectors.
6. Cabling system identification products.
7. Cable management system.

B. Related Sections:

1. Division 27 Section 271000 “Premise Distribution System.”
2. Division 27 Section 271100 “Communication Equipment Room Fittings”
3. Division 27 Section 271300 "Comm Backbone Cabling" for voice and data cabling associated with system panels and devices.

1.3 DEFINITIONS

A. BICSI: Building Industry Consulting Service International.

B. Consolidation Point: A location for interconnection between horizontal cables extending from building pathways and horizontal cables extending into furniture pathways.

C. Cross-Connect: A facility enabling the termination of cable elements and their interconnection or cross-connection.

D. EMI: Electromagnetic interference.

E. IDC: Insulation displacement connector.

F. Ladder Cable Tray: A fabricated structure consisting of two longitudinal side rails connected by individual transverse members (rungs).

G. LAN: Local area network.

H. MUTOA: Multi-user telecommunications outlet assembly, a grouping in one location of several telecommunications outlet/connectors.

I. Outlet/Connectors: A connecting device in the work area on which horizontal cable or outlet cable terminates.

J. RCDD: Registered Communications Distribution Designer.

K. UTP: Unshielded twisted pair.

1.4 HORIZONTAL CABLING DESCRIPTION

A. Horizontal cable and its connecting hardware provide the means of transporting signals between the telecommunications outlet/connector and the horizontal cross-connect located in the communications equipment room. This cabling and its connecting hardware are called "permanent link," a term that is used in the testing protocols.

1. TIA/EIA-568-B.1 requires that a minimum of two telecommunications outlet/connectors be installed for each work area.
2. Horizontal cabling shall contain no more that one transition point or consolidation point between the horizontal cross-connect and the telecommunications outlet/connector.
3. Bridged taps and splices shall not be installed in the horizontal cabling.
4. Splitters shall not be installed as part of the optical fiber cabling.

B. A work area is approximately 100 sq. ft. (9.3 sq. m), and includes the components that extend from the telecommunications outlet/connectors to the station equipment.

C. The maximum allowable horizontal cable length is 295 feet (90 m). This maximum allowable length does not include an allowance for the length of 16 feet (4.9 m) to the workstation equipment. The maximum allowable length does not include an allowance for the length of 16 feet (4.9 m) in the horizontal cross-connect.

1.5 PERFORMANCE REQUIREMENTS

A. General Performance: Horizontal cabling system shall comply with transmission standards in TIA/EIA-568-B.1, when tested according to test procedures of this standard.

1.6 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings:

1. System Labeling Schedules: Electronic copy of labeling schedules that are part of the cabling and asset identification system of the software.
2. Cabling administration drawings and printouts.
3. Wiring diagrams to show typical wiring schematics, including the following:

    a. Cross-connects.
    b. Patch panels.
    c. Patch cords.

4. Cross-connects and patch panels. Detail mounting assemblies, and show elevations and physical relationship between the installed components.

5. Cable tray layout, showing cable tray route to scale, with relationship between the tray and adjacent structural, electrical, and mechanical elements. Include the following:

   a. Vertical and horizontal offsets and transitions.
   b. Clearances for access above and to side of cable trays.
   c. Vertical elevation of cable trays above the floor or bottom of ceiling structure.
   d. Load calculations to show dead and live loads as not exceeding manufacturer's rating for tray and its support elements.

C. Samples: For workstation outlets, jacks, jack assemblies, in specified finish, one for each size and outlet configuration and faceplates for color selection and evaluation of technical features.

D. Qualification Data: For Installer, qualified layout technician, installation supervisor, and field inspector.

E. Source quality-control reports.

F. Field quality-control reports.

G. Maintenance Data: For splices and connectors to include in maintenance manuals.

H. Software and Firmware Operational Documentation:

   1. Software operating and upgrade manuals.
   2. Program Software Backup: On magnetic media or compact disk, complete with data files.
   3. Device address list.
   4. Printout of software application and graphic screens.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.

   1. Layout Responsibility: Preparation of Shop Drawings, Cabling Administration Drawings, and field testing program development by an RCDD.
   2. Installation Supervision: Installation shall be under the direct supervision of Registered Technician who shall be present at all times when Work of this Section is performed at Project site.

B. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

   1. Flame-Spread Index: 25 or less.
   2. Smoke-Developed Index: 450 or less.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

D. Telecommunications Pathways and Spaces: Comply with TIA/EIA-569-A.

E. Grounding: Comply with ANSI-J-STD-607-A.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Test cables upon receipt at Project site.

1. Test each pair of UTP cable for open and short circuits.

1.9 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install cables and connecting materials until wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

1.10 COORDINATION

A. Coordinate layout and installation of telecommunications pathways and cabling with Owner's telecommunications and LAN equipment and service suppliers.

B. Coordinate telecommunications outlet/connector locations with location of power receptacles at each work area.

1.11 SOFTWARE SERVICE AGREEMENT

A. Technical Support: Beginning with Substantial Completion, provide software support for two years.

B. Upgrade Service: Update software to latest version at Project completion. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software shall include operating system. Upgrade shall include new or revised licenses for use of software.

1. Provide 30 days' notice to Owner to allow scheduling and access to system and to allow Owner to upgrade computer equipment if necessary.

1.12 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Patch-Panel Units: One of each type.
2. Connecting Blocks: One of each type.
3. Device Plates: 10 of each type.
4. Multi-user Telecommunications Outlet Assemblies: 10 of each type.

PART 2 - PRODUCTS

2.1 PATHWAYS

A. General Requirements: Comply with TIA/EIA-569-A.

B. Cable Support: NRTL labeled for support of Category 6 cabling, designed to prevent degradation of cable performance and pinch points that could damage cable.

1. Support brackets with cable tie slots for fastening cable ties to brackets.
2. Lacing bars, spools, J-hooks, and D-rings.
3. Straps and other devices.

C. Cable Trays: See specification section 260537

D. Conduit and Boxes: Comply with requirements in Division 26 Section "Raceways" Flexible metal conduit shall not be used**.**

1. Outlet boxes shall be no smaller than 2 inches (50 mm) wide, 3 inches (75 mm) high, and 2-1/2 inches (64 mm) deep.

2.2 BACKBOARDS

A. Backboards: Plywood, fire-retardant treated**,** 3/4 by 48 by 96 inches (19 by 1220 by 2440 mm). Comply with requirements in Division 6 Section "Rough Carpentry" for plywood backing panels.

2.3 UTP CABLE

A. Manufacturers: Subject to compliance with requirements of paragraph 1.2 C., Section 271000, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Belden CDT Inc.; Electronics Division.
2. Berk-Tek; a Nexans company.
3. CommScope, Inc.
4. Genesis Cable Products; Honeywell International, Inc.
5. KRONE Incorporated.
6. Mohawk; a division of Belden CDT.
7. Nordex/CDT; a subsidiary of Cable Design Technologies.
8. Superior Essex Inc.
9. SYSTIMAX Solutions; a CommScope, Inc. brand.
10. Tyco Electronics/AMP Netconnect; Tyco International Ltd.
11. or approved equal.

B. Horizontal Wiring: Provide plenum rated 100 Ohm Unshielded Twisted Pair (UTP) cable with the following physical characteristics:

1. The diameter of the insulated conductor shall be .048 in. maximum and shall consist of (4) 22 to 24 AWG twisted pairs.
2. Shall be suitable for the environment in which they are to be installed. For Plenum, shall meet applicable requirements of ANSI/ICEA S-80-576. All four

pairs must be insulated with F.E.P. No 2x2 or 3x1 construction will be allowed. Plenum rated cable shall be UL certified to conform to UL 910, CMP and shall be marked as such. Riser rated cable shall be third party certified to conform to UL 1666, CMR, CMG and IEC 332-1 and shall be marked as such.

3. The color-coding of pairs shall be:

   a. Pair 1 W-BL; BL
   b. Pair 2 W-O; O
   c. Pair 3 W-G; G
   d. Pair 4 W-BR;BR

C. Horizontal Category 6 Wiring: Provide high speed data cabling conforming to ANSI/TIA/EIA 568-B.3 Category 6. All Category 6 cables shall conform to ANSI/TIA/EIA 568-B Commercial Building Telecommunications Cabling Standard. Applications standards supported should include, but are not limited to, IEEE 802.3, 10BaseT-T, IEEE 802.5, 4 Mbps, 16 Mbps, 100 Base-T and 155 Mbps ATM1, 1000BaseT Gbps Ethernet, potentially 1.2 Gbps ATM and 2.4 Gbps ATM, Multitasked Split Screen Computing, Virtual Holographic Video Conferencing, 3D CAD/CAM Engineering, Internet-Intranet Communications/Commerce, as well as all 77 channels (550 MHz) of analog broad band video.

1. From each jack location there will be one sheath of plenum rated Inside Wiring Cable to the associated distribution frame.
2. The plenum cable shall be composed of 22 to 24 AWG bare solid copper conductors each with an insulation of Teflon. The insulated conductors are tightly twisted into pairs and jacketed with white low smoke PVC. It shall conform to a UL Type CMP listing for plenum and riser applications.
3. Each sheath shall contain four unshielded copper pairs. Each pair shall have a different twist ratio per foot.
4. The cables shall meet or exceed the following standards:

   a. ANSI/TIA/EIA 568-B “Commercial Building Wiring Standard
   b. UL listed
   c. National Electrical Code – Article 800

5. The cables shall meet the following representative electrical and transmission characteristics:

Frequency	Insertion loss	Pair to Pair	Power Sum	ELFEXT	SRL	Power Sum ELFEXT
MHz	cB/100m	NEXT dB	NEXT dB	DB	dB	dB
1.	2.0	74.3	72.3	67.8	20	64.8
4.	3.8	65.3	63.3	55.8	23	52.8
10.	6.0	59.3	57.3	47.8	25	44.8
16.	7.6	56.2	54.2	43.7	25	40.7
20.	8.5	54.8	52.8	41.8	25	38.8
25.	9.5	53.3	51.3	39.8	24.3	36.8
31.25	10.7	51.9	49.9	37.9	23.6	34.9
62.5	15.4	47.4	45.4	31.9	21.5	28.9
Frequency	Insertion loss	Pair to Pair	Power Sum	ELFEXT	SRL	Power Sum ELFEXT
100	19.8	44.3	42.3	27.8	20.1	24.8
200	29.3	39.8	37.8	21.8	18	18.8

250.	32.8	38.3	36.3	19.8	17.3	16.8

6. Cable Manufacturer shall be ISO-9001 certified.
7. The cable packaging shall be constructed so as to prevent kinking and other damage to the cable during shipping and handling. All damaged cable will be replaced.

D. 25 Pair High Speed Data Tie Cable: Provide high speed data cabling conforming to ANSE/TIA/EIA 568-B Category 5e. All cables shall meet applicable requirements of ANSI/ICEA S-80-576. All Category 5e cables shall conform to ANSI/TIA/EIA 568-B Commercial Building Telecommunications Cabling Standard, Horizontal Cable Section. Applications standards supported should include, but are not limited to, IEEE 802.3, 10BaseT-T, IEEE 802.5, 4 Mbps, 16 Mbps and TP-PMD. In addition, these cables shall be capable of supporting evolving high-end applications such as 100 Base-T and 52/155 Mbps ATM.

1. The cable shall be composed of 22 to 24 AWG bare solid copper conductors with a suitable plastic dielectric material.
2. Each cable shall contain 25 unshielded copper pairs. Installed in tight sub-units to meet power sum Near End Crosstalk, swept Insertion loss and SRL requirements. The insulated conductors shall be twisted into pairs and stranded into mini-units. The cable shall employ a honeycomb core construction, consisting of multiple three and four pair tightly stranded sub-units. A total of seven unjacketed sub-units will be stranded to comprise the cable core.
3. The cables shall meet or exceed the following standards:

   a. ANSI/TIA/EIA 568-B “Commercial Building Wiring Standard,” Category 5e Backbone
   b. Cable Section
   c. Certified Category 5e Cable under UL’s LAN Cable Certification Program
   d. UL Listed CMR or CMP as required, UL Verified Cat 5e
   e. National Electrical Code – Article 800

4. The cables shall meet the TIA/EIA electrical and transmission characteristics.

   a. Outside Diameter .48 inches
   b. Mutual Capacitance 5.6 nF/100m
   c. Impedance Z 100 ± 15% Ohms from 1-100 MHz
   d. DC Resistance – Max. 9.38 Ohms/100 m

5. Cable Manufacturer shall be ISO-9001 certified.
6. The cable packaging shall be constructed so as to prevent kinking and other damage to the cable during shipping and handling. All damaged cable will be replaced.

2.4 UTP CABLE HARDWARE

A. Manufacturers: Subject to compliance with requirements of paragraph 1.2 C of Section 271000, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. American Technology Systems Industries, Inc.

2. Dynacom Corporation.
3. Hubbell Premise Wiring.
4. KRONE Incorporated.
5. Leviton Voice & Data Division.
6. Molex Premise Networks; a division of Molex, Inc.
7. Nordex/CDT; a subsidiary of Cable Design Technologies.
8. Panduit Corp.
9. Tyco Electronics/AMP Netconnect; Tyco International Ltd.
10. Or approved equal...

B. General Requirements for Cable Connecting Hardware: Comply with TIA/EIA-568-B.2, IDC type, with modules designed for punch-down caps or tools. Cables shall be terminated with connecting hardware of same category or higher.

C. Connecting Blocks: 110-style IDC for Category 6. Provide blocks for the number of cables terminated on the block, plus 25 percent spare. Integral with connector bodies, including plugs and jacks where indicated.

D. Patch Panel: Modular panels housing multiple-numbered jack units with IDC-type connectors at each jack for permanent termination of pair groups of installed cables.

1. Number of Jacks per Field: One for each four-pair UTP cable indicated, plus 20% spares and blank positions adequate to suit specified expansion criteria.

E. Jacks and Jack Assemblies: Modular, color-coded, eight-position modular receptacle units with integral IDC-type terminals.

F. Patch Cords: Factory-made, four-pair cables in 72-inch lengths; terminated with eight-position modular plug at each end.

1. Patch cords shall have bend-relief-compliant boots and color-coded icons to ensure Category 6 performance. Patch cords shall have latch guards to protect against snagging.

2.5 CONSOLIDATION POINTS

A. Manufacturers: Subject to compliance with requirements of paragraph 12. C of Section 271000, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. American Technology Systems Industries, Inc.
2. Chatsworth Products, Inc.
3. Dynacom Corporation.
4. Hubbell Premise Wiring.
5. Molex Premise Networks; a division of Molex, Inc.
6. Nordex/CDT; a subsidiary of Cable Design Technologies.
7. Ortronics, Inc.
8. Panduit Corp.
9. Siemon Co. (The).
10. Or approved equal.

B. Description: Consolidation points shall comply with requirements for cable connecting hardware.

1. Number of Terminals per Field: One for each conductor in assigned cables.
2. Number of Connectors per Field:

    a. One for each four-pair conductor group of indicated cables, plus 25 percent spare positions.

3. Mounting: Recessed in ceiling, wall, desk or furniture as shown on drawings.
4. NRTL listed as complying with UL 50 and UL 1863.
5. When installed in plenums used for environmental air, NRTL listed as complying with UL 2043.

2.6 MULTIUSER TELECOMMUNICATIONS OUTLET ASSEMBLY (MUTOA)

A. Manufacturers: Subject to compliance with requirements of paragraph 12. C of Section 271000, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Chatsworth Products, Inc.
2. Hubbell Premise Wiring.
3. Molex Premise Networks; a division of Molex, Inc.
4. Nordex/CDT; a subsidiary of Cable Design Technologies.
5. Ortronics, Inc.
6. Panduit Corp.

B. Modular Category 6 Jacks: The category 6 jack shall meet or exceed the following standards:
ANSI/TIA/EIA 568-B “Commercial Building Wiring Standard”.
FCC Part 68, Subpart “F”

1. The Category 6 modular jacks shall meet the following physical requirements:
2. Connector-insulation displacement connectors accepting 22 and 24 gauge AWG solid conductor wire
3. Jack wires-square copper alloy wires with 50 micro-inch lubricated gold plating over 100 micro-inch nickel plate
4. High impact, flame retardant UL-rated 94V-O thermoplastic
5. The Category 6 modular jacks shall meet the following mechanical requirements:

    a. Plug insertion life – minimum 750 plug insertions
    b. Contact Force – 100 grams minimum using FCC-approved modular plugs
    c. Plug Retention Force –(133N) minimum between modular plug and jack
    d. Temperature Range - -40° to 66°C

6. The outlet shall be approved to work in all applications up to 250 MHz, including, but are not limited to 1000BaseT Gigabit Ethernet.

Frequency	Insertion loss	Pair to Pair	FEXT dB	SRL
MHz	dB/100 m	NEXT dB	dB/100 m	dB
		dB/100 m		dB/100 m
1.	.1	75	75	19.8
4.	.1	75	71.1	21.6
10.	.1	74	63.1	22.8
16.	.1	69.9	59	23.4
20.	.1	68	57.1	23.7
25.	.1	66	55.1	24
31.25	.11	64.1	53.2	23
62.5	.16	58.1	47.2	20
100	.2	54	43.1	18
200	.28	48	37.1	15
250	.32	46	35.1	14

2.7 HIGH SPEED CATEGORY 6 DATA CROSS-CONNECT PATCH PANELS

A. The data patch panels will be co-located on 19-inch racks with the network hubs and the fiber optical interconnection cabinets as designated on the drawings or as required by the owner. The configuration of the patch panels shall be in an arrangement that minimizes patch cord lengths.

B. The modular patch panels shall have eight wires, 8-position modular jacks with 110 terminations on the rear for connection of station cables. The horizontal Category 6 cables to the outlets will be directly connected to 110 insulation displacement hardware associated with each jack on the patch panel. These panels will be designed to operate at 100/250 MHz. Quantities sufficient for all positions of every outlet are required.

C. The patch panel shall be a Category 6 modular jack panel with the following characteristic:

1. The patch panel will utilize a 110 insulation displacement connector field on the back of the panel to terminate the horizontal cables. The 110 field is to remain continuous to the 8-pin modular jack field in the front of the panel.
2. The cross-connect patch panel shall meet the following standards: ANSI/TIA/EIA 568-B “Commercial Building Wiring Standard FCC Part 68, Subpart F.

D. The Cross-connect patch panel shall meet the following physical requirements:

Wire termination – insulation displacement, gas tight, slotted beam contact
Plug contact force – 100 grams
Plug retention force – 133 Newtons

E. The cross-connect patch panel shall meet the following environmental requirements:

Operating Environment
Temperature: 32°F to 140°F (0° to 60°C)
Humidity: 5% to 95% (noncondensing)

Storage Environment

Temperature -40°F to 150°F (-40° to 66°C)
Humidity: 5% to 95% (noncondensing)

F. The Category 6 panels shall be approved to work in all applications up to 250 MHz, including, but are not limited to, 1000BaseT Gigabit Ethernet.

G. The Category 6 panels shall meet or exceed the following representative electrical and transmission characteristics:

Frequency	Insertion loss	Pair to Pair	FEXT dB	SRL
MHz	dB/100 m	NEXT dB	dB/100 m	dB
		dB/100 m		dB/100 m
1.	.1	75	75	30
4.	.1	75	71.1	30
10.	.1	74	63.1	30
16.	.1	69.9	59	30
20.	.1	68	57.1	30
25.	.1	66	55.1	30
31.25	.11	64.1	53.2	30
62.5	.16	58.1	47.2	28.1
100	.2	54	43.1	24
200	.28	48	37.1	18
250	.32	46	35.1	16

H. Category 5e/6 Modular Patch Cords

1. Provide 100% factory assembled and tested Category 6 plug-end cross-connecting patch cables for each modular patch panel jack. Cable shall be sized for the longest cross-connect and installed in accordance with a schedule developed by the installation contractor. The length of the patch cable or cross-connect jumpers shall not exceed 20 feet. Provide color-coded boot assemblies to match owner's requirements.

2.8 GROUNDING

A. Comply with requirements in Division 26 Section "Grounding and Bonding for Electrical Systems" for grounding conductors and connectors.

B. Comply with ANSI-J-STD-607-A.

2.9 IDENTIFICATION PRODUCTS

A. Comply with TIA/EIA-606-A and UL 969 for labeling materials, including label stocks, laminating adhesives, and inks used by label printers. Use Penduit Ultimate 10 Network Labeling system or equal.

B. Comply with requirements in Division 26 Section "Identification for Electrical Systems"

2.10 CABLE MANAGEMENT SYSTEM

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Basis-of-Design Product: Subject to compliance with requirements, provide comparable product by one of the following:

1. iTRACS Corporation.
2. Telsoft Solutions.
3. Or approved equal.

C. Description: Computer-based cable management system, with integrated database and graphic capabilities.

D. Document physical characteristics by recording the network, TIA/EIA details, and connections between equipment and cable.

E. Information shall be presented in database view, schematic plans, or technical drawings.

1. AutoCAD drawing software shall be used as drawing and schematic plans software.

F. System shall interface with the following testing and recording devices:

1. Direct upload tests from circuit testing instrument into the personal computer.
2. Direct download circuit labeling into labeling printer.

2.11 SOURCE QUALITY CONTROL

A. Factory test UTP and optical fiber cables on reels according to TIA/EIA-568-B.1.

B. Factory test UTP cables according to TIA/EIA-568-B.2.

C. Cable will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 WIRING METHODS

A. Wiring Method: Install cables in raceways and cable trays except within consoles, cabinets, desks, and counters and except in accessible ceiling spaces where unenclosed wiring method may be used. Conceal raceway and cables except in unfinished spaces.

1. Install plenum cable in environmental air spaces, including plenum ceilings.
2. Comply with requirements for raceways and boxes specified in Division 26 Section "Raceways".

B. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.

C. Wiring within Enclosures: Bundle, lace, and train cables to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.

3.2 INSTALLATION OF PATHWAYS

A. Cable Trays: Comply with NEMA VE 2 and TIA/EIA-569-A-7.

B. Comply with requirements for demarcation point, pathways, cabinets, and racks specified in Division 27 Section "Communications Equipment Room Fittings." Drawings indicate general arrangement of pathways and fittings.

C. Comply with TIA/EIA-569-A for pull-box sizing and length of conduit and number of bends between pull points.

D. Comply with requirements in Division 26 Section "Raceways" for installation of conduits and wireways.

E. Install manufactured conduit sweeps and long-radius elbows whenever possible.

F. Pathway Installation in Communications Equipment Rooms:

1. Position conduit ends adjacent to a corner on backboard where a single piece of plywood is installed, or in the corner of room where multiple sheets of plywood are installed around perimeter walls of room.
2. Install cable trays to route cables if conduits cannot be located in these positions.
3. Secure conduits to backboard when entering room from overhead.
4. Extend conduits 3 inches (76 mm) above finished floor.
5. Install metal conduits with grounding bushings and connect with grounding conductor to grounding system.

G. Backboards: Install backboards with 96-inch (2440-mm) dimension vertical. Butt adjacent sheets tightly, and form smooth gap-free corners and joints.

3.3 INSTALLATION OF CABLES

A. Comply with NECA 1.

B. General Requirements for Cabling:

1. Comply with TIA/EIA-568-B.1.
2. Comply with BICSI ITSIM, Ch. 6, "Cable Termination Practices."
3. Install 110-style IDC termination hardware unless otherwise indicated.
4. MUTOA shall not be used as a cross-connect point.
5. Consolidation points may be used only for making a direct connection to telecommunications outlet/connectors:

   a. Do not use consolidation point as a cross-connect point, as a patch connection, or for direct connection to workstation equipment.

b. Locate consolidation points for UTP at least 49 feet (15 m) from communications equipment room.

6. Terminate conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.
7. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches (760 mm) and not more than 6 inches (150 mm) from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
8. Install lacing bars to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer.
9. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIM, "Cabling Termination Practices" Chapter. Install lacing bars and distribution spools.
10. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
11. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.
12. In the communications equipment room, install a 10-foot- (3-m-) long service loop on each end of cable.
13. Pulling Cable: Comply with BICSI ITSIM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.

C. UTP Cable Installation:

1. Comply with TIA/EIA-568-B.2.
2. Do not untwist UTP cables more than 1/2 inch (12 mm) from the point of termination to maintain cable geometry.

D. Optical Fiber Cable Installation:

1. Comply with TIA/EIA-568-B.3.
2. Cable may be terminated on connecting hardware that is rack or cabinet mounted.

E. Open-Cable Installation:

1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
2. Suspend UTP cable not in a wireway or pathway a minimum of 8 inches (200 mm) above ceilings by cable supports not more than 60 inches (1524 mm) apart.
3. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.

F. Installation of Cable Routed Exposed under Raised Floors:

1. Install plenum-rated cable only.
2. Install cabling after the flooring system has been installed in raised floor areas.
3. Coil cable 6 feet (1800 mm) long not less than 12 inches (300 mm) in diameter below each feed point.

G. Group connecting hardware for cables into separate logical fields.

H. Separation from EMI Sources:

1. Comply with BICSI TDMM and TIA/EIA-569-A for separating unshielded copper voice and data communication cable from potential EMI sources, including electrical power lines and equipment.
2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:

   a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches (127 mm).
   b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches (300 mm).
   c. Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches (610 mm).

3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:

   a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 2-1/2 inches (64 mm).
   b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches (150 mm).
   c. Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches (300 mm).

4. Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:

   a. Electrical Equipment Rating Less Than 2 kVA: No requirement.
   b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches (76 mm).
   c. Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches (150 mm).

5. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches (1200 mm).
6. Separation between Communications Cables and Fluorescent Fixtures: A minimum of 5 inches (127 mm).

3.4 FIRESTOPPING

A. Comply with requirements in Division 7 Section "Penetration Firestopping."

B. Comply with TIA/EIA-569-A, Annex A, "Firestopping."

C. Comply with BICSI TDMM, "Firestopping Systems" Article.

3.5 GROUNDING

A. Install grounding according to BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.

B. Comply with ANSI-J-STD-607-A.

C. Locate grounding bus bar to minimize the length of bonding conductors. Fasten to wall allowing at least 2-inch (50-mm) clearance behind the grounding bus bar. Connect grounding bus bar with a minimum No. 4 AWG grounding electrode conductor from grounding bus bar to suitable electrical building ground.

D. Bond metallic equipment to the grounding bus bar, using not smaller than No. 6 AWG equipment grounding conductor.

3.6 IDENTIFICATION

A. Using cable management system software specified in Part 2, develop Cabling Administration Drawings for system identification, testing, and management. Use unique, alphanumeric designation for each cable and label cable, jacks, connectors, and terminals to which it connects with same designation. At completion, cable and asset management software shall reflect as-built conditions.

B. Comply with requirements in Division 9 Section "Painting" for painting backboards. For fire-resistant plywood, do not paint over manufacturer's label.

C. Paint and label colors for equipment identification shall comply with TIA/EIA-606-A for Class 3 level of administration, including optional identification requirements of this standard.

D. Cable Schedule: Post in prominent location in each equipment room and wiring closet. List incoming and outgoing cables and their designations, origins, and destinations. Protect with rigid frame and clear plastic cover. Furnish an electronic copy of final comprehensive schedules for Project.

E. Cabling Administration Drawings: Show building floor plans with cabling administration-point labeling. Identify labeling convention and show labels for telecommunications closets, backbone pathways and cables, entrance pathways and cables, terminal hardware and positions, horizontal cables, work areas and workstation terminal positions, grounding buses and pathways, and equipment grounding conductors. Follow convention of TIA/EIA-606-A. Furnish electronic record of all drawings, in software and format selected by Owner.

F. Cable and Wire Identification:

1. Label each cable within 4 inches (100 mm) of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.
2. Each wire connected to building-mounted devices is not required to be numbered at device if color of wire is consistent with associated wire connected and numbered within panel or cabinet.
3. Exposed Cables and Cables in Cable Trays and Wire Troughs: Label each cable at intervals not exceeding 15 feet (4.5 m).
4. Label each terminal strip and screw terminal in each cabinet, rack, or panel.

    a. Individually number wiring conductors connected to terminal strips, and identify each cable or wiring group being extended from a panel or cabinet to a building-mounted device shall be identified with name and number of particular device as shown.
    b. Label each unit and field within distribution racks and frames.

5. Identification within Connector Fields in Equipment Rooms and Wiring Closets: Label each connector and each discrete unit of cable-terminating and connecting hardware. Where similar jacks and plugs are used for both voice and data communication cabling, use a different color for jacks and plugs of each service.
6. Uniquely identify and label work area cables extending from the MUTOA to the work area. These cables may not exceed the length stated on the MUTOA label.

G. Labels shall be preprinted or computer-printed type with printing area and font color that contrasts with cable jacket color but still complies with requirements in TIA/EIA-606-A.

1. Cables use flexible vinyl or polyester that flex as cables are bent.

3.7 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:

1. Visually inspect UTP and optical fiber cable jacket materials for NRTL certification markings. Inspect cabling terminations in communications equipment rooms for compliance with color-coding for pin assignments, and inspect cabling connections for compliance with TIA/EIA-568-B.1.
2. Visually confirm Category 6, marking of outlets, cover plates, outlet/connectors, and patch panels.
3. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.

C. UTP Performance Tests:

1. Test for each outlet and MUTOA. Perform the following tests according to TIA/EIA-568-B.1 and TIA/EIA-568-B.2:

a. Wire map.
b. Length (physical vs. electrical, and length requirements).
c. Insertion loss.
d. Near-end crosstalk (NEXT) loss.
e. Power sum near-end crosstalk (PSNEXT) loss.
f. Equal-level far-end crosstalk (ELFEXT).
g. Power sum equal-level far-end crosstalk (PSELFEXT).
h. Return loss.
i. Propagation delay.
j. Delay skew.

2. Final Verification Tests: Perform verification tests for UTP systems after the complete communications cabling and workstation outlet/connectors are installed.

a. Voice Tests: These tests assume that dial tone service has been installed. Connect to the network interface device at the demarcation point. Go off-hook and listen and receive a dial tone. If a test number is available, make and receive a local, long distance, and digital subscription line telephone call.
b. Data Tests: These tests assume the Information Technology Staff has a network installed and is available to assist with testing. Connect to the

network interface device at the demarcation point. Log onto the network to ensure proper connection to the network.

D. Document data for each measurement. Data for submittals shall be printed in a summary report that is formatted similar to Table 10.1 in BICSI TDMM, or transferred from the instrument to the computer, saved as text files, and printed and submitted.

E. End-to-end cabling will be considered defective if it does not pass tests and inspections.

F. Prepare test and inspection reports.

3.8 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel in cable-plant management operations, including changing signal pathways for different workstations, rerouting signals in failed cables, and keeping records of cabling assignments and revisions when extending wiring to establish new workstation outlets. Include training in cabling administration software.

END OF SECTION 271500

SECTION 275000 – AIR TRAFFIC CONTROL (ATC) EQUIPMENT

1. General

The criterion set forth in this section includes the minimum equipment, materials, and labor to satisfy the ATC communication requirements for a new Level I, Low Activity Airport Traffic Control Tower (ATCT) at the Lynchburg Regional Airport (LYH). The Contract Drawings directly related to this section are TE-100, TE-200, TE-201, and TE-300. However, all of the Contract Drawings shall be referred to in coordinating the installation of ATC equipment in the new ATCT.

2. Codes and Standards

All electronic and electrical equipment and installations shall be provided in accordance with the current required local, state and national codes and standards, as applicable. Qualified personnel shall perform the installations and shall also be in attendance for all punch list and final inspections. All equipment is based on the guidelines set forth in the FAA Contract Tower Minimum Equipment List (MEL) FAA JO 7210.54 Appendix B dated October 1, 2006 including current updates by the Federal Contract Tower (FCT) Program Office, Washington, DC.

3. Qualifications

The Contractor must provide a minimum of two (2) technicians on-site for this project, both having prior experience. These installers must have demonstrated the ability to install, configure and integrate all equipment needed to meet FAA minimum standards, as provided in the FAA MEL, in at least four (4) locations over the past twenty four (24) months. Radios shall be tuned and certified by FCC licensed installers as provided by the Contractor. The Contractor shall provide qualifications documentation with its materials submittals and shop drawings.

4. Equipment Submittals, Installation and Coordination

The Contractor shall furnish, install, test, and verify all equipment, hardware, software, racks (securely attached to each other and to the floor), cabling, conduit, connectors, labeling (identification), and miscellaneous equipment required to provide a complete and usable installation. All ATC equipment shall be new unless otherwise indicated and shall be installed in a new control tower. All components of the new ATCT at the Lynchburg Regional Airport shall be constructed to Federal Contract Tower (FCT) standards. The completed ATCT will be equipped with an elevator to the floor below the control cab. ATC Equipment shall be installed in the Control Cab, on its roof and in the Equipment Room (3rd level of the tower). The Federal Aviation Administration (FAA) electronics will also be located in the same room on the 3rd level which may be installed during and/or after the Contractor's installation timeframe. The Contractor shall be responsible to coordinate its equipment installation with the FAA through the Owner or its designated representative, so as not to conflict with equipment that FAA will install. At this time, the FAA's installation includes but is not limited to a STARS remote radar system, NAIMES, FDIO, RVR, IDS, ASOS, ILS, MALSR and FTI Telecommunications lines. At a minimum, FAA's equipment will be located in the ground floor Telco Room, the 3rd floor Equipment Room, Cab Roof and in the Control Cab.

All submittals shall be provided in pdf electronic format with at least two (2) full size hard copies to the Architect/Engineer. A general arrangement of the ATC equipment console is provided on the Contract Drawings. The cab console is designed with alternating flat and sloped (turrets) surfaces in anticipation of supporting pedestal mounted displays and panels as well as flush mounts. ATC Equipment Submittals shall be submitted with the Console (cabinetry/millwork) Submittal. The ATC Equipment sizes and locations shall be coordinated with the Console shop drawings by the Contractor. Additional time will be required for architectural review in order to coordinate an FAA review for placement of their equipment. If the Contractor proposes to make any modifications to the console layout from that presented in the Contract Drawings or as subsequently approved, then the Contractor shall submit a statement and/or drawings with the equipment and console submittals for approval at least ninety (90) days prior to fabrication of the consoles. The Contractor shall submit a roof plan showing antenna locations in relation to other appurtenances that are shown on the project electrical plans. Alternate console and/or roof layouts presented shall be reviewed further with FAA, the Owner and its project representative, as required, for coordination and approval. Sufficient space shall be reserved in the facility for FAA provided equipment and other equipment or monitors as may be identified prior to or during construction. Coordination of task lighting, telephone, data and electrical outlets locations with Console construction and electronic equipment locations during shop drawing preparations and installations shall all be the responsibility of the Contractor.

5. Scheduling Installation

Electronics installation shall not begin until a Temporary Certificate of Occupancy (TCO) is issued by the Authority Having Jurisdiction (AHJ) or when all other trades are out of the building to prevent dust from settling into the new equipment. Antennas and cabling may be accomplished prior to a TCO. Punchlist items for the rest of the building may be worked on simultaneously only if they do not create dust or any potential for degradation of the electronics being installed. Work shall normally be conducted during typical daytime weekday working hours and shall not interfere with the conduct of air traffic control. Any work proposed to be conducted during other hours shall be requested by the Contractor and approved by the Owner in writing prior to any attempt.

The Contractor shall supply the Owner and his Authorized Representative with an initial schedule and monthly updates. It is the Contractor's responsibility to schedule and coordinate work with the Owner and others, as required. The Contractor shall report any difficulties or delays to the Owner or his Authorized Representative, immediately.

6. Voice Communications Switching System (VCSS) Requirements

The Installer shall furnish and install the components necessary to provide a new voice communications switching system <u>for three (3) controller positions</u> and expandable to at least 4 total positions in the future. This system shall be capable of providing connectivity between the airport traffic controllers and the voice communications equipment in the facility. This system shall provide the airport traffic controllers with the ability to utilize the equipment specified in the radio, telecommunications, and voice recording requirements, FAA dedicated circuits, intercom system between positions, position relief brief recording system, redundant capability between positions, and software that is programmable either at station or remotely.

Acceptable manufacturers and models shall be Harris Corporation Liberty Star 3, Frequentis Smart 3020X, or an approved equal with a 15" pedestal mounted or 10" hinge & lock touch screen control monitor, as appropriate to the approved manufacturer, at each of the three (3)

positions noted on the plans. The screen shall provide high contrast color, be adjustable to viewing angles and have brightness controls to be easily readable during day and night. The screen shall be sun readable and have a non-glare surface. The screen housing shall be as provided by the switch manufacturer, or if not provided, then an approved housing shall be gray or black. The existing voice switch control panels shall be removed from the console. The hole left in the console for the existing voice switch shall be completely covered by the new touch screen mounting material or a black powder coated aluminum bezel plate.

The VCSS shall be installed as independent operator positions with station-to-station redundancy in the ATCT cab. The screens for these positions shall be adjustable and pedestal mounted, as approved. All termination cabling for the voice communications system will be terminated in the equipment room to avoid interference in the cab area.

A request will have been made by the Owner for the Federal Aviation Administration (FAA) to install the required dedicated line circuits and the local telephone company to install the required commercial line circuits. The switching system shall have the proper interfaces required to handle FAA lines from the parent Approach Control facility and other dedicated circuits. The Installer shall be responsible for confirming the number and type of lines and the coordination of the FAA interface.

The voice communications switching system shall have the capability to handle four (4) central office type phone lines. The system shall be able to preset all lines for automatic call out at the same time for emergency agencies on the airport. The system shall also be equipped with a generator tone ring down line that has the capability to ring a phone at the city's emergency call center. This requires that each of the two (2) operating positions have a 12 digit keypad (0 through 9, #, and *) to access these lines and others. The city will connect their emergency line at a future date, if so desired. The switching system shall have the capability to program at least 10 speed dial telephone numbers. Each of the switching consoles shall include the required number of audio jacks to facilitate the use of the two (2) headsets or two (2) handsets at each of the operating positions (with instructor/student override capability at the station or from a distant station).

<u>Summary of features (VCSS)</u>

- Fourteen (14) Communication channels, including MIL/DSN (Radio 4 wire)
- Two (2) FAA dedicated 2 or 4 wire communication circuits to include voice page (SHOUT) and SS-1/4 two or three digits dial circuits.
- Four (4) Commercial Analog Phone lines including FAA Domestic Emergency Network (DEN)
- Busy out feature
- Redundant position capability for failure point control
- One Button call feature that will seize a telephone line to automatically dial a preprogrammed number to include preset conference dialing for multiple emergency agencies all at the same time.

- Capable of group call-out on all radio channels
- Position should support loop configuration that provides redundant voice and data communications with the VCCS Central Equipment.

- Automatic ring down for alerting emergency personnel and/or 911 including alert connectivity (no dial required) to the airport fire station and/or local fire station, as required.

7. Main Radio Transmitters and Receivers

The Contractor shall furnish and install three (3) VHF Single Channel Rack Mount Transmitters, and two (2) VHF Single Channel Rack Mount Receivers for the purpose of two-way air traffic control communications for the frequencies and uses listed below. One of the Transmitters may be an incorporated radio in the ATIS device (see related requirements for the ATIS/ASOS in paragraphs 17 and 19).

Transmitters shall be General Dynamics Model CM-300VT or an approved equal. Receivers shall be General Dynamics Model CM-300VR or an approved equal. Radios must achieve all applicable FAA standards and acceptance. Radios shall be tuned to the frequencies issued for ASOS, the standard emergency frequency, airport ground control and the local air traffic control. These radios shall be installed so that all frequencies are available to each controller position in the cab area. Radios shall be rack mounted in approved new equipment racks provided by the Installer in the FCT Equipment Room.

<u>Summary of Features for UHF and VHF Single Channel Receivers and Transmitters</u>

VHF Frequency Range: 117.975 MHz – 136.975 MHz (25 kHz increments)
UHF Frequency Range: 225.000 MHz – 399.995 MHz (25 kHz increments)
Power Output: 10 Watts Maximum (adjust to license, as required)
Digital Tunable:

TX & RX	121.90	VHF Ground
TX & RX	127.65	VHF Tower
TX	119.80	VHF ATIS/ASOS

8. Tunable Back-up Base Station

The Installer shall furnish and install one (2) VHF Tunable Base Station Radio, ICOM IC-A-110 or approved equal, for the purpose of back-up two way air traffic control communications of the Ground and Tower frequencies and to monitor the VHF Emergency frequency, 121.5 MHz but shall include tuning to the entire range specified below. Base Station shall utilize a compatible small antenna mounted on the cab windowsill.

<u>Typical Frequency Range:</u>
VHF Frequency Range: 117.975 – 136.975

9. Tunable Back-up Hand-Held Transceivers

The Contractor shall furnish two (2) VHF hand held radios (ICOM IC-A6) with charger bases or approved equivalent for the purpose of back-up evacuation capability for two-

way air traffic control communications**.** The radios will be utilized for back-up purposes for both the ground control and local control frequencies but shall also include the tuning ability to cover all VHF frequencies used by the controllers at LYH.

Minimum Specifications (Radios)
Frequency Range 118.00 to 136.975 MHz (25 kHz increments)
Power Requirements: DC battery with AC Charger Base
Power Output: 5 watts minimum

11. Radio Antennas and Cable Management

The Contractor shall provide four (4) VHF antennas for the (3) VHF frequencies and one (1) spare. They shall meet the requirements of Taco D4072, Antenna Products DPV or approved equal. Antennas shall be positioned on the roof in such a way that will not result in bleed-over or any interference from other antennas or air terminals.

Mounting hardware and junction boxes shall be rated for outdoor use and provide acceptable resistance to the elements. This shall require the Contractor to install galvanized rigid steel pipes, fittings, accessories and mounting channels, such as Unistrut or Cooper Industries, suitable for the antennas provided.

Summary of Features (Antennas)

VHF Frequency Range: 117.975 – 136.975
VSWR 2 to 1 or less: (Across the entire bandwidth)
Wind Velocity/Loading: 100 MPH (with 0.5” icing)
Lightning Protection: Direct Ground

Antennas shall be tested by the Installer and, when found satisfactory in relation to all frequencies, shall be installed on the cab roof as required for the configuration of radios in this particular installation. Provide polyphasers for each antenna in a junction box on the roof. A conduit and junction box routing system shall be provided by the Contractor with all mounting hardware and weather tight junction boxes to complete an antenna system in a manner that meets industry codes and standards. Mounting hardware and junction boxes shall be rated for outdoor use in the local wind zone and provide acceptable resistance to the elements (i.e., all pipes, channels, fittings and clamps; use compatible metals for all hardware connections).

12. Radio Filters

When required, the Contractor shall furnish and install cavity type filters to each of the VHF/AM single channel receivers and/or backup transceivers. Radio filters built-in each new transmitter and receiver shall be provided to minimize channel interference. Cavity filters will only be required if the new installation creates any unique interference with respect to its components or the control tower’s location. Contractor must determine this prior to completion and acceptance. Provide Telewave Bandfilters, Sinclair Technologies Low Band Aviation, or an approved equal..

13. Controllers Headsets and Handsets

The Contractor shall provide eight (8) headsets with 25 feet of coiled cord and four (4) handsets with 15 feet of coiled cord. The headsets shall be Plantronics Star sets (Part No. H-31 C/D; cord

shall be Part No. SHS 1890-15), GN Netcom 2120-NC, or approved equal. The handsets shall be Walker PTS-500-OP4-00, or an approved equal.

14. Telecommunications Requirements

The Contractor shall tie one (1) central office type line, one (1) Shout type line, one (1) SS/1 or SS/4 multi-point ring down line and/or Hybrid line, as required by FAA to match existing capabilities, into the voice communications switching systems at each of the thee (3) controller operating positions (Local, Ground and Flight Data). The Contractor shall also furnish and install six (6) new business style, corded, black, Multi-Purpose Telephone sets, with intercom capability, base speakerphone and expandable to sixteen (16) stations (AT&T 1040 multi line phone or equivalent) in the locations specified.

Phone Locations (7):

1 – Air Traffic Manager's Office
1 – ATC Equipment Room
1 – TELCO Room
1 – Break Room
1 – Training / Conference Room
2 – Control Cab

Types of Phones:
Multiple-Line (4 lines minimum)
Speaker Phone (Wall/Desk Mountable, as approved)

15. Voice Recording Requirements

The Contractor shall furnish and install one (1) voice activated, rack mounted, industrial quality digital STANCIL NextGeneration Multi-Media Logging Recorder (SLR) or an approved equal. The SLR shall have dual redundancies including but not necessarily limited to removable hard drives, fans and power supplies. It shall support RAID-1 storage up to 2TB with archiving options to record audio from multiple sources. The recorder shall have the capability to record a minimum of twenty-four (24) channels, including "dead air", simultaneously and be equipped with a rack mounted LCD monitor, keyboard, mouse and/or touchpad.

The purpose of this component is to provide a means for the recording, playback, and duplication of the audio announcement for the GPS master time code generator plus all radio and telephone communications to and from the control tower with the exception of the dedicated facsimile and non-essential telephone lines that are not being used by controller positions. The SLR shall support multi-channel playback and have the ability to export recordings using multiple methods including saving as .mp3 or .wav files, burn to a CD/DVD and attach them directly to an email. More details of the SLR requirements are contained in the Installation Check List and the Standard Hardware Configuration, both dated January 1, 2012 (or as currently updated), as can be found on the www.stancilcorp.com website.

17. Airport Terminal Information System (ATIS)

The Contractor shall furnish and install a complete ATIS with voice integrated announcer and transmitter. The equipment shall be provided as an ATIS (brand) CV(JBIII), Interalia SBX AP4 or an approved equal. The ATIS announcer shall be integrated with the VCSS. A radio

transmitter (see requirements in paragraph 7, above) as well as all wiring, antenna, filter (as required) and all incidentals shall be furnished and installed in order to provide a complete and operating ATIS.

Summary of Features

- At least 2 announcement channels
- Minimum of 15 minutes of recording time
- DTMF call transfer
- Remote access recording
- Call statistics
- System operating battery backup
- Compatible with all major telephone systems

18. FAA ASOS

Automated Surface Observing System (ASOS) units are automated sensor suites that are designed to serve meteorological and aviation observing needs. These systems generally report at hourly intervals, but also report special observations if weather conditions change rapidly and cross aviation operation thresholds. An ASOS is located on the LYH airfield and is owned and operated by the National Weather Service (NWS) for the FAA. It will be FAA's responsibility to relocate the connectivity, cab display and equipment rack from the existing to the new ATCT. Coordination, floor and console space, power and grounding responsibilities lie with the Contractor and shall be considered incidental to those ancillary provisions.

19. ATIS/ASOS Interface Unit (AAIU)

The AAIU facilitates switching to independent broadcasts between the existing NWS owned ASOS and the new ATIS. The device shall be FAA approved, professionally fabricated and appropriately labeled with permanent markings as manufactured by WOLEN, LLC or an approved equal. The AAIU shall be located on the new cab console in accordance with the console layout plan. The AAIU shall be compatible for use with the ASOS make and model.

The AAIU shall be fabricated so that the audio from each device (ASOS and ATIS) can be switched by the air traffic controllers when closing and opening of the tower. The device shall allow both radio broadcast and telephone dial-in for pilots to obtain ATIS and ASOS information as switched by the controllers. It must be an FAA Approved device and receive local NCP approval from the FAA Non-Federal Coordinator as well as ASOS CCB RC approval from the NWS. The Installer shall apply for and obtain these approvals in accordance with the Administrative Approval Considerations noted in FAA Memorandum dated 1/25/2010 and issued from Bettie Loudenslager, Manager, Weather Processors and Sensors Engineering Team, AJW-14A entitled "Automated Terminal Information System and Automated Weather Reporting Facility Switched Connections to a Common Transmitter". Contact Dennis Kamin, P.E., FAA Oklahoma City, (405) 954-1815. Provide said approvals to the Engineer along with its manufacturer's data, installation details and operation manual.

20. Back-up Wind Indicators/Sensor

Provide the Sensor and Displays in accordance with FAA Memorandum dated June 12, 2014 by Bettie Loudenslager, Manager, Weather Systems, AJW-1440 entitled “Ongoing Approval of Stand Alone and Backup Weather Equipment for Federal Contract Towers, Non-FAA Control Towers and Other Aviation Facilities”. The installation of all associated instruments, data transmitter and receiver/display, steel mast, foundation and the provision of conduit, wire and all incidentals shall be completed by the Contractor, as required, to provide a complete and operating system. The Contractor shall provide power supply in accordance with the Electrical requirements specified in the Contract Documents.

The Contractor shall furnish and install two (2) sets of Wind Directional and Wind Speed Indicators and a remote sensor to provide backup wind velocity and direction information to the airport traffic controllers in the new ATCT. Its manufacture shall be certified for use by the FAA and/or the National Weather Service. Currently, the FAA has conditionally approved the RM Young 05108 Heavy Duty Wind Monitor, the 85000 or 85004 Ultrasonic, the 05103, 05106 or 05305 Wind Monitor and 03002 Wind Sentry models. Also, conditionally approved is the F420C by the Electric Speed Indicator Co.

The indicators/displays must be able to accurately show the velocity and direction of the wind from a location representative of the airfield conditions. These indicators must be internally illuminated and mounted on the control tower cab console, one at each Local and Flight Data controller position. The Contractor shall install the sensor on top of a steel mast as shown on the project plans and as specified below. The sensor shall transmit data via its own RF radio link or microwave transmitter and antenna to a receiver mounted on the roof of the new control tower and connected to the indicators in the ATCT cab. Provision and installation of all associated instruments, sensor, data transmitter and receiver, power extension and outlet, conduit, wire, and incidentals shall be completed by the Contractor, as required to result in a complete and operating system.

21. Back-up Temperature and Dewpoint Indicators/Sensor

The Contractor shall provide two (2) FAA Approved Temperature / Dewpoint Indicators mounted on the control tower cab console, one at each Local and Flight Data controller position. The Temperature/Dewpoint sensor shall be installed on a steel mast in a grassed area along with the wind sensor as shown on the Contact Drawings. The Contractor shall provide power supply in accordance with the Electrical requirements specified in the Contract Documents.

RM Young 41382LC T/DP Sensor has been “conditionally accepted” by the FAA. Caution: Based on information available from RM Young’s web site, this sensor’s range of -50°C to +50°C does not meet the FAA temperature range criteria of -35°C to +55°C. The T/DP sensor must be mounted 5 ±1 feet above ground level. It must be located such that measurements are representative of the free air circulating in the area and not adversely influenced by artificial conditions such as nearby buildings, cooling towers and expanses of concrete or asphalt.

RM Young 46203 Temperature Tracker Display with hardwired connection to sensor and the RM Young 43408 Aspirated Radiation Shield have been “conditionally accepted” by the FAA. Make provisions regarding the hardwired connections between the sensor and the aspirated radiation shield in the field and the display in the tower cab shall be subject to the same surge protection requirements and practices as any other power, communication or data line entering

the control tower building. Note that the FAA conditional acceptance of these items is subject to change.

22. Backup Altimeter Setting Indicator/Sensor

The Contractor shall furnish and install two (2) Digital Altimeter Setting Indicators (DASI) in the control cab that are traceable to NIST standards. A calibration certificate shall be provided to the Owner. Two (2) display monitors shall be provided, one at each Local and Flight Data controller position, to show the airport barometric pressure reading. DASI shall have the capability to be calibrated to the ASOS reading. Its manufacture shall be certified for use as acceptable to the FAA. A Setra 370 has recently been deemed "conditionally acceptable" by the FAA. The mean sea level sensor elevation, not the pressure port elevation, must be determined to the nearest whole foot by a qualified surveyor or verified with the as-built ATCT building elevation. This location and elevation must be documented in a certified letter by the Installer to the Owner. In accordance with the current siting order, FAA 6560.20B, the sensor must be installed within 100 feet of the field elevation. The Gill 61002 Pressure Port (also known as the RM Young 61002 Pressure Port) is currently listed as "conditionally acceptable" by FAA and must be mounted outside, at least three feet above ground level. It must be located in an area free of vibration and rapid temperature fluctuations due to exhaust vents, etc.

The barometer must have a minimum operating range of 25 to 31 inches of mercury (in/Hg) in an operational range of 5 degrees C to 50 degrees C with the humidity at 0 to 80 percent non-condensing. The gauge must have a digital display of at least one (1) inch high and shall be mounted on the cab console or integrated with other sensor displays. Installation of all related cabling, drilling, caulking, and incidentals shall be completed by Installer.

23. Weather Sensor Mast

Provide a 30' tall freestanding, fixed, hot dipped galvanized and bonderized steel mast that shall be installed at the sensor site shown on the project plans. The mast shall be a Rohn 45G triangular section, self-supporting tower or approved equal. It shall be certified by a registered professional engineer as rated for an ultimate wind velocity of 105 mph (3 second gust, 2012 Virginia Construction Code, Risk Category 1) with ½" of ice. The mast shall be primed and painted in accordance with FAA criteria which is a six-band marking with alternating bands of aviation surface orange (beginning at the top) and white. Paint shall conform to FED-STD-595 as Orange #12197 and White #17875. An LED FAA L-810 obstruction light shall be placed at the top of the weather sensor mast as shown on the Contract Drawings.

The mast shall be provided complete including excavation, backfill and compaction, site restoration, a reinforced concrete foundation including imbedded conduits, stone dressing around the foundation and a concrete north marker with brass disc. The Contractor shall provide power supply in accordance with the Electrical requirements specified in the Contract Documents.

24. Master Time Code Generator

The Installer shall furnish and install one (1) digital 24 hour format master time code generator in the control cab. Time code generator shall be integrated into the voice recorder to synchronize all time on audio recordings. The digital time readout shall appear on each of the voice switch displays in the control cab. The master time code generator shall be GPS synchronized through a RS 232 serial port for output data. Installation of all associated cabling,

gauges, and other required components shall be completed by the Installer. Provide ESE 101, Spectracom 9283, or an approved equal.

The 24 hour digital display shall be a light emitting diode (LED) display or liquid quartz with internal illumination. The digital clock display (such as Spectracom TimeView 210W or approved equal) shall be installed in a central unobstructed location between the Local and Ground controller positions having green or red LED digits that are a minimum of 2 inches high for minutes and 1 inch high for seconds.

25. Signal Light Gun

The Installer shall furnish and install one (1) new cordless, rechargeable, signal light guns with charger, spare battery and two desktop holders to perform visual ground to air communications. This equipment shall be manufactured by SLG LED or DME P/N 401200 or equal. This equipment shall meet FAA standards in order to facilitate ground to aircraft communications and operations in the event that the control tower and/or aircraft radio communications become inoperative.

26. Task Lighting

Furnish and install eight (8) LED desktop lampsets with an 18 inch gooseneck, two (2) at each of three (3) controller positions plus on the supervisor's desk. Exact locations shall be confirmed on the job with the Air Traffic Manager and the Engineer, as approved.

Lampsets shall have a three-way rotary switch which enables the user to toggle between a white light and red light output and an off position. Each lampset shall be dimmable and have a minimum 48-inch cord set. Provide LED task lighting by Littlite, LLC, Hamburg, MI, sales@littlite.com or an approved equal.

27. Racks and Misc. Supplies

The Installer shall provide two (2) new standard industry powder coated steel or aluminum equipment racks for the installation of all new and relocated equipment as required by this section of these specifications. The racks shall be 22.5 inches wide, 24 inches deep and a minimum of 72 inches in height. They shall meet EIA-310 standards and be painted black. Other miscellaneous supplies such as power strips, grounding, related hardware, cable, conduit, connectors, labels, etc. required to provide a complete and usable unit shall be considered incidental to an operating and approved installation. Provide racks as manufactured by the BUD Industries, Willoughby, OH or an approved equal.

28. Binoculars

The Contractor shall furnish three (3) sets of Permafocus 7 X 50 (or higher) power binoculars as manufactured by Bushnell or other approved source.

29. Flight Data Bays and Aircraft Counters

The Contractor shall furnish and install all necessary hardware for the organization of flight data strips to accommodate two (2) controller positions (Local and Ground). Each bay combine two (2) sets of 10 strip positions (2 X ten (10) white plastic holders for flight data strips). Provide 60 FAA Type 4 plastic strip holders.

The Contractor shall provide two (2) new aircraft counters, seven (7) counting places minimum, to allow the recording of traffic operations at the airport. Provide as manufactured by the Denominator Company, Woodbury, CT or an approved equal.

30. Commercial Grade Chairs

The Installer shall furnish and deliver four (4) new industrial quality, intensive use chairs for the airport traffic controllers. All chairs must have the following features:

Five leg metal base with a minimum diameter of 25”
Minimum of 5 - 2” caster wheels for carpeted floors
Seat height adjustment for three (3) chairs – Low Stool (min of 17” and maximum of 22”)
Seat height adjustment for one (1) chair – High Stool (min of 20” and maximum of 28”)
Backrest (approximately 19” wide x 16” high) with tension control
Arm rests (approximately 7” to 8” high from seat)
Material shall be Electrostatic Discharge type (ESD) including discharge chain below

The color of the chairs shall be coordinated with the color scheme of the control cab. Final determination shall be by the Owner. Chairs provided shall be manufactured by Bench Depot, Phoenix/Domore, or approved equivalent.

31. Transparent Cab Window Shades

The Contractor shall furnish and install ATC window shades for all glazing in the control tower cab. One shade roller shall be installed at each of eight (8) sides of the control cab. That is, one shade shall span the entire window, across and over the center curtainwall mullion, from structural column to structural column. Shade pockets shown on the architectural drawings are intended to accommodate a second roller at each location, if required in the future.

On sides requiring only one roller each, they shall be placed in the position closest to the window leaving enough space for a second future roller. The shade material shall closely follow the same incline as the cab glass in the down position. A wooden nailer board painted flat black shall be provided by the Contractor for the full length of each shade pocket for the shades to be securely and evenly screwed into. Only manufacturers and installers experienced with control tower installations shall be allowed to furnish and install cab window shades. Provide a list of prior experience with the material submittal.

The window shade materials and installation tolerances shall meet or exceed FAA E-2470b. Window shades shall be adjustable and have a scratch resistant surface on cord drawn rollers. Installation of window shades shall be coordinated on-site with the Air Traffic Manager and approved by the Engineer. Any operational defects, deviations from tolerances or optical distortion shall be cause for rejection. Provide ATC transparent cab window shades by Solar-Screen Co., Inc. of Corona, NY, Plastic-View of Simi Valley, CA or an approved equal.

32. Crash Alarm & Red Telephone System (CARTS)

The current crash phone in the existing control cab connects to the Airport Rescue and Fire Fighting (ARFF) Station. The CARTS shall be used to alert the ARFF Station when an incident occurs on the airfield by use of a dedicated red telephone in the control cab. The alarm function and connectivity shall duplicate the existing condition. The line shall be activated immediately

upon pick up of the receiver without dialing any numbers in order to provide a dedicated intercom system that will allow direct audio communication between the Controllers and the ARFF Station. The red phone in the ATCT shall not have a flashing light. The CARTS shall also provide an interface to the Recording and Playback System to allow recording of all voice communications between the users. The CARTS phone shall be a desk model as manufactured by Viking Electronics, Inc or an approved equal.

The city of Lynchburg IT Department will order the new telephone line with the telephone company. The Contractor shall provide the red phone, cabling and outlet in accordance with the Contract Documents for the new ATCT as well as be responsible for notifying the city IT Department, through the Owner's Representative, of when the building phone system will be installed and ready for this connection.

33. Cutover Requirements

"Cutover" from existing equipment to new equipment shall be carefully planned and coordinated in order to maintain safe and continuous operation of airport traffic control.

a. The Contractor shall make all required provisions to prevent impact to flight operations during control tower transfer from the existing equipment to the new replacements.
b. The Contractor shall coordinate all activities with the Owner and the Air Traffic Manager prior to and during the cutover. A pre-cutover meeting shall be scheduled at least 48 hours before the scheduled activity.
c. The existing equipment shall stay on-line and operable until all new systems are in place, tested and ready for operation as the primary equipment.
d. The Contractor shall perform the cutover during the hours of tower closure (2230 to 0630) and remain on-site for the first day of operation to provide whatever assistance and/or troubleshooting is required.
e. The Contractor shall provide an equipment cutover plan to the Owner and Engineer for review and consideration at least 14 days prior to the planned cutover date.

<u>The Cutover Plan shall address:</u>

- Submit a written equipment replacement plan that shall maintain control tower operational requirements and will dovetail into the FAA's cutover plan.

- Submit a list of all ATC equipment and incidentals to be replaced, removed, or relocated.

- Confirm critical equipment items necessary to maintain ATC operations.

- Confirm that all work will be done during tower off-hours and make written request for any required deviations.

- Develop a strategy and schedule that mitigates impact to ATC operations and coordinate this with all concerned parties including FAA.

- Verify operational capability after equipment replacement ~ Immediately identify and correct deficiencies, if any are encountered.

34. Warranty

The Contractor shall provide a minimum (1) one-year warranty on all installation work to include all labor, hardware, software, communication components, voice switchgear, and all related work completed throughout the facility. Any damage caused by natural causes (very high winds, lightning strike, etc.) or other construction trades are understood to normally void warranty conditions for labor. All equipment shall be provided with written one (1) year warranties from their manufacturers, except that the main radio transmitters/receivers shall carry a (3) three-year warranty on hardware. When repair is needed, Owner will be responsible for customary shipping charges back to the factory.

35. Training & Orientation

The Contractor shall schedule and provide a training session to the ATC controllers and the Owner's maintenance personnel at the completion time of the installation. Completion of this session shall be documented by the Contractor with the Owner, attendees, and specific equipment manufacturers, as required. A separate visit by the Contractor's Installer shall be made within the first 30 days after FAA Commissioning to provide an inspection and adjustments of the electronics performance, as required.

Sufficient written documentation shall be provided by the Contractor in order for the Owner and controllers to independently operate and maintain the equipment included in this specification. Documents shall include all owners' manuals, schematics, diagrams, as-built conditions, and any other related materials.

36. MEASUREMENT AND PAYMENT

Payment shall be made at the lump sum price bid for all work provided in this Section. The lump sum price bid shall include all materials, labor, equipment, submittals, shop drawings, warranties, transportation, testing, incidentals, and services required to install the equipment and satisfy the overall requirements for a new and operational Air Traffic Control Tower (ATCT) at the Lynchburg Regional Airport per this Section, the Contract drawings, and all other contract specifications and provisions.

Payment will be made per Pay Item 275000-1 ATC Equipment Package – Per Lump Sum

END SECTION 275000

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SECTION 283111 – DIGITAL ADDRESSABLE FIRE ALARM SYSTEM

PART 1 - GENERAL

1.1 SCOPE

A. This specification provides the requirements for addressable analog multiplexed voice notification type networked fire detection system. The system shall include but not be limited to:
1. Control panel.
2. Annunciator Panel
3. Tone alarm.
4. Alarm initiating devices.
5. Alarm notification devices.
6. Conduit and wire.
7. Accessories required for complete certified operating system.
8. Shutdown of air handling units.
9. Interface with building automation (BAS) and building security system.

B. The contractor shall be responsible for obtaining the required permits and approvals of the local AHJ and shall provide all required modifications at no expense to the owner.

C. Related work in other sections:
1. Section 142100 – Electric Traction Elevators

1.2 REFERENCES AND STANDARDS

A. The complete equipment and installation of the system shall comply with the latest edition of the following references and standards.
1. NFPA 70 – National Electric Code (NEC).
2. NFPA 72 – National Fire Alarm Code.
3. NFPA 101 – Life Safety Code.
4. IBC – International Building Code.
5. ANSI/ASME A17.1 – Safety Code for Elevators and Escalators.
6. American Disabilities Act (ADA).
7. UL 268 – Standard for Smoke Detectors In Fire-Protective Signaling Systems.
8. UL 864 – Standard for Control Units for Fire-Protective Signaling Systems.
9. UL 1971 – Standard for Signaling Devices for the Hearing-Impaired.

1.3 SUBMITTALS

A. SHOP DRAWINGS: The Contractor shall submit shop drawings within ninety (90) calendar days after award of the type, size, rating, style, catalog number, manufacturer's names, and catalog data sheets for all items to ensure compliance with these specifications. This equipment shall be subject to approval of the engineer and no equipment shall be ordered without this approval. Equipment devices are shown on the Contract drawings. Provide shop drawings as follows:
1. Complete one-line riser diagram showing all equipment and the size, type and number of all conductors.
2. 1/8" scale floor plan drawings showing all devices, wiring and conduit. Clearly indicate interface with other systems.
3. Scale drawings of the fire alarm panel.
4. Scale drawings of typical multiplexed field panel.
5. Drawings and drawing modifications required for permit.
6. Provide calculations to support the size of standby batteries submitted.
7 Provide calculations to support wire sizing requirements.

8 Include programming and installation manuals.

B. Contract Closeout Submittals ("As Builts"):
1. Deliver two (2) copies to the Owner's representative within thirty (30) days of date of substantial completion and acceptance.
   a. Installation and programming manuals covering the installed system with electronic copy of all software.
   b. Point to point diagrams of the entire system as installed. Number all conductors to show all terminations and splices.
   c. The application program listing for the system as installed at the time of acceptance.
   d. Name, address and telephone of the authorized factory representative.
2. The Contractor shall provide signed written documentation certifying that the system meets all applicable codes and standards for the application.

C. Operation and Maintenance Manuals: For fire-alarm systems and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 1 Section "Operation and Maintenance Manuals," include the following:
1. Comply with the "Records" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.
2. Provide "Record of Completion Documents" according to NFPA 72 article "Permanent Records" in the "Records" Section of the "Inspection, Testing and Maintenance" Chapter.
3. Record copy of site-specific software.
4. Provide "Maintenance, Inspection and Testing Records" according to NFPA 72 article of the same name and include the following:
   a. Frequency of testing of installed components.
   b. Frequency of inspection of installed components.
   c. Requirements and recommendations related to results of maintenance.
   d. Manufacturer's user training manuals.
5. Manufacturer's required maintenance related to system warranty requirements.
6. Abbreviated operating instructions for mounting at fire-alarm control unit.
7. Copy of NFPA 25.

D. Software and Firmware Operational Documentation:
1. Software operating and upgrade manuals.
2. Program Software Backup: On magnetic media or compact disk, complete with data files.
3. Device address list.
4. Printout of software application and graphic screens.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Personnel shall be certified by NICET as fire-alarm Level IV technician, trained and certified by the fire alarm manufacturer for installation of units required for this Project

B. Installer Qualifications: Installation shall be by personnel certified by NICET as fire-alarm Level IV technician.

C. Source Limitations for Fire-Alarm System and Components: Obtain fire-alarm system from single source from single manufacturer.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

1.5 WARRANTY

A. The Contractor shall warranty all materials, installation and workmanship for one (1) year from the date of substantial completion and acceptance.

B. All equipment shall be warranted for three (3) years the date of substantial completion and acceptance

1.4 CIRCUITING GUIDELINES FOR SYSTEM

A. All system sensors (ion / photo / thermal) shall be of addressable analog type for connection to an "intelligent loop." Although each individual device point number and message shall be displayed on the fire alarm panel's LCD, the initiating devices shall be zoned as follows to provide the appropriate indication.
1. Manual Fire Alarm Stations: Provide 1 alarm initiating zone per device.
2. Area Smoke / Thermal Sensor: Provide 1 alarm initiating zone per device.
3. Duct Detectors: Provide 1 alarm initiating zone per device.
4. Water Flow Switches: Provide 1 initiating zone per device.

B. Alarm notification devices shall be circuited as follows: Audio devices and strobes: Provide a minimum of 2 circuits per area connected so that adjacent audio devices are not on the same circuit, and the loss of one circuit will not impair the operation of remaining circuits.

PART 2 - PRODUCTS

2.1 EQUIPMENT MANUFACTURERS

A. All reference to pertinent information herein is supplied to establish minimum standards of performance, function and quality.

B. Acceptable manufacturers shall be engaged in the manufacture of multiplex point addressable and intelligent fire alarm systems for a minimum of 7 years and have a fully equipped, factory trained authorized service organization within 75 miles.

C. All equipment shall be new, unused and UL listed. All components and systems shall be designed for uninterrupted duty. All equipment, materials, accessories, devices and other facilities covered by this specification or noted on Contract drawings and installation specifications shall be the best suited for the intended use and shall be provided by a single manufacturer or if provided by different manufacturers, recognized as compatible by both manufacturers. Acceptable manufacturers are:
1. Gamewell / FCI Inc.
2. GE Security / EST.
3. Honeywell Fire Systems / Notifier.
4. Siemens Building Technologies, Inc

2.2 MAIN PANEL COMPONENTS

A. Provide all additional components required to accommodate the expansion of the existing main panel, including providing additional sub-panels, amplifiers and other components.

2.3 POWER SUPPLIES

A. Description: The power supply/charger provides the means of automatically supplying 24 VDC operating and emergency power to the system. The power supply shall be capable of

powering up to 3 control modules simultaneously. The power supply shall be a minimum of 80 percent efficient, switch mode solid state design, with built in maximum transient protection (up to 6 kV) including UL recognized EMI filter, spark gaps, tranzsorbs and varistors. The power supply shall provide adequate amperage outputs of usable, fully regulated, power limited 24 VDC to operate listed signaling devices. The power supply shall provide diagnostic LEDs to notify the operator upon AC power and/or the control unit CPU failure. The power supply shall contain brown out, low battery detection, system ground fault detection when connected to the network master and shall be capable of recharging the gel electrolyte nonmaintenance type battery to full capacity. Upon AC power failure, the power supply shall automatically transfer the system to battery backup to provide 4 hours of supervised operation. The battery charger may be disabled to provide additional auxiliary output power if required. The power supply / charger shall be used as remote auxiliary power for remote zone panels and may be mounted in any standard cabinet listed above.

B. Features:
1. High efficiency magnetic field switch mode design.
2. Completely power limited.
3. 100 percent fully regulated power supply.
4. Primary power (AC) presence monitor.
5. Automatic / demand battery charger circuit.
6. DC amperage outputs with electronic current limiting.
7. All conditions monitored and displayed.
8. Ground fault detection circuit.
9. Battery monitor circuit; hi/lo voltage and open.
10. Lead acid compatible.
11. Battery charging to full capacity.
12. Instant transfer to battery upon thermal overload.
13. Relay outputs for alarm, trouble, supervisor condition.
14. Dedicated output for distributed amplifiers.
15. Transient protected to 6 kV.

2.4 INTELLIGENT / ANALOG POINT ADDRESSABLE SYSTEM COMPONENTS

A. Description Intelligent Loop I/O Card (DIL): The DIL shall plug into 1 slot in the controller and serve as the interface between the controller and the addressable intelligent analog sensors and single and multizone I/O modules. The DIL is capable of supporting and providing positive point identification for intelligent sensors and I/O modules or multizone I/O modules or may be intermixed. The DIL contains its own dedicated resident Central Processor Unit (CPU) and shall provide power, process, store, control and communicate with sensors and I/O modules via a minimum 18-gauge twisted pair cable up to a maximum of 5,000 feet on copper lines. The controller through the card shall provide for sensitivity adjustment and alarm verification by point, process the analog values from all intelligent devices on its loop and determine normal, alarm and trouble conditions. The intelligent loop returns to the DIL and if a single conductor breaks in the loop, the system shall continue to detect any alarm condition. Communication with devices or addresses shall be performed every 4 seconds or less. The average time to detect an alarm shall be 3 seconds or less. The polling time for the system shall remain the same regardless of the number of intelligent loops in the system.

B. Intelligent Peripheral Requirements: Provide intelligent analog smoke and thermal sensors as shown. Intelligent analog sensors shall represent the latest in sensor technology. All intelligent sensors, single I/O modules, and multizone I/O modules shall communicate with the DIL card over 2 wires (twisted pair). The address shall be dialed at the sensor by the

installer using the rotary switches located in the sensor base, head or module. All intelligent analog sensors shall be interchangeable, ceiling mountable and shall use common twist-lock bases. All sensors shall provide dual alarm LEDs. Both LEDs shall flash under normal operating and communication conditions, and both LEDs shall illuminate at steady state when the sensor's sensitivity level (analog value) exceeds the predetermined limit and commands from the control panel place the sensor into the alarm state. All sensors shall include a test means, whereby the sensor's actual analog value and the number of times the sensor has entered the alarm verification mode shall be vectored to a hard copy printer, or by locally activating the sensor's internal magnetic switch. Activating the sensor remotely by a control panel command without the control panel being in other than the test mode, shall not be allowed. When the sensors reach a predetermined sensitivity, the network master shall automatically display a maintenance alert message. All single I/O modules shall contain an alarm LED that shall flash during normal operation and communication and shall go to a steady state when commanded by the control panel that an alarm or supervisory value has been detected.

C. Intelligent Ionization Sensor: The intelligent ionization sensor shall be easy to install into a twist-lock base. The sensor shall incorporate a built-in type identification so the system can identify the type of sensor. The sensor shall be continually monitored to measure any change in their sensitivity because of the environment (dirt, smoke, temperature, humidity, etc.). The sensor shall use the ionization principle to measure products of combustion. The sensor shall provide advanced indication of the analog value of the products of combustion to the control panel that maintenance is required, thus reducing the maintenance required to inspect routinely all sensors, in order to ensure normal operation. The sensor sensitivity shall be adjustable per device (within UL limits).

D. Intelligent Photoelectric Sensor: The intelligent photoelectric sensor shall be easy to install into a twist-lock base. The sensor shall incorporate a built-in type identification so the system can identify the type of sensor. The sensor shall be continually monitored to measure any change in their sensitivity because of the environment (dirt, smoke, temperature, humidity, etc.). The sensor shall use the photoelectric principle to measure smoke density and shall on command from the control panel, send data to the panel representing the analog value of the smoke density. The sensor shall provide advanced indication of the analog value of the level of smoke density to the panel that maintenance is required, reducing the maintenance required to inspect routinely all sensors, in order to ensure normal operation. The sensor sensitivity shall be adjustable per device.

E. Intelligent Beam-Type Smoke Detector: Each detector consists of a separate transmitter and receiver with the following features:
1. Adjustable sensitivity over a 6-level range, minimum.
2. Linear Range of Coverage: 600 feet (183 m), minimum.
3. Tamper switch initiates trouble signal at the central FACP when either transmitter or receiver is disturbed.
4. Separate color-coded LEDs indicate normal, alarm, and trouble status. Any detector trouble, including power loss, is reported to the central FACP as a composite "trouble" signal.
5. Provide intelligent monitor module for fully addressable system.

F. Intelligent Thermal Sensor: The intelligent analog thermal sensor shall be easy to install into a twist-lock base. The sensor shall incorporate a built-in type identification so the system can identify the type of sensor. The sensor shall be continually monitored to measure any change in their sensitivity because of the environment (dirt, smoke, temperature, humidity, etc.). The sensor shall use dual solid state thermistors and shall monitor the ambient temperature from -10 degrees C, to +60 degrees C and provide a fast response to rapid increases in

temperature. The sensor on command from the control panel shall send data to the panel representing the analog value of the ambient temperature.

G. Intelligent Monitor Module: The intelligent monitor module shall be used to connect supervised conventional initiating device or zone of supervised conventional initiating devices (water flow switches, tamper switches, manual pull stations, 4 wire smoke detectors, conventional 4 wire duct detectors, etc. to one of the 2 wire intelligent analog loop cards. The intelligent monitor module shall mount in a 4-inch square, 2-1/8-inch deep electrical box and shall be capable of Class "A" or "B" supervised wiring to the initiating device. In order to maintain proper supervision, there shall be no T-taps allowed on Class "A" lines. The intelligent monitor module shall mount behind the manual station in a single gang electrical box. The monitor module shall provide address setting means using rotary decimal switches and also store an internal identifying code which the control panel shall use to identify the type of device. The monitor module shall contain an integral LED that flashes each time the monitor module is polled.

H. Intelligent Control Module: The intelligent control module shall be used to connect and supervise conventional indicating device or zone of indicating devices that require an external power supply, such as horns, strobes, bells, speakers or telephones to one of the 2 wire intelligent analog loop cards (Class "B"). The control module shall be capable of operating as a relay (dry contract form C), to control door holders, air handling units, etc. The intelligent control module shall mount in a 4-inch square, 2-1/8-inch deep electrical box and shall be capable of Class "A" or "B" supervised wiring to the indicating or control device. The control module shall contain an integral LED that shall flash each time the module is polled. The control module shall provide address setting means using rotary decimal switches and also store in internal identifying code which the control panel shall use to identify code which the control panel shall use to identify the type of device.

I. Isolation Module: The isolation module shall be an automatic switch, which will open when the intelligent loop voltage drops below 4 volts. The isolator module shall be placed between groups of sensors/intelligent modules on the loop in order to protect the intelligent loop if a short (less than 4 volts) should occur. If a short occurs between any 2 isolators, then both isolators switch to an open circuit condition and isolate the group of sensors /modules between them. The remaining devices on the intelligent loop shall continue to operate and communicate normally. The number of devices between isolators shall be 25 or less. The isolator shall be designed to mount in a 4-inch square, 2-1/8-inch electrical box.

J. Duct Detector: Duct detector shall be intelligent ionization sensor with suitable housing and sampling tubes designed for duct mounting. The sampling tubes shall be installed across the width of the duct in the air system. The detector shall be provided with contacts for associated air handling unit shut down and remote alarm indication. Detector shall include auxiliary relay with contacts for alarm annunciation to the Division 15 direct digital control (DDC) system and to a remote alarm indicator. Duct detectors shall be supplied with LED-type remote alarm indicators.

2.5 PERIPHERAL EQUIPMENT

A. Manual Stations: Provide manual station as shown, the single action manual station shall be of the noncoded type with terminals and contain an internal toggle switch. The red manual station shall be constructed of rugged aluminum with a key reset switch for positive resetting action and shall be available with an optional break glass rod. The manual station shall mount to a standard single gang switch box.

B. Alarm Indicating Devices:

1. General: Equip alarm indicating devices for mounting as indicated. Provide terminal blocks for system connections.
2. Alarm speakers shall be UL listed, suitable for flush mounting in wall box. Provide cover grille with red finish. Unit shall have a minimum rating of 2 watts with a minimum sound rating of 85 dbA at 4 feet when tapped at 1/4 watt. Provide line matching transformer to match amplifier output (25 volt line) with taps for 1/8, 1/4, 1/2, 1, and 2 watts. Minimum frequency response 300 Hz. to 10,000 Hz. Unit to have double projector attachment if shown on the plans.
3. Visual Alarm Signals: 24 V d.c. strobe lights utilizing high intensity, clear, optic lens and xenon flash tube. Provide luminaires having their lenses mounted on an aluminum face plate. Provide the word "FIRE" engraved in minimum 1-inch high letters displayed on the unit. Provide strobe lights complying with UL 1971 standard "Signaling Devices for the Hearing Impaired," 1994 edition.
4. Combination Signals: Provide factory-combined audible and visible alarm units of type indicated in a single mounting unit where indicated. Combination units shall be wired such that the alarm initiating circuits are separate for audio and visual devices.

2.7 REMOTE DEVICE LOCATION-INDICATING LIGHTS AND IDENTIFICATION PLATES

A. Description: An LED-indicating light in the vicinity of each sprinkler water-flow switch and valve tamper switch denotes the associated device is in an abnormal or trouble mode. Lamp is flush mounted in a single gang wall plate. A red, laminated, phenolic-resin identification plate at the indicating light identifies, in engraved white letters, the room where the valve is located or the protected spaces downstream from the water-flow switch.

2.8 MAGNETIC DOOR HOLDERS

A. Description: Units are equipped for wall or floor mounting as indicated and are complete with matching door plate. Electromagnet operates from a 120-V ac source and requires no more than 3 W to develop 25-lbf (111-N) holding force.

B. Material and Finish: Match door hardware.

2.9 GRAPHIC COMMAND CENTER

A. Provide computer graphic work station for F.A. System

2.10 FIRE ALARM AND PROTECTIVE SYSTEM SEQUENCE OF OPERATION

A. General Requirements: The network master shall support addressable / analog sensors and modules as well as traditional initiating and indicating circuits simultaneous intermixed in any controller. In the sequence of operations described below, an indicating circuit may be traditional Class "A" or "B" or addressable module configured Class "A" or "B." In the description below, a signaling circuit (horns, strobes, speakers or emergency telephone) may be a traditional Class "A or "B" or an addressable module configured Class "A" or "B." Initiating circuits used for manual stations, waterflow, tampers, 4 wire duct detectors, etc., shall be addressable I/O modules or traditional Class "A or "B" circuits.

B. Sequence of Operation: The operation of a manual station or activation of any area smoke detector, elevator smoke detector, duct smoke detector, thermal detector, sprinkler waterflow switch, or any automatic alarm initiating device shall automatically:
1. Sound all speakers throughout the building. Provide selection of alarm tone or pre-recorded digitized voice record system activation by Owner.
2. Flash all alarm lights/strobes throughout the building. Silencing the alarm devices (audible circuit) shall not automatically turn off flashing alarm lamps / strobes.

3. Initiate the transmission of an alarm to central station selected by the Owner or his representative. This section, its fees and fees for any telephone lines are the sole responsibility of the Owner or his representative.
4. Visually indicate the control panel LCD and graphic display screen device or the circuit of alarm initiation. When the control panel goes into the alarm condition the (green) normal LED shall extinguish the (red) alarm LED shall light, the buzzer shall pulsate and the display LCD shall indicate the real time, the number of messages waiting, the type of alarm, the alarm zone number, the time that the alarm occurred, and shall display the user specified message. In order to reduce false alarms, all inputs shall be capable of alarm verification (analog / addressable, traditional, I/O modules). The system shall be capable of setting the sensitivity of all analog sensors by point and be capable of displaying the analog value of the sensor by device and/or traditional input and vectoring the value to the printer. The system shall automatically identify any analog sensor which becomes dirty (maintenance alert) prior to false alarming.
   a. The operator shall acknowledge that alarm by pressing the acknowledge button, and the buzzer will silence providing there is not an additional alarm pending. If there are additional alarms waiting, the operator shall acknowledge all pending alarms before the buzzer will silence. To silence audible devices, the operator shall press the alarm silence button, a new alarm shall cause the audibles to resound. To reset the system, the operator shall press the reset button.
5. Print a record of alarm on the system printer by time, alarm zone or device number, alarm type and the use specified message. All restorations shall likewise be recorded, except the user specified message shall not be repeated.
6. Operate prioritized outputs to release all magnetically held smoke doors and magnetically locked doors throughout the building.
7. Operate prioritized output to release Type 3 series access control doors as indicated on the drawings.

C. Activation of a supervisory condition such as a sprinkler valve tamper switch:
1. Display on the control panel LCD and graphic display screen the zone or the addressable device from which the off normal (active point) condition was initiated. During the supervisory condition, the amber supervisory LED shall light, the normal LED shall go out, and the buzzer shall pulsate. The LCD shall indicate ("SUPERV.SHORT") and the zone/device number. The operator shall silence the buzzer by acknowledging all messages and pressing the trouble silence button.
2. Operate the prioritized output to initiate transmission to the central station.

D. Fire pump power failure, including a dead phase or phase-reversal condition, causes or initiates the following:
1. A supervisory, audible, and visible "fire pump power failure" signal indication at the FACP and the annunciator.
2. A printed record of the event on the system printer.
3. Transmission of trouble signal to remote central station.

2.11 WIRING

A. Wiring shall comply with NFPA 72. Where required, 2-hour fire rated circuit integrity cable listed to UL 2196 shall be used.

PART 3 - EXECUTION

3.1 INSTALLATION

A. The entire system shall be installed in a workmanlike manner in accordance with approved manufacturers manuals and wiring diagrams. The Contractor shall furnish all conduit, wiring, outlet boxes, junction boxes, cabinets and similar devices necessary for the complete installation. All wiring shall be of the type recommended by the NEC, approved by local authorities having jurisdiction for the purpose, and shall be installed in dedicated conduit throughout (maximum 40 percent fill for conduits).

B. All penetration of floor slabs and fire walls shall be fire stopped in accordance with all local fire codes.

C. End of Line Resistors: Shall be furnished as required for mounting as directed by the manufacturer.

D. All wiring shall be color coded throughout, and shall be in conduit to NEC standards and a minimum of No. 14 AWG, unless otherwise noted.

E. Field Quality Control: The system shall be installed and fully tested under the supervision of trained manufacturer's representative. The system shall be demonstrated to perform all the functions as specified.

F. All outlet boxes, pull boxes and junction boxes shall be painted red on the exterior and shall be installed in accordance with specification Section 260534.

G. Cable for RS 232-C devices (CRT, printer) shall be dual pair twisted-shielded installed in conduit.

H. Provide 1/2-inch conduit from control panel to nearest telephone terminal backboard with remote alarm conductors and trouble conductors.

I. Provide wiring and conduit for connection to all sprinkler flow switches, tamper switches and fire pump system.

J. Provide wiring and conduit for connection of lobby detectors to elevator control systems for all the elevators (3).

K. Provide wiring and conduit for duct mounted smoke detectors to shut down their respective air handling units.

L. Provide wiring and conduit to fire pump controller for monitoring per NFPA 20 requirements.

M. Fire alarm control panel shall be connected to a separate dedicated emergency power branch circuit, maximum 20 amperes. Circuit shall be labeled as "fire alarm." Provide point of use 30 minute minimum UPS for all fire alarm system panels.

N. Contractor shall provide the Owner with two "spare" detectors for each type installed. These units shall be in their original factory packaging and shall clearly indicate manufacturer and model number.

O. Elevator control circuits shall be provided for shutdown and recall. Provide wire and conduit to each elevator controller.

3.2 DUCT-MOUNTED DETECTORS

A. Sampling tubes shall be factory drilled with the number and size of holes required for duct size.

B. Sampling tubes shorter than 48 inches shall be supported at the remote end by a support mounted on inside of the duct. Tubes longer than 48 inches shall be supported with a "V" bracket or strap hanger. Supports shall not cover any holes in sampling tubes. Remote end of tubes shall not penetrate opposite duct walls. Relief tube shall extend a minimum of 2 inches beyond any internal insulation or duct wall.

C. Duct access panels, as specified in Division 23, shall be provided at all locations where sampling tubes are installed.

D. Air Duct Velocity: Shall be checked on each duct detector and the reading included in the test report by the technician.

E. Provide smoke detectors in the air ducts indicated for each individual air-handling unit. Provide shutdown contacts for operation with air handling control circuit. Detector location shall be approved by local authority having jurisdiction and shall meet manufacturer's recommendations for correct operation. Detectors shall annunciate as an individual zone for each air handling unit.

3.3 DETECTOR INSTALLATION

A. Detectors shall not be installed until project is complete, painted and final cleaning has taken place. Detector used for testing or installed prior to final project cleanup will not be accepted for final installation.

B. Elevator lobby detectors shall have relay provisions for operation with elevator controls.

C. Detectors and alarms for elevator machine rooms shall be approved by local authority having jurisdiction. Contractor shall obtain approval of local Fire Marshal and elevator inspector prior to installation of equipment.

3.4 TESTS

A. Reports of any testing during installation shall be forwarded to the engineer.

B. Each individual system operation on a point basis shall be tested for its complete operation. Procedures for testing the entire fire alarm system shall be set forth with the consent of local authority having jurisdiction, the engineer and the manufacturer. A hard copy of the analog value of each initiating input/device (addressable point and traditional zone) shall be given to the engineer upon completion of system test. This copy shall be used as reference in future tests to determine sensor maintenance.

3.5 TRAINING

A. In addition to requirements 1.3.B Closeout Submittals, and a manufacturer's recommended spare parts list, the Contractor shall provide the services of the manufacturer's trained

representative for a period of 4 hours, during normal business hours, to instruct the Owner's designated personnel on the operation and routine maintenance of the system.

END OF SECTION 283111

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SECTION 310000 – GEOTECHNICAL DATA

A geotechnical exploration of existing conditions in the general area at the site of this project has been performed and reports of the findings and recommendations are bound herein behind this specification section.

“Geotechnical Investigative Engineering Report” dated May 20, 2015 prepared by Hurt & Proffit, Inc. is available only as information and as a convenience to the bidders and expressly not as a part of the contract documents.

Actual subsurface conditions which may be encountered in connection with this project may vary widely from the report described above, and any information or conclusions drawn from this report shall be at the bidder’s risk.

Neither Owner, Architect nor any of their respective consultants, agents and employees make any promise, representation or guarantee as to the accuracy of the geotechnical information made available herein.

END OF SECTION 310000

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Geotechnical Investigative Engineering Report

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Appendix G ..... Sieve Analysis Results
Appendix H ..... Expansion Index Analysis Results
Appendix I ..... Direct Shear Analysis Results
Appendix J ..... Unit Weight Results

May 20, 2015

HURT & PROFFITT
INCORPORATED

Mr. Nicholas Patternson, PE LEED AP
Aviation Engineer
RS&H
909 N Washington Street
Suite 300
Alexandria, VA 22314

Re: LYH Air Traffic Control Tower
Lynchburg, Virginia
Subsurface Geotechnical Investigation
Project No. 20140992

Dear Mr. Patternson:

Hurt & Proffitt, Inc. (H&P) has completed the requested subsurface investigation on the above referenced project. The investigation was initiated to evaluate existing site conditions and provide a geotechnical engineering investigative report.

This investigation encompassed the following scope of services:

1. Two (2) standard penetration test borings (SPT) in the area of the proposed tower pad.
2. Diamond bit rock coring completed at both SPT boring locations.
3. Four (4) Shelby tube sample collections and extractions.
3. One (1) California bearing ratio (CBR) analysis in accordance with VTM-8.
4. One (1) standard Proctor analysis in accordance with ASTM D 698.
5. Five (5) Atterberg limit analyses in accordance with ASTM D 4318.
6. Five (5) washed sieve analyses in accordance with ASTM D 1140.
7. Five (5) natural moisture analyses in accordance with ASTM D 2216.
8. One (1) expansion index analysis in accordance with ASTM D 4829.
9. Two (2) direct shear analyses in accordance with ASTM D 3080.
10. Four (4) unit weight analyses in accordance with ASTM D 2987.
11. Evaluation of ground water levels at the completion of the investigation.
12. Geotechnical engineering report preparation.

H&P appreciates the opportunity to complete this study for you. Should you have any questions in reference to this work or the site, please do not hesitate to contact us.

Sincerely,
Hurt & Proffitt, Inc.

J. Kenneth Meritt, P.G., P.E.
Director, Geotechnical and Materials Testing

attachments

COMMONWEALTH OF VIRGINIA
J. KENNETH MERITT
Lic. No. 049743
5/20/15
PROFESSIONAL ENGINEER

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LYNCHBURG VA 24501
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Lynchburg Regional Airport
Air Traffic Control Tower
Lynchburg, Virginia

1.0 PROJECT INFORMATION

Project plans are to construct a 5-story airport control tower. The proposed tower footprint measures 26 feet by 26 feet.

Construction will utilize pre-cast reinforced concrete load bearing panels. The maximum perimeter wall loads are estimated at 20 kips per lineal foot.

Finish Floor Elevation = 969.5 feet

2.0 SUMMARY OF FINDINGS

Prior to constructing the proposed tower structure, a moderate amount of site work will be required. Existing site elevations in the area of the tower footprint vary by approximately 5 feet; subsequently, some grading will be required to establish final subgrades. H&P personnel also observed multiple utilities located within the area which will most likely need to be relocated prior to construction. Any backfill related to the removal and relocation of utilities located within the tower footprint should be compacted to 98% of the material's maximum dry density as determined by a standard Proctor (ASTM D 698).

Based on the proposed finish grades and because of the sloping terrain, cut/fill excavations on the order of 3± feet are expected to achieve subgrade elevations across the site. All fill material should be tested and placed in accordance with the Earthwork and Grading section of this report on Page 4.

The on-site soils are primarily residual elastic silts (MH) and sandy silts (ML) that transition with depth to silty sands (SM). Bedrock was encountered at a depth range of 53 feet to 57 feet. The seasonal groundwater table was encountered at depth of 43 feet.

Based on the provided foundation loads, excessive settlements are likely to occur if the tower structure is supported on a conventional shallow spread footing foundation; subsequently, we recommend supporting the structure on a mat foundation or on a deep foundation system.

If a mat foundation is considered, the net bearing pressure should not exceed 2,000 psf. Also, the mat foundation should be placed a minimum depth of 6 feet below final exterior grades.

Based on the subsurface conditions, several options are available for a deep foundation system. Drilled shaft foundations (combination end bearing and skin friction) are an option and are discussed in further detail in Section 7 of this report. Steel H-piles or micropiles are other possible options that could be considered to support the proposed tower structure.

3.0 INVESTIGATIVE PROCEDURES

Subsurface conditions at the air traffic control tower site were analyzed by completing 2 standard penetration test (SPT) borings. Both borings were taken to the refusal. Please refer to the Test Boring Logs in Appendix C and to the Boring Location Plan in Appendix B for further details.

The test borings were performed in accordance with generally accepted practices with a trailer-mounted CME 45C rotary drill rig. Continuous flight hollow-stem augers were advanced to pre-selected depths, the center plug removed and a disturbed soil sample recovered with a standard split spoon sampler (1.375-inch I.D., 2.0-inch O.D.) in accordance with ASTM D 1586.

A weight of 140 pounds is freely dropped from a height of 30 inches to drive the sampler into the soil to be sampled; this is known as the Standard Penetration Test (SPT). The number of blows required to drive the sampler three consecutive 6-inch increments is recorded and the blows of the last two increments are added to obtain the Standard Penetration Resistance (N-value). The N-value is a measure of in-situ soil conditions and has been correlated with engineering properties of the soils for design purposes.

Hurt & Proffitt personnel placed soil samples in glass jars and transported them to the laboratory for geotechnical personnel to review and classify in accordance with the Unified Soil Classification System (USCS). These samples will be discarded after 90 days.

Upon auger refusal at each boring location, diamond bit rock coring was performed to verify the bedrock conditions. The percent recovery and rock quality designation (RQD) of the rock was measured, and the core samples were placed in wooden boxes and transported to our laboratory for further classification.

Four (4) Shelby tube samples were collected during the investigation. Laboratory soil classifications (Atterberg limits and grain size analyses) and unit weight analyses were completed on all of the tube samples. Direct shear analyses were completed on 2 samples from Borings B-1 (14'-16') and B-2 (19'-21').

One (1) composite bulk soil sample from the auger cuttings was collected from borings B-1 and B-2 (0'-5' depth range). A California bearing ratio (CBR), standard Proctor, Atterberg limit analysis, grain size analysis, natural moisture analysis, and expansion index analysis were completed on the bulk sample.

Measurements for potential ground water conditions and/or cave-in depths were recorded at the completion of each of the test borings. Refer to the Test Boring Elevation Datum table on page 3 for further details.

The test boring locations were staked in the field by others prior to H&P mobilizing on the site. The ground surface elevations were estimated from the topographic contours as shown on the site plan prepared by RS&H (May 11, 2015).

4.0 GEOLOGY/SUBSURFACE CONDITIONS

The underlying bedrock in the area of study consists of "Late Proterozoic" aged mica gneiss and schist that have been mapped as belonging to the Alligator Back Formation. The collected rock core samples are consistent with the mapped lithological units. Geographically, the site is situated in the Blue Ridge Anticlinorium Physiographic Province. The site is also located in the northwest quadrant of the USGS City Farm, Virginia Topographic Quadrangle.

The following soil profiles were encountered during the site investigation:

Boring B-1
0'-2' – Fill, Medium Stiff Elastic SILT (MH), SPT Avg "N" value = 6
2'-14' – Residual, Stiff to Very Stiff Sandy SILT (ML), SPT Avg "N" value = 22
14'-44' – Residual, Medium Dense Silty SAND (SM), SPT Avg "N" value = 17
44'-53' – Residual, Dense Silty SAND (SM), SPT Avg "N" value = 30
53'-56' – Schist Rock

Boring B-2
0'-2' – Residual, Stiff Elastic SILT (MH), SPT Avg "N" value = 9
2'-14' – Residual, Stiff Sandy SILT (ML), SPT Avg "N" value = 12
14'-24' - Residual, Loose Silty SAND (SM), SPT Avg "N" value = 11
24'-39' – Residual, Medium Dense Silty SAND (SM), SPT Avg "N" value = 23
39'-44' – Residual, Dense Silty SAND (SM), SPT Avg "N" value = 47
44'-54' – Residual, Very Stiff to Hard Sandy SILT (ML), SPT Avg "N" value = 34
54'-57' – Partially Weathered Rock (PWR), SPT Avg "N" value = 50/4"
57'-68' – Schist Rock

The residual soils have formed in place due to the decomposition of the parent rock underlying the site. A detailed description of the soil conditions is provided in the Test Boring Logs located in Appendix C of this report.

Weathered Rock or Partially Weathered Rock (PWR) are terms generally used when SPT blow count values exceed 50 over 6 inches. PWR material was encountered in boring B-2 at a depth of 54 feet.

The following table lists the test boring elevation datum.

TEST BORING LOCATION	GROUND ELEV.	ROCK DEPTH (ft)	ROCK ELEV.	TEST BORING DEPTH (ft)	BOTTOM OF BORING ELEV.	DEPTH TO WATER FROM GROUND (ft)	STATIC WATER LEVEL (SWL) ELEV.
B-1	970.0	53.0	917.0	56.0	914.0	42.7	927.3
B-2	966.5	57.0	909.5	68.0	898.5	43.0	923.5

The proposed tower site is located just southeast of an existing parking lot that borders the southeastern edge of the existing Lynchburg Regional Airport control tower. (Please refer to the USGS Map in Appendix A). Site drainage, based on the topographic conditions, is to the northeast.

The site is gently to moderately sloped and vegetated with grass. Elevations within the proposed construction limits range from 965 feet to 970 feet over a distance of approximately 70 feet. Utilities observed marked within or adjacent to the project limits included communications and electric. This notation is only intended to state what was observed by our on-site personnel and does not intend to imply that a full survey or research was performed to locate and/or determine presence of utilities. Full investigation should be performed by others to determine extent and nature of any/all utilities in the project area.

5.0 LABORATORY RESULTS

	Sample Location Boring B-1(14'-16')	Sample Location Boring B-1(19'-21)	Sample Location Boring B-2 (14'-16')	Sample Location Boring B-2 (19'-21)	Sample Location Boring B-1& B-2 (0'-5')
Sample Type	Shelby Tube	Shelby Tube	Shelby Tube	Shelby Tube	Bulk
Proctor Wet Density (pcf)	NT	NT	NT	NT	119.6
Proctor Dry Density (pcf)	NT	NT	NT	NT	98.0
Proct.Optimum Moisture (%)	NT	NT	NT	NT	22.0
In-Place Moist Unit Weight (pcf)	106.9	107.1	106.2	105.9	NT
In-Place Dry Unit Weight (pcf)	84.1	92.0	91.4	87.1	NT
Natural Moisture (%)	27.0	16.4	16.3	21.5	20.5
CBR Value (0.1")	NT	NT	NT	NT	2.4
CBR Value (0.2")	NT	NT	NT	NT	3.1
Atterberg Liquid Limit	48	43	47	46	48
Atterberg Plastic Limit	NP	NP	46	NP	36
Atterberg Plasticity Index	NP	NP	1	NP	12
Minus #200 Sieve (%)	46.7	40.0	39.6	30.6	69.1
Expansion Index Potential	NT	NT	NT	NT	Medium, 84
Direct Shear (friction angle, φ')	37.3	NT	NT	35.1	NT
Direct Shear (cohesion, c' - psf)	526	NT	NT	180	NT
USCS Classification	Sandy SAND - SM	Sandy SAND - SM	Sandy SAND - SM	Sandy SAND - SM	Sandy SILT - ML

Test Methods:

1. Standard Proctor Analysis — ASTM D 698
2. Unit Weight Analysis — ASTM D 2937
3. CBR Analysis — VTM-8, Modified
4. Moisture Content Analysis — ASTM D 2216

5. Atterberg Limit Analysis	ASTM D 4318
6. Washed Sieve Analysis	ASTM D 1140
7. Expansion Index Analysis	ASTM D 4829
8. Direct Shear Analysis	ASTM D 3080

6.0 EARTHWORK AND GRADING

Prior to the earthwork operations, a limited amount of clearing and grubbing will be required. Multiple utility lines and/or structures will also need to be removed and/or relocated.

After clearing the vegetation and prior to any fill placement, site preparation should begin with the removal of existing surficial organic soils and other deleterious materials. Following the stripping and grubbing operations, all fill areas should be compacted and proof-rolled in the presence of a qualified geotechnical representative. Proof-rolling should be completed with a loaded 20 to 30 ton truck or other approved equipment across the soil subgrade. During the proof-rolling process, it is recommended that a roller pattern be established that will maximize the densification of the subgrade prior to fill placement. Proof-rolling should be performed during good weather and not while the site is wet as a result of recent rain or snow. Areas that pump, rut, weave, or are otherwise determined to be unsuitable or unstable by the geotechnical representative, should be excavated and replaced as directed by the geotechnical representative.

Based on the existing grades and based on the proposed elevations, a limited amount of cutting and filling of soils will be required to establish final subgrades across the site. Maximum cut/fill depths are estimated at 3± feet.

Compacted structural fill for building areas, pavements, and utility trench backfill may be constructed using on-site soils or approved off-site borrow soils.

Suitable off-site borrow soils for this area generally includes non-cohesive soils and cohesive soils (low to medium plasticity) as defined by the Unified Soils Classification System (CL, ML, SC, or SM) which are free of organics or other deleterious materials.

We also recommend that fill materials have a minimum dry density of 90 pounds per cubic foot as determined by a standard Proctor (ASTM D 698).

Structural fill material under and within 15 feet of the building pad should be placed in horizontal lifts, with an 8 inch to 9 inch loose thickness, and compacted to at least 98% of the material's maximum dry density as determined by a standard Proctor (ASTM D 698).

Structural fill material for the foundation walls and material placed in slopes and parking areas should be placed in horizontal lifts, with an 8 inch to 9 inch loose thickness, and compacted to at least 95% of the material's maximum dry density as determined by a standard Proctor (ASTM D 698).

The following minimum density test frequencies are recommended:

1. Building pad – One compaction test per 1,000 square feet per lift, minimum 3 tests per lift.
2. Pavement Areas – One compaction test per 2,500 square feet per lift.
3. Slope and Retaining Wall Areas – One compaction test per 1,000 square feet per lift.
4. Utilities – One compaction test per 100 lineal feet per lift.

The site should be graded to provide positive drainage away from the proposed structures and not allow ponding of water on the building pads and pavement sections. A 2% slope across the site is recommended. On-site fill zones should be sealed prior to forecasted rain events using a smooth drum roller to promote drainage and to prevent ponding of storm water.

Excessively wet or excessively dry soils should not be used as fill materials unless the soils are properly dried or wetted to an acceptable moisture content. A moisture content range of plus 2% or minus 3% from the optimum moisture content of the fill material is recommended.

Excavations for footings within the prepared building pad should be made in such a way as to provide bearing-surfaces that are firm and free of loose, wet, or otherwise disturbed soils. If such deleterious materials are allowed to remain below the footing, settlement will increase. Concrete for footings should be placed the same day as the bearing surface is prepared to prevent softening due to overnight rain or other moisture. We recommend that all footing-bearing surfaces be observed and probed by qualified geotechnical personnel. The footing subgrades that do not achieve the allowable soil bearing capacity should be over-excavated to the depth and lateral limits recommended by the on-site geotechnical personnel. H&P recommends that the over-excavated material be replaced with a compacted dense graded aggregate (VDOT #21A or #21B size aggregate).

7.0 FOUNDATION DESIGN RECOMMENDATIONS

This section of the report provides recommendations for geotechnical design aspects of the proposed tower structure. The primary requirement in evaluating the most suitable foundation system for a structure is to determine the stratum on which the structure may be safely supported. This determination includes considerations with regard to the allowable bearing capacity of the strata, anticipated structural loads, and estimated settlement to be experienced by the proposed structure(s).

Based on the subsurface conditions and provided foundation loads (20 klf), excessive settlements are likely to occur if the tower structure is supported on a conventional shallow spread footing foundation; subsequently, we recommend supporting the structure on a mat foundation or on deep foundation system.

A mat foundation, if utilized, should be designed for net bearing pressure of 2,000 psf. The bottom of the mat should be placed at minimum depth of 6 feet below final grades. All foundation subgrades should be compacted using manually-operated vibratory equipment to promote densification of any loose or disturbed materials resulting from the excavation. Following the compaction operations, the foundation subgrades should be tested to ensure the 2,000 psf bearing capacity is achieved. We also recommend that the foundation subgrade be protected with a 3-inch thick mud mat of lean concrete.

In consideration of a deep foundation system, we recommend using drilled shaft piers for this project site. Based on the provided foundation loads and assuming a group of 9 piers, it is estimated that each pier would need to provide the capacity to support 230 kips. For a group of 12 piers, it is estimated that each pier would need to provide a capacity of 166 kips.

Based on the boring and laboratory results, H&P analyzed the capacities for 36-inch and 48-inch diameter piers. The following soil parameters were used in the analysis:

Boring B-1
Design Soil Parameters for Undrained Conditions

Soil Layer	Soil Layer Depth (feet)	Effective Unit Weight (pcf)	Undrained Shear Strength (ksf)	Lateral Earth Pressure Coeff. (k_s)	Internal Friction Angle (degrees)	Bearing Capacity Factor N_c (-)	Bearing Capacity Factor N_q (-)
Medium Stiff Elastic SILT	0-4	115	1	0.00	0	9	-
Stiff Sandy SILT	4-14	105	0	1.00	30	-	18
Medium Dense Silty SAND	14-24	110	0	1.00	32	-	23
Medium Dense Silty SAND	24-34	110	0	1.00	34	-	29

The following estimated capacities for 36-inch and 48-inch diameter shafts were calculated:

Diameter	Depth (ft)	Load (kips)	Uplift (kips)	F.S.
36-inch	30	186	120	2.5
36-inch	40	274	170	2.5
48-inch	30	306	160	2.5
48-inch	24	210	106	2.5

For the purpose of increasing the efficiency of the pile group, the recommended minimum center-to-center pile spacing for the group is 3 times the pile diameter.

7.1 FLOOR SLAB CONSTRUCTION

Floor slabs may be designed as slab-on-grade. A minimum 4" layer of stone should be placed beneath all grade slabs.

A vapor barrier should be used beneath the floor slab if an impermeable floor finish is applied to the floor. A vapor barrier may also be required if moisture sensitive equipment and/or moisture sensitive floor coverings are to be in direct contact with the floor. Vapor barriers can result in excessive curling of floor slabs during curing. For this reason, H&P recommends that the floor slab designer refer to ACI 302.1R-96, Sections 4.1.5 and 11.11 for further discussion associated with concrete shrinkage, curling, and the use of vapor barriers.

In order to minimize cracking due to settlement, it is recommended that the grade slabs be placed independent of wall footings. Isolation joints should be constructed around columns and along bearing walls to minimize cracking associated with minor settlement. Proper jointing for non-reinforced concrete should be completed to minimize cracking. Joint spacing, as suggested by ACI, should be placed at 24 to 36 times the slab thickness.

Based on the on-site soils, H&P recommends using a subgrade modulus (k) of 100 pci.

8.0 RETAINING WALL CONSTRUCTION

Project retaining walls and below grade foundation walls are not expected to be required for the project site.

The following parameters are provided in the event that design changes are made:

- Allowable Soil Bearing Capacity = 2,000 psf
- Moist Soil Density = 115 pcf
- Effective Internal Friction Angle (phi) = 30 degrees
- "At Rest" Earth Pressure Coefficient (K_o) = 0.50
- "Active" Earth Pressure Coefficient (K_a) = 0.33
- "Passive" Earth Pressure Coefficient (K_p) = 3.0
- Equivalent Fluid Pressure for At Rest Condition = 58 psf/ft depth
- Equivalent Fluid Pressure for Active Condition = 38 psf/ft depth
- Coefficient of Friction to resist sliding between wall foundations and underlying soils = 0.38

9.0 PAVEMENT DESIGN

Based on the proposed site plan, no new pavement sections are currently included with the construction of the Tower structure; however, Laboratory California Bearing Ratio (CBR) testing was completed on one (1) sample during this site investigation. The composite sample from Borings B-1 and B-2 has a design CBR value of 2.0. The recommended resiliency factor (RF) is 1.5. Using a design CBR value of 2.0 and RF value of 1.5, the soil support value (SSV) computes to 3.0.

As a future consideration, final soil subgrades should be compacted to a minimum of 98% of the soil's maximum dry density as determined by a Standard Proctor (ASTM D 698). A proof roll should be completed on the soil subgrade prior to placement of any crushed stone. Proof roll should be completed in the same manner as described in the Earthwork and Grading Section in Section 6 of this report. Crushed stone subgrades should be compacted to 98% of the material's maximum dry density as determined by a standard Proctor or as determined by a roller pattern.

Assuming light traffic with a design ADT value of 200, the recommended minimum pavement designs for the facility are as follows:

Flexible Asphalt Concrete Sections:

Heavy Duty Pavement - 10"

Subbase	6"	of Untreated #21B VDOT Size Aggregate
Base	2"	of BM-25.0
Surface	2"	of SM-9.5D

Light Duty Pavement - 8"

Subbase	6"	of Untreated #21B VDOT Size Aggregate
Surface	2"	of SM-9.5D

Rigid Portland Cement (PC) Concrete Sections:

Heavy Duty Pavement

6" x 0.14 = 0.84
4" x 0.44 = 1.76
Structural Number (S.N.) = 2.60
Concrete Thickness: 2.60/0.50 = 5"

Light Duty Pavement

6" x 0.14 = 0.84
2" x 0.44 = 0.88
Structural Number (S.N.) = 1.72
Concrete Thickness: 1.72/0.50 = 3.5"

10.0 ANTICIPATED SETTLEMENT

Based on the subsurface conditions that were encountered during the investigation; the estimated maximum loads; the engineering properties of the soils; and the standard penetration results, maximum total settlements, if the recommendations in this report are adhered to, are estimated at less than 1 inch.

11.0 SLOPE STABILITY

A detailed slope stability analysis was not completed as part of this site investigation. Based on the sandy silt and silty sand type conditions, no permanent slopes should be steeper than 2H to 1V (horizontal to vertical). For long term stability and maintenance considerations, 3H to 1V (horizontal to vertical) is recommended.

Appropriate measures should be taken to prevent excess surface storm water from impacting the fill slopes. Both temporary berms and slope drains should be utilized until permanent diversion structures are in place.

Surface protection measures including erosion control fabric and protective vegetation cover should be implemented immediately following the slope construction operations.

12.0 FROST DEPTH

Foundation footings should be placed a minimum of 24 inches below finish soil subgrade elevations.

13.0 SEISMIC CLASSIFICATION

In accordance with the International Building Code 2012, a site class seismic rating is required to complete the structural engineering analysis. Based on the standard penetration results and based on the depth of bedrock, a "D" site class seismic rating is recommended in evaluating the foundation designs for the new tower structure.

The mapped Spectral Response Acceleration at short periods is S_s = 0.22. The mapped Spectral Response Acceleration at one-second periods is S_1 = 0.07. Site coefficient values of F_a = 1.6 and F_v = 2.4 correspond to the site class and mapped spectral response accelerations.

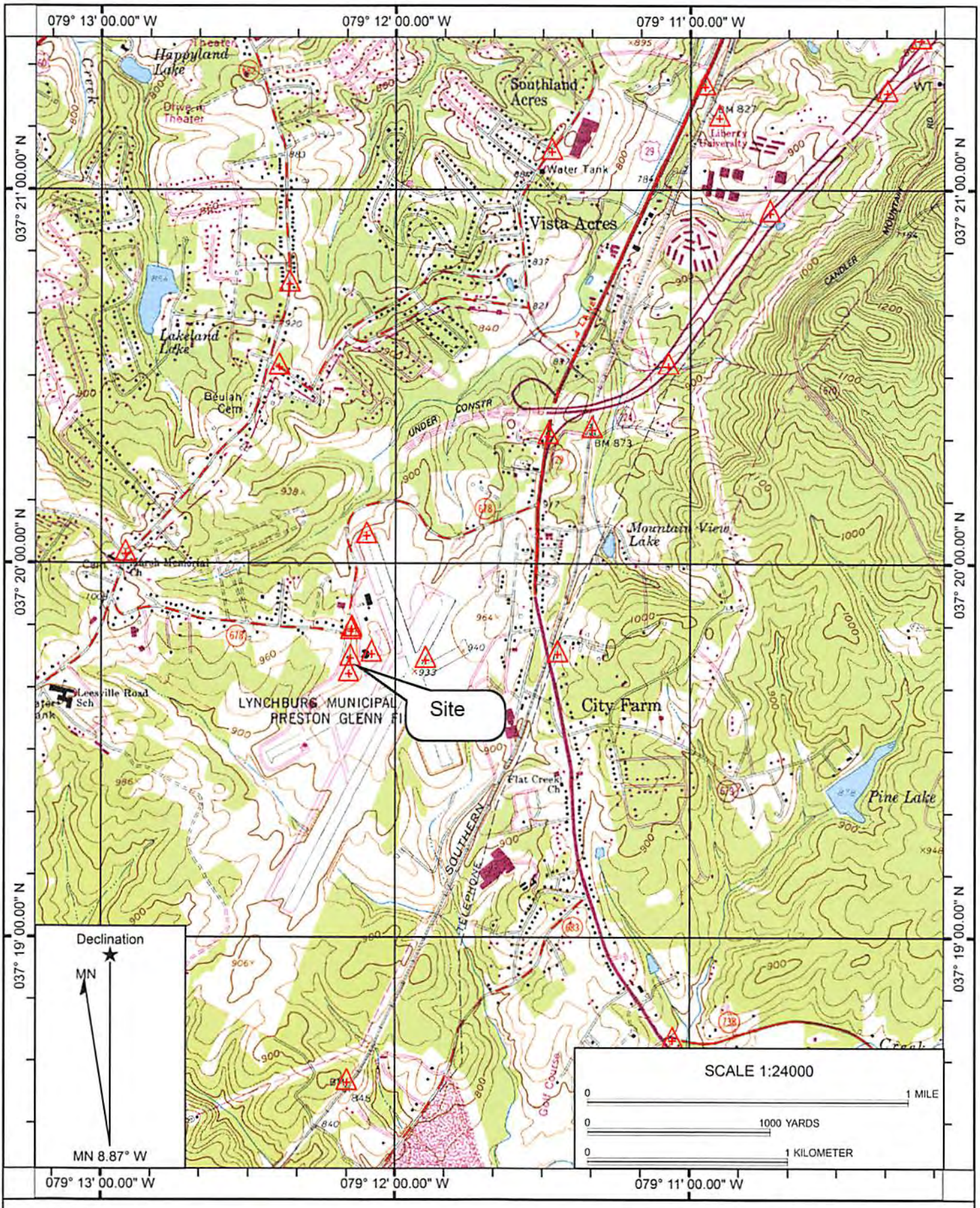
14.0 LIMITATIONS

The analyses and recommendations submitted in this report are based upon data obtained from soil borings performed at the locations shown on the Test Boring Map in Appendix B. Variations that may occur between these borings and other unexplored areas of the site are not reflected in this report. The nature and extent of variations between these borings may not become evident until construction is underway. If variations become apparent, H&P should be notified immediately to observe site conditions and to make appropriate recommendations.

This report has been prepared for the exclusive use of RS&H and their authorized design team for the design of the Lynchburg Regional Airport Air Traffic Control Tower. The conclusions and recommendations made in this report are based on the data obtained in the subsurface geotechnical investigation as described in this report and on the design information furnished to H&P for this project. H&P's recommendations are in accordance with generally accepted soil and foundation engineering practices. No warranty, express or implied, is made by H&P. Interpretations of this report by anyone other than H&P may not be valid.

Appendix A

USGS Topographic Map



Name: [City Farm]
Date: 05/18/15
Scale: 1 inch = 2,000 ft.

Location: 037° 19' 53.56" N 079° 11' 40.84" W

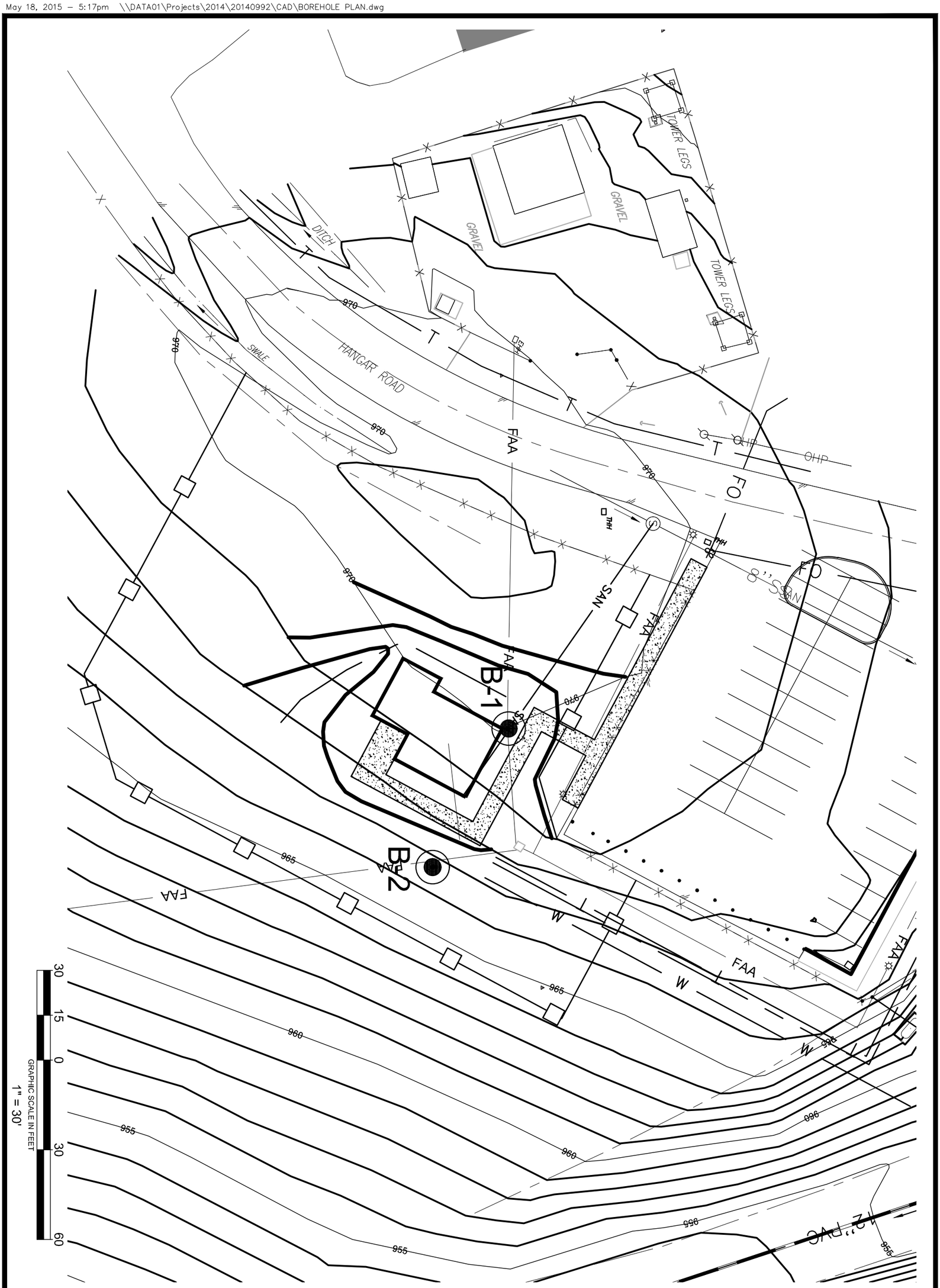
Copyright (C) 2008, MyTopo

Datum: NAD27

Appendix B

Boring Location Plan

May 18, 2015 – 5:17pm \\DATA01\Projects\2014\20140992\CAD\BOREHOLE PLAN.dwg



TEST BORING LOCATION MAP

LYNCHBURG REGIONAL AIRPORT

AIR TRAFFIC CONTROL TOWER

CAMPBELL COUNTY, VIRGINIA

PROJECT NO.	20140992
LAT.	
LONG.	
DATE:	05/18/2015
DRAWN BY:	RKW
CHECKED BY:	JKM

SHEET NO.
1 OF 1

HURT & PROFFITT
2524 LANGHORNE ROAD
LYNCHBURG VA 24501
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ENGINEERING • SURVEYING • LAND DEVELOPMENT • ENVIRONMENTAL
GEOTECHNICAL • CONSTRUCTION TESTING & INSPECTION • CULTURAL RESOURCES

Appendix C

Test Boring Logs

LOG OF BORING B-1

Hurt & Proffitt, Inc.
2524 Langhorne Road
Lynchburg, VA 24501
Telephone: (434) 847-7796
Fax: (434) 847-0047
http://www.HandP.com

CLIENT: RS&H
PROJECT: Lynchburg Regional Airport New Control Tower
LOCATION: Lynchburg, Virginia

PROJECT NO. 20140992

DRILLING DETAILS:
Drilled by N. Hurdis using CME-45C and Hollow Stem Augers and Diamond Core Drilling. Boring completed 4/24/2015.

SURFACE ELEVATION: 970.0
BORING DEPTH (ft): 56.00
PROPOSED SUBGRADE ELEVATION:
GROUNDWATER DEPTH AT COMPLETION (ft): 42.70
GROUNDWATER DEPTH AFTER 24 HRS (ft):

ELEVATION (feet)	DEPTH (feet)	SAMPLES / BLOW COUNT	PERCENT RECOVERY / R.Q.D. / N-value	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT (LL)	ATTERBERG LIMITS: PLASTIC LIMIT (PL)	ATTERBERG LIMITS: PLASTICITY INDEX (PI)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
	1	1 3 3	6	20	48	36	12	69	6 inches of Topsoil
	1								**FILL:** Medium stiff, Reddish Brown ELASTIC SILT (MH), moist
	2								
	3	2 5 8	13						RESIDUUM: Stiff, Reddish Brown Sandy SILT (ML), micaceous, contains relict structure, moist
	4								
965	5	5 9 18	27						Very stiff
	6								contains quartz rock fragments
	7	WOH 6 13	19						
	8								
	9								
960	10	8 12 17	29						
	11								
	12								
	13								
	14			27	48	48	NP	47	Medium dense, Yellowish Reddish Brown, Silty SAND (SM), micaceous, contains manganese staining, moist
955	15	5 8 10	18						
	16								
	17								
	18								
	19			16	43	43	NP	40	
950	20	8 9 11	20						Grayish Olive Brown
	21								
	22								
	23								
	24								
945	25	4 6 7	13						Grayish Yellow Brown
	26								
	27								
	28								
	29								
940	30	6 8 10	18						
	31								
	32								
	33								
	34								
935	35	5 6	13						

N - Standard Penetration Test Resistance (ASTM D 1586)
R.Q.D. - Rock Quality Designation

NOTES:
Boring penetrated existing airport control cable

LOG OF BORING B-1

Hurt & Proffitt, Inc.
2524 Langhorne Road
Lynchburg, VA 24501
Telephone: (434) 847-7796
Fax: (434) 847-0047
http://www.HandP.com

CLIENT: RS&H
PROJECT: Lynchburg Regional Airport New Control Tower
LOCATION: Lynchburg, Virginia

PROJECT NO. 20140992

DRILLING DETAILS:
Drilled by N. Hurdis using CME-45C and Hollow Stem Augers and Diamond Core Drilling. Boring completed 4/24/2015.

SURFACE ELEVATION:
BORING DEPTH (ft): 56.00
PROPOSED SUBGRADE ELEVATION:
GROUNDWATER DEPTH AT COMPLETION (ft): 42.70
GROUNDWATER DEPTH AFTER 24 HRS (ft):

ELEVATION (feet)	DEPTH (feet)	SAMPLES / BLOW COUNT	PERCENT RECOVERY / R.Q.D. / N-value	MOISTURE CONTENT (%)	LIQUID LIMIT (LL)	PLASTIC LIMIT (PL)	PLASTICITY INDEX (PI)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
	36	7							
	37								
	38								
	39								
930	40	6 7 10	17						Olive Grayish Brown
	41								
	42								
	43								
	44								
925	45	12 12 13	25						
	46								
	47								
	48								
	49								
920	50	11 15 20	35						Dense, WET SPOON
	51								
	52								
	53								Diamond Bit Coring Initiated at 53.0 feet, upon Auger Refusal
	54								
915	55		100 72						
	56								Schist: Slightly to Moderately weathered, Slightly fractured, Gray to Olive Gray, micaceous Moderately fractured from 55ft. to 56ft. Boring Terminated at 56.0 feet, due to core bit loss.

N - Standard Penetration Test Resistance (ASTM D 1586)
R.Q.D. - Rock Quality Designation

NOTES:
Boring penetrated existing airport control cable

LOG OF BORING B-2

Hurt & Proffitt, Inc.
2524 Langhorne Road
Lynchburg, VA 24501
Telephone: (434) 847-7796
Fax: (434) 847-0047
http://www.HandP.com

CLIENT: RS&H
PROJECT: Lynchburg Regional Airport New Control Tower
LOCATION: Lynchburg, Virginia

PROJECT NO. 20140992

DRILLING DETAILS:
Drilled by N. Hurdis using CME-45C and Hollow Stem Augers and Diamond Core Drilling. Boring completed 4/24/2015.

SURFACE ELEVATION: 966.5
BORING DEPTH (ft): 68.00
PROPOSED SUBGRADE ELEVATION:

GROUNDWATER DEPTH AT COMPLETION (ft): 43.00
GROUNDWATER DEPTH AFTER 24 HRS (ft):

ELEVATION (feet)	DEPTH (feet)	SAMPLES / BLOW COUNT	PERCENT RECOVERY / R.Q.D. / N-value	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT (LL)	ATTERBERG LIMITS: PLASTIC LIMIT (PL)	ATTERBERG LIMITS: PLASTICITY INDEX (PI)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
		1 4 4	8						6 inches of Topsoil
965	1								RESIDUUM: Stiff, Reddish Brown ELASTIC SILT (MH), moist
	2	2 3 6	9						contains mica
	3								
	4	4 6 8	14						
	5								Stiff, Reddish Brown Sandy SILT (ML), micaceous, moist
960	6	2 4 5	9						
	7								
	8								
	9	3 6 8	14						Reddish Grayish Brown
	10								
955	11								
	12								
	13								
	14	3 4 6	10	21	47	46	1	40	Loose, Reddish Grayish Brown, Silty SAND (SM), micaceous, moist
	15								
950	16								
	17								
	18								
	19	5 6 6	12	16	46	46	NP	31	Medium dense
	20								
945	21								
	22								
	23								
	24	7 10 11	21						Grayish Olive Brown
	25								
940	26								
	27								
	28								
	29	6 11 12	23						
	30								
935	31								
	32								
	33								
	34	6 10	25						
	35								

N - Standard Penetration Test Resistance (ASTM D 1586)
R.Q.D. - Rock Quality Designation

NOTES:
Boring close to unlocated electric line.

LOG OF BORING B-2

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http://www.HandP.com

CLIENT: RS&H
PROJECT: Lynchburg Regional Airport New Control Tower
LOCATION: Lynchburg, Virginia

PROJECT NO. 20140992

DRILLING DETAILS:
Drilled by N. Hurdis using CME-45C and Hollow Stem Augers and Diamond Core Drilling. Boring completed 4/24/2015.

SURFACE ELEVATION:
BORING DEPTH (ft): 68.00
PROPOSED SUBGRADE ELEVATION:
GROUNDWATER DEPTH AT COMPLETION (ft): 43.00
GROUNDWATER DEPTH AFTER 24 HRS (ft):

ELEVATION (feet)	SOIL SYMBOL	DEPTH (feet)	SAMPLES	BLOW COUNT	PERCENT RECOVERY / R.Q.D.	N-value	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT (LL)	ATTERBERG LIMITS: PLASTIC LIMIT (PL)	ATTERBERG LIMITS: PLASTICITY INDEX (PI)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
930		36		15								
		37										
		38										
		39		16								Dense, Light Gray
		40		22		47						
				25								
		41										
925		42										
		43										
		44		8								Very stiff, Olive Grayish Brown Sandy SILT (ML), micaceous, moist
		45		10		24						
				14								
		46										
920		47										
		48										
		49		9								Hard, WET SPOON
		50		18		43						
				25								
		51										
915		52										
		53										
		54		50/4"		50/4"						Partially Weathered Rock: Brown Silty SAND (SM), wet
		55										
		56										
910		57										Diamond Bit Coring Initiated at 57.0 feet, upon Auger Refusal
		58				58						
						0						
		59										
		60										
		61				95						Schist: Moderately weathered, Highly fractured, Brown to Gray, micaceous, fracturing at 50-60 degrees to core axis
905						15						
		62										Schist: Slightly weathered, Highly fractured, Gray, micaceous, fracturing at 50-60 degrees to core axis
		63										
		64										Schist: Slightly weathered, Slightly fractured, Gray, micaceous, fracturing at 50-60 degrees to core axis
		65				100						
900		66				65						
		67										
		68										Boring Terminated at 68.0 feet.

N - Standard Penetration Test Resistance (ASTM D 1586)
R.Q.D. - Rock Quality Designation

NOTES:
Boring close to unlocated electric line.

LOB 20140992.GPJ 5/18/15

Appendix D

CBR Results

Hurt & Proffitt, Inc.
2524 Langhorne Road
Lynchburg, Virginia 24501
(phone) 434-847-7796 (fax) 434-847-0047

Project:	Lynchburg Airport Tower
Project. No:	20140992
Location:	B-1 & B-2 (depth 0'-5')
Date	May 15, 2015
	Sample # 1

California Bearing Ratio Computations (VTM-8 Modified)

Soil Description: Red Sandy Silt (ML)
Liquid Limit: 48
Plasticity Index: 12

Minus 200 (%): 69.1
Proctor Density (pcf): 98.0
Optimum Moisture (%): 22.0

Computed Weight of Compacted Soil in CBR Mold

0.075	x	98.0	=	7.35	lbs., weight of dry soil
453.6	x	7.35	=	3334	grams, weight of dry soil
3334	x	1.220	=	4067	grams, weight of wet soil

Actual Weight and Density of Soil in CBR Mold

	Soaked Mold (s)	Soaked Mold After Immersion (i)	
Wt. of mold and wet soil	11124	11335	grams
Wt. of mold	7052	7052	grams
Wt. of wet soil (S_w)	4072	4283	grams
Moisture content (w)	21.7	31.9	percent
Wt. of dry soil	3345	3246	grams
Percent Density Obtained:	100.3 %	93.7 %	

Compaction Effort
3 Layers
56 Blows/Layer

Mold ID: # 6

Density (D) = S_w / (V x (1+w) x 453.6), w is expressed as a decimal

D_S = 98.3 V_s = 0.0750 w = 0.217
D_I = 91.8 V_i = 0.0779 w = 0.319

V_i = resulting volume after soak, $V_i = [(1/4\pi d^2) \times (ho + \Delta h)] \times 0.0005787$

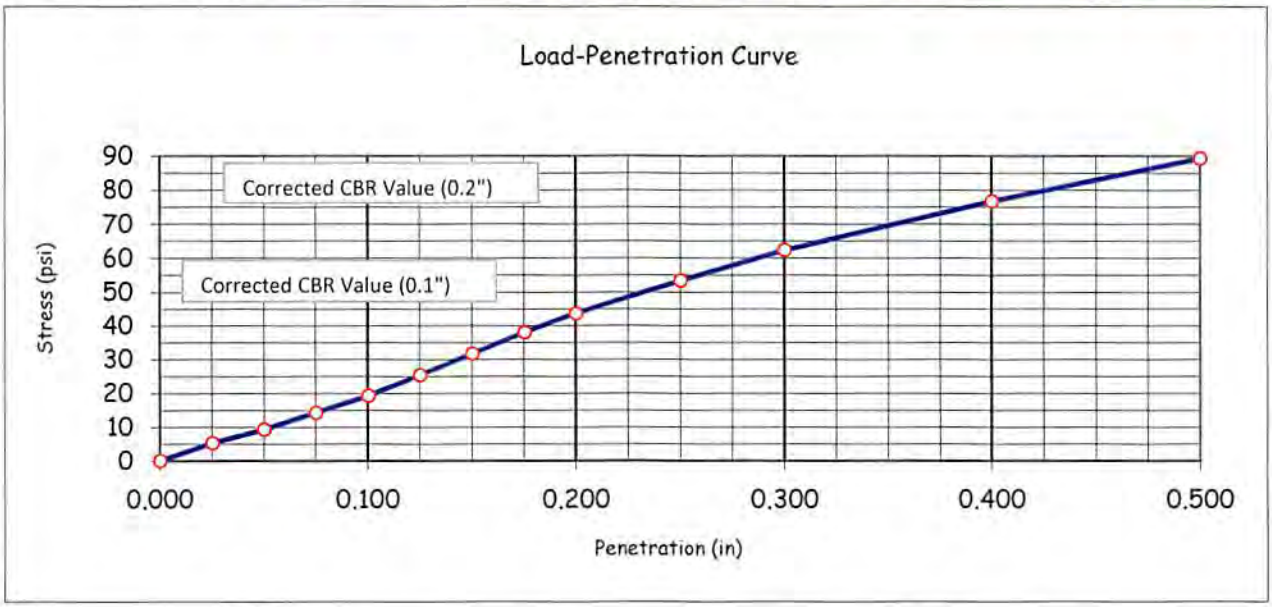
Computation of Swell

Reading before immersion	0.032	points
Reading after immersion	0.210	points
Amount of Swell	0.178	points

% Swell = 3.88

Determination of CBR Value (Penetration and Total Load)

Inches	0.000	0.025	0.050	0.075	0.100	0.125	0.150	0.175	0.200	0.250	0.300	0.400	0.500
Stress on Piston (psi)	0	5	9	14	19	25	32	38	44	53	62	77	89
Total load after 4 day soak	0	16	28	43	58	76	95	114	131	160	187	230	268

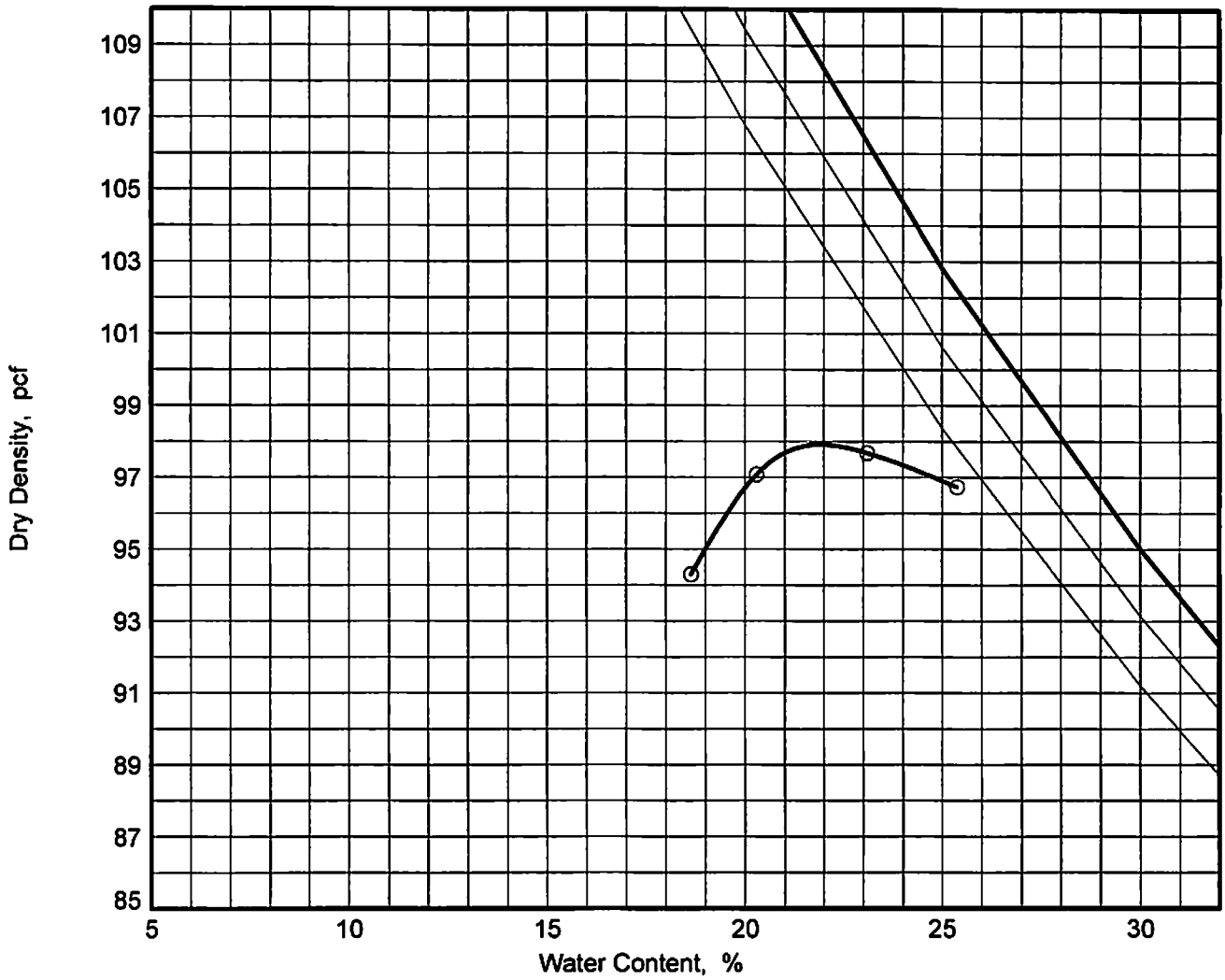


CBR Value (0.1") = 1.9 % **Corrected CBR Value (0.1") =** 2.4%
CBR Value (0.2") = 2.9 % **Corrected CBR Value (0.2") =** 3.1%

Appendix E

Standard Proctor Curve

MOISTURE - DENSITY RELATIONSHIP



85

Standard Proctor - ASTM D 698, Method A, using the Dry Preparation method and Manual Rammer

MATERIAL DESCRIPTION	AASHTO	SAMPLE ID: **B-1**
Red SANDY SILT (ML)	A-7-5(9)	Maximum Dry Density = **98.0 pcf** Optimum Moisture = **22.0 %**

Natural Moisture	Specific Gravity	Liquid Limit	Plasticity Index	% < 3/4 in.	% < 3/8 in.	% < No. 4	% < No. 200
20.5		48	12	100.0	100.0	99.0	69.1

Sampled by S. Osbeck April 23, 2015
Sample location: B-1 & B-2 (depth 0'-5')
Proposed use:

Hurt & Proffitt, Inc.
2524 Langhorne Road
Lynchburg, Virginia 24501
Telephone: (434) 847-7796
Fax: (434) 847-0047
http://www.HandP.com

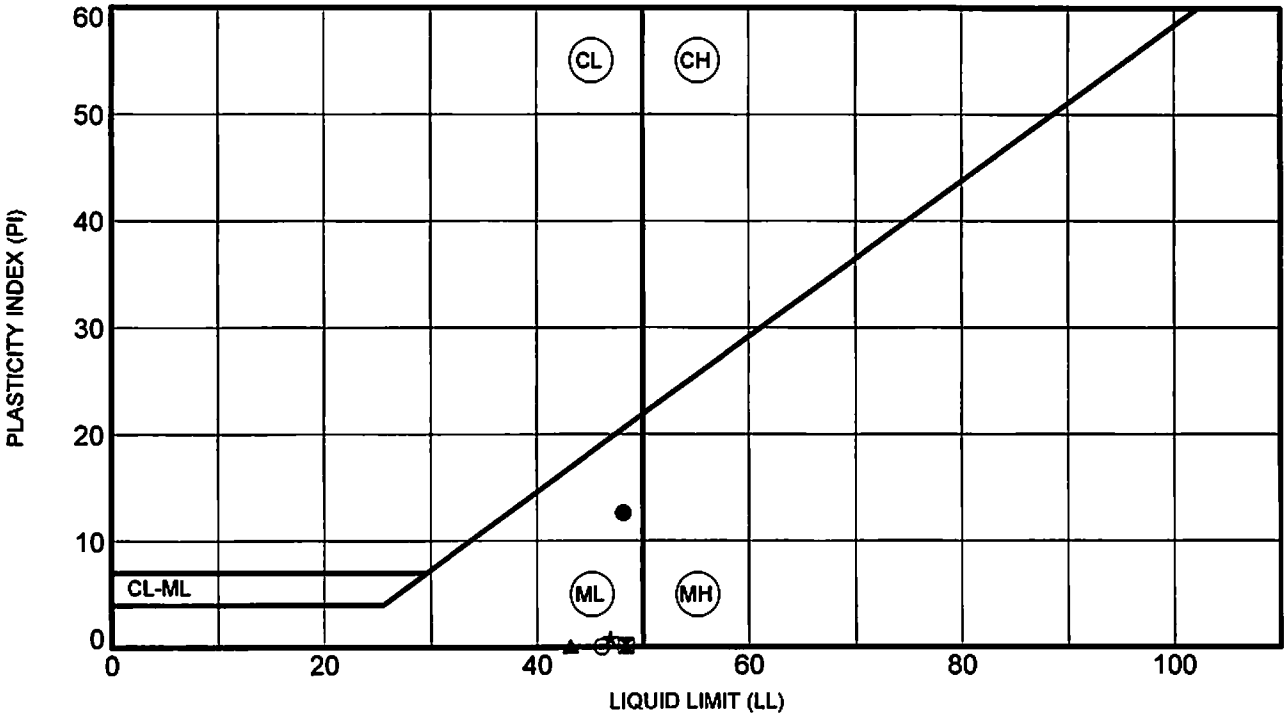
CLIENT: RS&H
PROJECT: Lynchburg Regional Airport New Control Tower
LOCATION: Lynchburg, Virginia

PROJECT NO. 20140992

Appendix F

Atterberg Limit Results

ATTERBERG LIMITS' RESULTS



Specimen Identification			LL	PL	PI	Fines	Classification
●	B-1	0.0	48	36	12	69.1	Red SANDY SILT (ML)
⊠	B-1	14.0	48	48	NP	46.7	Strong Brown SILTY SAND (SM)
▲	B-1	19.0	43	43	NP	40.0	Brown SILTY SAND (SM)
★	B-2	14.0	47	46	1	39.6	Red SILTY SAND (SM)
⊙	B-2	19.0	46	46	NP	30.6	Light Yellowish Brown SILTY SAND (SM)

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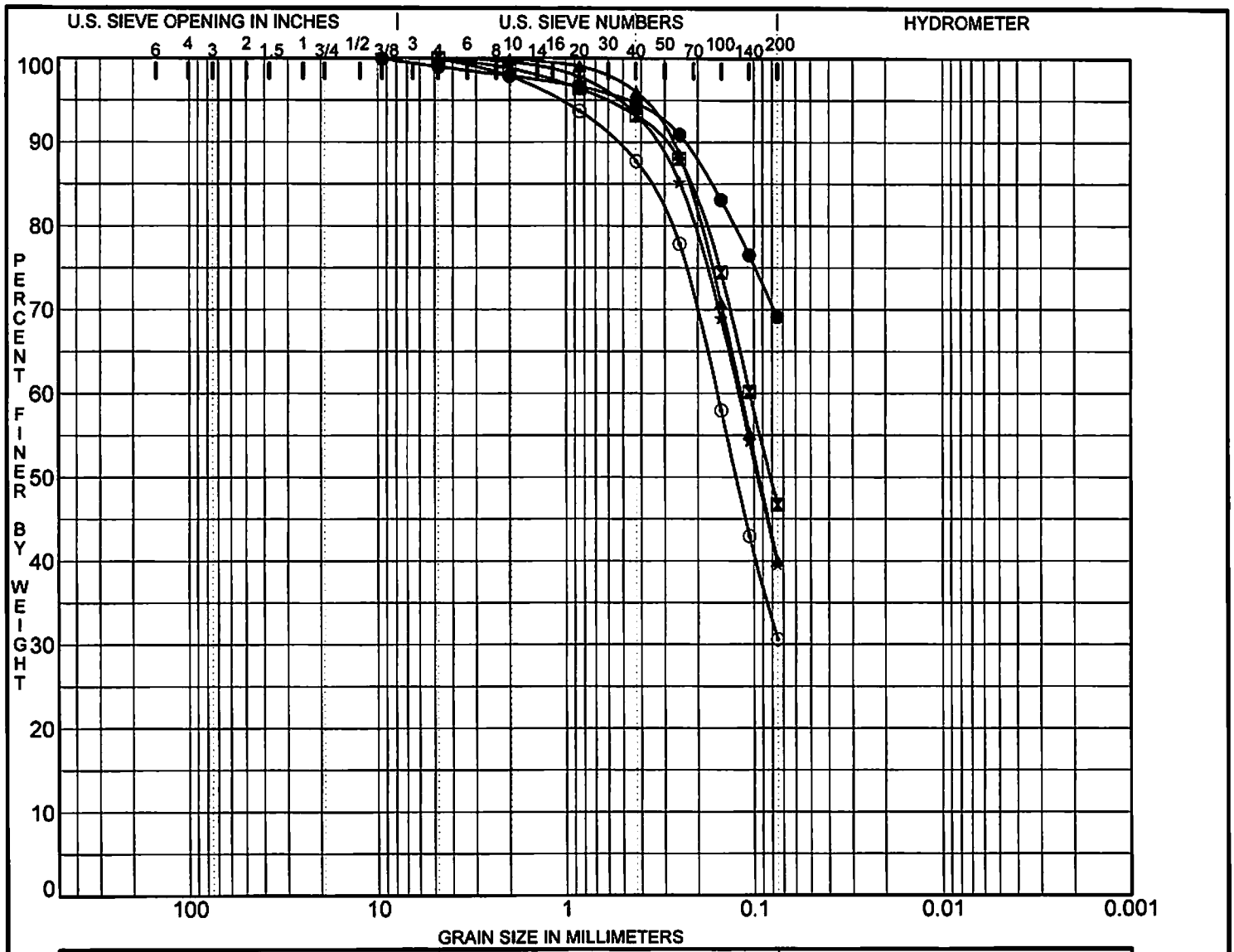
http://www.HandP.com

CLIENT: RS&H
PROJECT: Lynchburg Regional Airport New Control Tower
LOCATION: Lynchburg, Virginia

PROJECT NO. 20140992

Appendix G

Sieve Analysis Results



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	MC%	LL	PL	PI
●	B-1	0.0	Red SANDY SILT (ML)	20.5	48	36	12
⊠	B-1	14.0	Strong Brown SILTY SAND (SM)	27.0	48	48	NP
▲	B-1	19.0	Brown SILTY SAND (SM)	16.4	43	43	NP
★	B-2	14.0	Red SILTY SAND (SM)	21.5	47	46	1
⊙	B-2	19.0	Light Yellowish Brown SILTY SAND (SM)	16.3	46	46	NP

	Specimen Identification		D100	D60	D30	D10	Cc	Cu	%Gravel	%Sand	%Silt	%Clay
●	B-1	0.0	9.50						1.0	29.9	69.1	
⊠	B-1	14.0	4.75	0.11					0.0	53.3	46.7	
▲	B-1	19.0	4.75	0.12					0.0	60.0	40.0	
★	B-2	14.0	4.75	0.12					0.0	60.4	39.6	
⊙	B-2	19.0	4.75	0.16					0.0	69.4	30.6	

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Fax: (434) 847-0047
http://www.HandP.com

CLIENT: RS&H
PROJECT: Lynchburg Regional Airport New Control Tower
LOCATION: Lynchburg, Virginia

PROJECT NO. 20140992

Appendix H

Expansion Index Analysis Results

Hurt & Proffitt, Inc.
2524 Langhorne Road
Lynchburg, Virginia 24501
434-847-7796 (phone) -- 434-847-0047 (fax)

EXPANSION INDEX REPORT

ASTM D 4829

PROJECT: Lynchburg Airport Tower
DATE SAMPLED: 5/5/15
CLIENT: RS & H
DATE TESTED: 5/11/15
H&P REPRESENTATIVE: Ken Meritt
PROJECT NO: 20140992

SAMPLE LOCATION: Boring B-1 and B-2 (0'-5' Depth Range) bulk sample

SOIL DESCRIPTION: Red Sandy Silt (ML)

MOISTURE/DENSITY DETERMINATION	
Wt. of Empty Dish (g)	8.25
Wt. of Dish & Wet Soil (g)	118.72
Wt. of Dish & Dry Soil (g)	104.04
% Moisture	15.3
Wt. of Mold (g)	365.98
Wt. of Mold & Wet Soil (g)	725.24
Wt. of Wet Soil (g)	359.26
Ring Volume (ft^3)	0.00725
Wet Density (lbs/ft^3)	109.2
Dry Density (lbs/ft^3)	94.7

Field Moisture = 20.5 %

% SATURATION CALCULATIONS	
Specific Gravity	2.7
% Moisture	15.3
Dry Density (lbs/ft^3)	94.7
(S), % Saturation	53.1

EXPANSION INDEX CALCULATIONS

Initial Height (H_1 = 1.000 in)	Dial reading (in)	Time (hr:min)	Date
D_1	0.0041	11:10 AM	5/11/15
D_2	0.0757	11:45 AM	5/11/15
D_3	0.0826	1:59 PM	5/11/15
D_4	0.0835	3:59 PM	5/11/15
D_5	0.0840	6:11 PM	5/11/15
D_6	0.0851	8:27 AM	5/12/15

Expansion Index (EI_{meas})	81	Final Moisture %	35.8%
Expansion Index (EI_{50})	84	% +4 Material	<5 %
Potential Expansion	Medium		

Appendix I

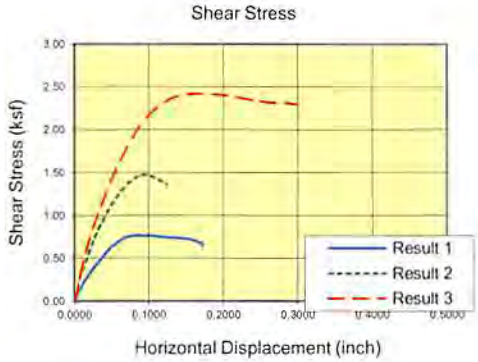
Direct Shear Analysis Results

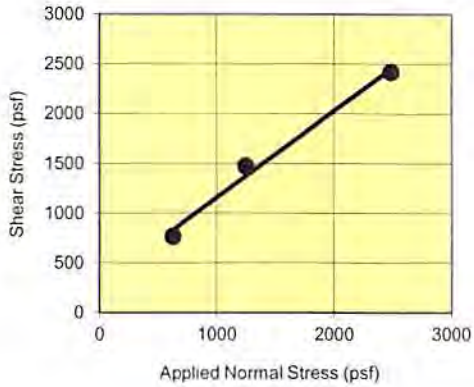
HURT & PROFFITT INCORPORATED
2524 LANGHORNE ROAD
LYNCHBURG, VA 24501
800.242.4906 TOLL FREE
434.847.7796 MAIN
434.847.0047 FAX
WWW.HANDP.COM

Direct Shear
ASTM D-3080

Client	RS&H
Project	Lynchburg Regional Airport Control Tower
Project No.	20140992
Date	5/11/2015

Sample No.	B-1	Sample Depth (ft)	14'-16'
Sample Type	Shelby Tube	Avg Moist Unit Weight (pcf)	97.6
USCS Classification	SM	Field Moisture (%)=	20.9%
Sample Description	Silty SAND	Liquid Limit (LL)	48
Sample Diameter (inch)=	2.5	Plastic Limit (PL)	48
Sample Height (inch)=	1	Plasticity Index (PI)	0
Sample Volume (ft^3)=	0.00284	% Passing #200 Sieve	46.7





Test No.	1	2	3
Disp. Rate (in/min)	0.0008	0.0008	0.0008
Normal Stress (psf)	625	1248	2485
Shear Stress (psf)	768	1477	2420
Initial			
Wet Density (pcf)	97.04	99.00	96.76
Dry Density (pcf)	80.48	81.88	79.76
Moisture Content (%)	20.6%	20.9%	21.3%
Final			
Wet Density (pcf)	115.60	115.74	113.73
Dry Density (pcf)	80.80	82.45	79.82
Moisture Content (%)	43.1%	40.4%	42.5%
Sample Results			
Friction Angle (Φ')	**37.3**	Cohesion, c' (psf)	**526**

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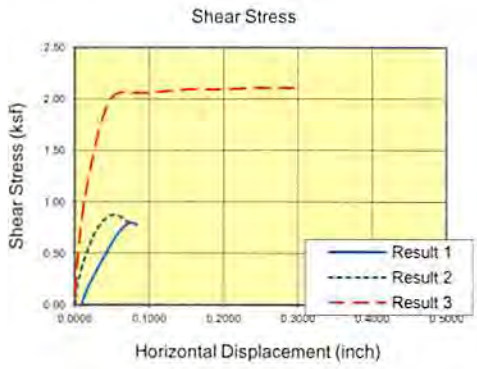
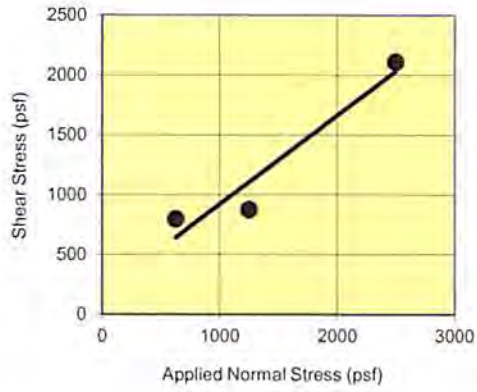
Direct Shear
ASTM D-3080

Client	RS&H
Project	Lynchburg Regional Airport Control Tower
Project No.	20140992
Date	5/11/2015

Sample No.	B-2
Sample Type	Shelby Tube
USCS Classification	SM
Sample Description	Silty SAND
Sample Diameter (inch)=	2.5
Sample Height (inch)=	1
Sample Volume (ft^3)=	0.00284

Sample Depth (ft)	19'-21'
Avg Moist Unit Weight (pcf)	96.6
Field Moisture (%)=	19.2%
Liquid Limit (LL)	46
Plastic Limit (PL)	46
Plasticity Index (PI)	0
% Passing #200 Sieve	30.6





Test No.	1	2	3
Disp. Rate (in/min)	0.0008	0.0008	0.0008
Normal Stress (psf)	625	1249	2499
Shear Stress (psf)	798	877	2114
Initial			
Wet Density (pcf)	97.92	92.99	99.03
Dry Density (pcf)	82.75	77.09	83.55
Moisture Content (%)	18.3%	20.6%	18.5%
Final			
Wet Density (pcf)	114.49	107.59	115.42
Dry Density (pcf)	81.69	77.03	82.62
Moisture Content (%)	40.2%	39.7%	39.7%
Sample Results			
Friction Angle (Φ')	**35.1**	Cohesion, c' (psf)	**180**

Appendix J

Unit Weight Results

HURT & PROFFITT
INCORPORATED

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Density of Soil In-Place By Drive-Cylinder Method (Shelby Tube)

ASTM D-2937

Boring No:	B-1 & B-2	Project:	Lynchburg Airport Tower Site
Sample Depth(s):	Variable	Location:	Lynchburg, VA
Soil Description(s):	Variable	Project No:	20140992
Specific Gravity (Assume G_s = 2.70):	2.70	Date Tested:	4/30/2015

Boring No.	B-1	B-1	B-2	B-2			
Depth	14'-16'	19'-21'	14'-16'	19'-21'			
Tare #	998	999	B-B	A-A			
Tare Weight (gm x 0.01)	85.57	85.31	85.99	85.31			
Wet Soil + Tare Wgt. (gm x 0.01)	647.83	709.80	716.67	663.39			
Dry Soil + Tare Wgt. (gm x 0.01)	528.23	621.97	628.51	561.13			
Moisture Content (%)	27.0	16.4	16.3	21.5			
Sample Wet Soil Wgt. (gm x 0.01)	1398.6	2186.8	1829.3	2177.4			
Sample Height (in x 0.01)	7.60	11.70	10.00	11.70			
Sample Diameter (in x 0.01)	2.89	2.91	2.89	2.92			
Volume of Sample (ft^3)	0.0289	0.0450	0.0380	0.0453			
Wet Density (pcf x 0.1)	106.9	107.1	106.2	105.9			
Dry Density (pcf x 0.1)	84.1	92.0	91.4	87.1			

SECTION 311000 - SITE CLEARING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Protecting existing vegetation to remain.
2. Removing existing vegetation.
3. Clearing and grubbing.
4. Stripping and stockpiling topsoil.
5. Removing above- and below-grade site improvements.
6. Disconnecting, capping or sealing, and abandoning site utilities in place.
7. Temporary erosion- and sedimentation-control measures.

B. Related Sections:

1. Section 015000 "Temporary Facilities and Controls" for temporary utility services, construction and support facilities, security and protection facilities, and temporary erosion- and sedimentation-control measures.
2. Section 024119 "Selective Demolition" for partial demolition of buildings or structures.

1.3 DEFINITIONS

A. Subsoil: All soil beneath the topsoil layer of the soil profile, and typified by the lack of organic matter and soil organisms.

B. Surface Soil: Soil that is present at the top layer of the existing soil profile at the Project site. In undisturbed areas, the surface soil is typically topsoil; but in disturbed areas such as urban environments, the surface soil can be subsoil.

C. Topsoil: Top layer of the soil profile consisting of existing native surface topsoil or existing in-place surface soil and is the zone where plant roots grow.

D. Topsoil: Top layer of the soil profile consisting of existing native surface topsoil or existing in-place surface soil and is the zone where plant roots grow. Its appearance is generally friable, pervious, and black or a darker shade of brown, gray, or red than underlying subsoil; reasonably free of subsoil, clay lumps, gravel, and other objects

more than 2 inches (50 mm) in diameter; and free of subsoil and weeds, roots, toxic materials, or other nonsoil materials.

E. Plant-Protection Zone: Area surrounding individual trees, groups of trees, shrubs, or other vegetation to be protected during construction, and indicated on Drawings.

F. Tree-Protection Zone: Area surrounding individual trees or groups of trees to be protected during construction, and defined by a circle concentric with each tree with a radius 1.5 times the diameter of the drip line unless otherwise indicated.

G. Vegetation: Trees, shrubs, groundcovers, grass, and other plants.

1.4 MATERIAL OWNERSHIP

A. Except for stripped topsoil and other materials indicated to be stockpiled or otherwise remain Owner's property, cleared materials shall become Contractor's property and shall be removed from Project site.

1.5 INFORMATIONAL SUBMITTALS

A. Existing Conditions: Documentation of existing trees and plantings, adjoining construction, and site improvements that establishes preconstruction conditions that might be misconstrued as damage caused by site clearing.

1. Use sufficiently detailed photographs or videotape.
2. Include plans and notations to indicate specific wounds and damage conditions of each tree or other plants designated to remain.

B. Record Drawings: Identifying and accurately showing locations of capped utilities and other subsurface structural, electrical, and mechanical conditions.

1.6 QUALITY ASSURANCE

A. Preinstallation Conference: Conduct conference at Project site.

1.7 PROJECT CONDITIONS

A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during site-clearing operations.

1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
2. Provide alternate routes around closed or obstructed traffic ways if required by Owner or authorities having jurisdiction.

B. Improvements on Adjoining Property: Authority for performing site clearing indicated on property adjoining Owner's property will be obtained by Owner before award of Contract.

1. Do not proceed with work on adjoining property until directed by Architect.

C. Salvable Improvements: Carefully remove items indicated to be salvaged and store on Owner's premises where indicated.

D. Utility Locator Service: Notify Miss Utility for area where Project is located before site clearing.

E. Do not commence site clearing operations until temporary erosion- and sedimentation-control and tree-protection measures are in place.

F. The following practices are prohibited within protection zones:

1. Storage of construction materials, debris, or excavated material.
2. Parking vehicles or equipment.
3. Foot traffic.
4. Erection of sheds or structures.
5. Impoundment of water.
6. Excavation or other digging unless otherwise indicated.
7. Attachment of signs to or wrapping materials around trees or plants unless otherwise indicated.

G. Do not direct vehicle or equipment exhaust towards protection zones.

H. Prohibit heat sources, flames, ignition sources, and smoking within or near protection zones.

I. Soil Stripping, Handling, and Stockpiling: Perform only when the topsoil is dry or slightly moist.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Satisfactory Soil Material: Requirements for satisfactory soil material are specified in Section 312000 "Earth Moving."

1. Obtain approved borrow soil material off-site when satisfactory soil material is not available on-site.

B. Antirust Coating: Fast-curing, lead- and chromate-free, self-curing, universal modified-alkyd primer complying with MPI #79, Alkyd Anticorrosive Metal Primer.

1. Use coating with a VOC content of 420 g/L (3.5 lb/gal.) or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect and maintain benchmarks and survey control points from disturbance during construction.

B. Locate and clearly identify trees, shrubs, and other vegetation to remain. Wrap a 1-inch (25-mm) blue vinyl tie tape flag around each tree trunk at 54 inches (1372 mm) above the ground.

C. Protect existing site improvements to remain from damage during construction.

1. Restore damaged improvements to their original condition, as acceptable to Owner.

3.2 TEMPORARY EROSION AND SEDIMENTATION CONTROL

A. Provide temporary erosion- and sedimentation-control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to erosion- and sedimentation-control Drawings and requirements of authorities having jurisdiction.

B. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross protection zones.

C. Inspect, maintain, and repair erosion- and sedimentation-control measures during construction until permanent vegetation has been established.

D. Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

3.3 TREE AND PLANT PROTECTION

A. General: Protect trees and plants remaining on-site according to requirements in Section 015639 "Temporary Tree and Plant Protection."

B. Repair or replace trees, shrubs, and other vegetation indicated to remain or be relocated that are damaged by construction operations, in a manner approved by Architect.

3.4 EXISTING UTILITIES

A. Owner will arrange for disconnecting and sealing indicated utilities that serve existing structures before site clearing, when requested by Contractor.

1. Verify that utilities have been disconnected and capped before proceeding with site clearing.

B. Locate, identify, disconnect, and seal or cap utilities indicated to be removed or abandoned in place.

1. Arrange with utility companies to shut off indicated utilities.
2. Owner will arrange to shut off indicated utilities when requested by Contractor.

C. Locate, identify, and disconnect utilities indicated to be abandoned in place.

D. The Contractor shall be responsible for proper drainage of the site(s) during construction of the project. Water shall not be alloed to accumulate in any of the excavated areas. Storm or ground water collecting on the site during construction shall be removed by pumping, ditching, or other suitable means.

E. Interrupting Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:

1. Notify Engineer not less than two (2) days in advance of proposed utility interruptions.
2. Do not proceed with utility interruptions without Engineer's written permission.

F. Excavate for and remove underground utilities indicated to be removed.

G. Removal of underground utilities is included in earthwork sections and with applicable fire suppression, plumbing, HVAC, electrical, communications, electronic safety and security and utilities sections and Section 024119 "Selective Demolition."

3.5 CLEARING AND GRUBBING

A. Remove obstructions, trees, shrubs, and other vegetation to permit installation of new construction.

1. Do not remove trees, shrubs, and other vegetation indicated to remain or to be relocated.
2. Grind down stumps and remove roots, obstructions, and debris to a depth of 18 inches (450 mm) below exposed subgrade.
3. Use only hand methods for grubbing within protection zones.
4. Chip removed tree branches and dispose of off-site.

B. Fill depressions caused by clearing and grubbing operations with satisfactory soil material unless further excavation or earthwork is indicated.

1. Place fill material in horizontal layers not exceeding a loose depth of 8 inches (200 mm), and compact each layer to a density equal to adjacent original ground.

3.6 TOPSOIL STRIPPING

A. Remove sod and grass before stripping topsoil.

B. Strip topsoil to depth of 6 inches (150 mm) in a manner to prevent intermingling with underlying subsoil or other waste materials.

1. Remove subsoil and nonsoil materials from topsoil, including clay lumps, gravel, and other objects more than 2 inches (50 mm) in diameter; trash, debris, weeds, roots, and other waste materials.

C. Stockpile topsoil away from edge of excavations without intermixing with subsoil. Grade and shape stockpiles to drain surface water. Cover to prevent windblown dust and erosion by water.

1. Limit height of topsoil stockpiles to 72 inches (1800 mm).
2. Do not stockpile topsoil within protection zones.
3. Dispose of surplus topsoil. Surplus topsoil is that which exceeds quantity indicated to be stockpiled or reused.
4. Stockpile surplus topsoil to allow for respreading deeper topsoil.

3.7 SITE IMPROVEMENTS

A. Remove existing above- and below-grade improvements as indicated and necessary to facilitate new construction.

B. Remove slabs, paving, curbs, gutters, and aggregate base as indicated.

1. Unless existing full-depth joints coincide with line of demolition, neatly saw-cut along line of existing pavement to remain before removing adjacent existing pavement. Saw-cut faces vertically.
2. Paint cut ends of steel reinforcement in concrete to remain with two coats of antirust coating, following coating manufacturer's written instructions. Keep paint off surfaces that will remain exposed.

3.8 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Remove surplus soil material, unsuitable topsoil, obstructions, demolished materials, and waste materials including trash and debris, and legally dispose of them off Owner's property.

B. Separate recyclable materials produced during site clearing from other nonrecyclable materials. Store or stockpile without intermixing with other materials and transport them to recycling facilities. Do not interfere with other Project work.

END OF SECTION 311000

SECTION 312000 –EARTH MOVING

PART 1 - GENERAL

1.1 SUMMARY

A. Provide building excavation, fill, backfill and compaction specified and shown on the drawings. Included is preparation of subgrade for footings, and slabs pavement within the general building area.

1.2 SUBMITTALS

A. Test Reports: The independent testing lab shall submit copies of the following reports to the Architect-Engineer and Owner:

1. Report and certification of backfill and fill materials.
2. Test reports on borrow material.
3. Verification of each footing subgrade.
4. Field density test reports.
5. One optimum moisture-maximum density curve for each type of soil encountered.
6. Other tests and material certificates, as required.

1.3 QUALITY ASSURANCE

A. Codes and Standards: Comply with the provisions of the following codes, specifications and standards except as otherwise shown or specified:

1. Governing Local Building Code.
2. American Society for Testing and Materials (ASTM).

B. Regulations: Perform excavation work in compliance with applicable requirements of governing authorities having jurisdiction.

1. Inspection Testing Laboratory: The Contractor shall employ and pay an independent geotechnical testing laboratory, acceptable to the Architect-Engineer, to perform sampling and testing of soil materials proposed for use in the work, field observation and testing for quality control during earthwork operations. All testing and inspection shall be under the direct supervision of a registered geotechnical engineer. The geotechnical engineer shall review and approve the probe compaction pattern from the specialty soil improvement contractor.

1.4 PROJECT/SITE CONDITIONS

A. Site Information: The data on subsurface conditions shall be as interpreted in the General Conditions. Additional test borings and other exploratory operations may be made at no cost to the Owner.

B. Existing Utilities: Locate existing underground utilities in the areas of work. Relocate all utilities within 10’ of the face of the tower walls (see plans for additional information). If

utilities are to remain in place, provide adequate means of protecting during excavation operations.

1. Should uncharted, or incorrectly charted, piping or other utilities be encountered during excavation, consult the utility owner immediately for directions. Cooperate with the Owner, the public and private utility companies in keeping their respective services and facilities in operation. Repair damaged utilities to the satisfaction of the utility Owner.

2. Do not interrupt existing utilities serving facilities occupied and used by the Owner or others, except when permitted in writing by the Architect-Engineer and then only after acceptable temporary utility services have been provided.

3. Demolish and completely remove from the site existing underground utilities indicated to be removed. Coordinate with local utility companies for shut-off of services if lines are active.

C. Use of explosives is not permitted.

D. Protection: Protect structures, utilities, sidewalks, pavements and other facilities from damages caused by settlement, lateral movement, undermining, washout and other hazards created by excavation operations.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

A. Backfill and Fill Materials:

1. Satisfactory soil materials for backfill and fill shall be non-cohesive soils and cohesive soils (low to medium plasticity) as defined by the Unified Soil Classification (CL, ML, SC, or SM) and shall be free of organics or other deleterious materials.

2. Satisfactory soil materials for backfill and fill shall have a minimum dry density of 90 pounds a cubic foot as determined by a standard Proctor (ASMT D698).

2.2 COMPACTION EQUIPMENT

A. Vibratory Rollers: The vibratory drum roller shall have the following minimum requirements:

1. Drum Roller: 60 inches in diameter minimum

2. Static at Drum Weight: 10,000 pounds minimum

3. Approved compactors include Galion, Dynapac and Bros.

4. Vibratory compaction shall be performed so as not to damage existing structures. Rollers shall not be used adjacent to the existing structures or within a distance that will have an adverse effect. When compacting within 15 feet of the existing structure, a lightweight walk-behind sled or roller compactor should be used. Use mechanical hand equipment or alternate compaction equipment as needed at the mat foundation bearing level.

B. Mechanical Hand Equipment: Hand vibratory sleds, rollers and tampers shall be capable of meeting the compaction requirements specified herein. Total weight shall be on the order of 100 to 500 pounds.

2.3 SOURCE QUALITY CONTROL

A. Testing: The independent testing laboratory shall perform the following:

1. Test soil materials proposed for use in the work and promptly submit test result reports.

2. Provide one optimum moisture-maximum density curve for each type of soil encountered in subgrade and fills under building slabs and foundations. Determine maximum densities in accordance with ASTM D 698.

3. For backfill and fill materials, perform a mechanical analysis, AASHTO T88; plasticity index, AASHTO T90; and moisture-density curve, AASHTO T99 or ASTM D 698.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine the areas and conditions under which building excavation and fill is to be performed and do not proceed with the work prior to correcting unsatisfactory conditions.

3.2 CLEARING AND STRIPPING BUILDING AREAS

A. Clear and grub the entire building area to at least 10 feet beyond perimeter of tower mat foundation to remove stumps, roots, trees, vegetation, organic material, surficial silt and silty sand zones, and other obstructions to the work. Grub out or remove all roots larger than 1/4 inch in diameter, matted roots, other organic material, surficial silt and sandy silt zones to at least 24 inches below finished grade.

B. All topsoil, organic, or otherwise, within areas to receive fill should be excavated and stockpiled for replacement on completed slopes to provide a seed bed. The Architect-Engineer shall be the sole judge as to what constitutes organic soil and suitability of its disposal from areas within the building and slab areas and stockpile on the site for future use in site grading.

3.3 COMPACTION OF EXPOSED SOILS

A. After cleaning and stripping, exposed soils compaction shall be performed in the presence of a qualified geotechnical representative.

B. The entire building area to 10 feet beyond the perimeter of the tower mat foundation shall be leveled and proof-rolled using a heavy vibratory drum roller or a loaded 20 to 30 ton truck. A minimum of eight complete coverages, four in each direction, shall be made with the construction equipment. Continue compaction until requirements specified herein are attained. Placement of structural fill to achieve design grade shall then proceed. Adhere to the compaction requirements set forth herein.

1. Proof-rolling shall be performed during good weather and not while the site is wet. Areas that pump, rut, weave, or are otherwise determined unsuitable or unstable, by a qualified geotechnical representative, shall be excavated and replaced.

3.4 EXCAVATION

A. Excavation consists of the removal and disposal of materials encountered when establishing the required grade elevations for the site including footings, utilities and all other items indicated in the drawings and specifications.

B. Earth excavation includes the removal and disposal of pavement and other obstructions visible on the ground surface, under-ground structures and utilities to be demolished and removed, material of any classification indicated in data on subsurface conditions, and other materials encountered that are not classified as unauthorized excavation.

C. Unauthorized excavation consists of removal of materials beyond indicated subgrade elevations or side dimensions without the specific direction of the Architect-Engineer. Unauthorized excavation, as well as remedial work shall be at the Contractor's expense. Backfill and compact unauthorized excavations as specified for authorized excavations of the same classification, unless otherwise directed by the Architect-Engineer.

D. Additional Excavation:

1. When excavation has reached required subgrade elevations, notify the independent testing laboratory, which shall test and inspect the conditions.

2. If unsuitable bearing materials are encountered at the required subgrade elevations, or the existing subgrade does not meet the required bearing capacity as shown on the drawings, over-excavate to the depth and lateral limits recommended by the Geotechnical Engineer
   a. Over-excavation shall be replaced with compacted dense graded aggregate: VDOT #21A or #21B size aggregate. Compact to the required percentages of maximum dry density determined in accordance with ASTM D 698.

3. Removal of unsuitable material in excess of one foot in depth and its replacement as directed will be paid on the basis of contract conditions relative to changes in the work.

E. Stability of Excavations:

1. Comply with local codes and ordinances and requirements of agencies having jurisdiction. Slope sides of excavations as necessary for stability and compliance. Shore and brace where sloping is not possible either because of space restrictions or stability of material excavated. Maintain sides and slopes of excavations in a safe condition until completion of backfilling.

2. Shoring and Bracing: Provide shoring and bracing designed for and adequate to resist all imposed loads.

F. Dewatering:

1. Prevent surface water and subsurface or groundwater from flowing into the excavations and flooding the project site and surrounding area.

2. Do not allow water to accumulate in excavations. Remove water from excavations to prevent softening of foundation bottoms, undercutting footings and soil changes detrimental to the stability of subgrades and foundations. Provide and maintain pumps, well points, sumps, suction and discharge lines and other dewatering system components necessary to convey the water away from excavations.

3. Convey water removed from excavations and rainwater to collecting or run-off area. Establish and maintain temporary drainage ditches and other diversions outside the excavation limits for each structure. Do not use trench excavations for site utilities as temporary drainage ditches.

4. Provide groundwater control as required to maintain groundwater levels at least 12 inches below the bottom of any excavation made during construction and at least 24 inches below the surface of any vibratory compaction operations.

G. Material Storage:

1. Stockpile excavated materials classified as satisfactory soil material where directed, until required for backfill or fill. Place, grade and shape stockpiles for proper drainage.

2. Locate and retail fill materials away from edges of excavations.

3. Dispose of excess soil material and waste materials as herein specified.

H. Excavation for Structures:

1. Conform to the elevations and dimensions shown on the drawings, within a tolerance of plus or minus 0.10 foot, and extending a sufficient distance from footings and foundations to permit placing and removal of concrete formwork, installation of services, other construction and for inspection.

2. In excavating for footings and foundations, take care not to disturb the bottom of the excavation. Excavate by hand to final grade just before concrete reinforcement is placed. Trim bottoms to the required lines and grades to leave a solid base to receive concrete.

3. Mat foundation concrete should be placed on the same day bearing surface is prepared and tested.

I. Excavation for Trenches: Dig trenches to the uniform width required for the particular item to be installed, sufficiently wide to provide ample working room.

1. Excavate trenches to the depth indicated or required. Carry the depth of trenches for piping to establish the indicated flow lines and invert elevations. Beyond the building perimeter, keep bottoms of trenches sufficiently below finish grade to avoid freeze-ups.

2. Grade bottom of trenches as indicated, notching under pipe bells to provide solid bearing for the entire body of the pipe.

3. Backfill trenches with concrete where trench excavations pass within 18 inches of column or wall footings and which are carried below the bottom of such footings, or which pass under wall footings. Place concrete to the level of the bottom of adjacent footing. Concrete is specified in Division 3.

4. Do not backfill trenches until tests and inspections have been made and backfilling authorized by the Architect-Engineer. Use care in backfilling to avoid damage or displacement of pipe systems.

J. Closing Abandoned Underground Utilities: Fully grout any abandoned underground utilities not indicated to be removed.

K. Cold Weather Protection: Protect excavation bottoms against freezing when the atmospheric temperature is less than 35 degrees F.

3.5 BACKFILL AND FILL

A. General:

1. In all excavations, use satisfactory excavated or borrow material that has been sampled, tested and approved by the soil-testing agency.

2. Backfill excavations as promptly as the work permits, but not until completion of the following:

   a. Completion of construction below finish grade including, where applicable, damp proofing, waterproofing and perimeter insulation.

   b. Inspection, testing, approval and recording locations of underground utilities.

   c. Removal of concrete framework.

   d. Removal of shoring and bracing, and backfilling of voids with satisfactory materials. Cut off temporary sheet piling driven below bottom of structures and remove in manner to prevent settlement of the structure or utilities, or leave in place if required.

   e. Removal of trash and debris.

   f. Permanent or temporary horizontal bracing is in place on horizontally supported walls.

B. Placement and Competition:

1. Place backfill and fill materials in lifts of 8 to 9 inch loose thickness for material compacted by heavy vibratory compaction equipment and not more than 4 inches in loose depth for material compacted by hand-operated tampers.

2. Before compaction, moisten or aerate each layer as necessary to provide the soil material within plus 2%, minus 3% of optimum moisture content of the soil material. Compact each layer to the required percentage of maximum dry density or relative dry for each area classification. Do not place backfill or fill material on surfaces that are muddy, frozen or contain frost or ice.

3. Place backfill and fill materials evenly adjacent to structures, to the required elevations. Take care to prevent wedging action of the backfill against structures by carrying the material uniformly around the structure to approximately the same elevation in each lift. Do not overcompact against retaining walls and structures. Provide temporary bracing for retaining walls which are backfilled prior to construction of any restraining slab or other element.

3.6 COMPACTION

A. General: Control soil compaction during construction for compliance with the percentage of density specified.

B. Percentage of Maximum Density Requirements: Compact soil to the following percentages of maximum dry density determined in accordance with ASTM D 698:

1. Typical Building and Structure Areas: Compact 12 inches below stripped existing grade, mat footing bottoms and all slabs and structures and each layer of backfill or fill material to not less then 98 percent maximum dry density determine in accordance with ASTM D 698.

C. Moisture Control:

1. Where the subgrade or layer or soil material must be moisture conditioned before compaction uniformly apply water to the surface of subgrade, or layer of soil material, to prevent free water appearing on the surface during or subsequent to compaction operations.

2. Remove and replace, or scarify and air dry, soil material that it too wet to permit compaction to specified density.

3. Soil material that has been removed because it is too wet to permit compaction may be stockpiled or spread and allowed to dry. Assist drying by discing, harrowing or pulverizing, until the moisture content is reduced to a satisfactory value.

3.7 FIELD QUALITY CONTROL

A. Allow independent testing laboratory to inspect and approve subgrades and fill layers before further construction work is performed.

B. The independent testing laboratory shall perform the following:

1. Field density tests in accordance with ASTM D 1556 (sand cone method) or ASTM D 2922 (nuclear method).

2. Foundation Subgrade: For each strata of soil on which foundations will be placed, conduct, at least one density test to verify the required design bearing capacities.
   a. One density test per 1,000 sf per lift, 3 minimum per lift

3. Utilities: One compaction test per 100 linear feet per lift

C. If, in the opinion of the Architect-Engineer, based on testing service reports and inspection, the subgrade or fills which have been placed are below the specified density, provide additional compaction and testing at no additional cost to the owner.

1. The results of density tests will be considered satisfactory when the average of any four consecutive test are each instance equal to or greater than the specified density, and if not more than one density test out of five has a value greater than two percent below the required density.

3.8 PROTECTION

A. Protection of Graded Areas:

1. Protect newly graded areas from traffic and erosion. Keep free of trash and debris.

2. Repair and re-establish grades in settled, eroded and rutted areas to the specified tolerances.

B. Reconditioning Compacted Areas: Where completed compacted areas are disturbed by subsequent construction operations or adverse weather, scarify the surface, re-shape and compact to the required density prior to further construction. Use hand tamping for recompaction over underground utilities and underfloor subdrains, if any.

3.9 DISPOSAL OF EXCESS AND WASTE MATERIAL

A. Removal from Owner's Property: Remove all waste materials, including excavated material classified as unsatisfactory soil material, trash and debris, and legally dispose of it off the Owner's property.

3.10 SPECIAL INSPECTIONS

A. General: Special inspection and verification of earthwork construction shall conform to the requirements of Section 014500 – Statement of Special Inspections.

END OF SECTION 312000

SECTION 312318 - BLASTING

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section includes procedures for blasting for excavation. The use of explosives during construction shall be as specified herein. However, no blasting will be permitted which, in the blasting supervisor's judgment or the judgment of the Engineer or Owner, may be detrimental to existing facilities or pipelines.

B. The Contractor shall be liable for all injuries to, or death of, persons, or damage to property caused by a blast or explosive, and he agrees by submission of a bid to indemnify and hold the Owner, its officers, agents, employees, volunteers and project consultants harmless from any and all liability claims, costs, expenses including expenses of investigation and defending against the same in regard thereto.

C. At least 28 calendar days in advance of any proposed blasting, Contractor shall submit to the Engineer a request for permission to blast that includes a general description of the proposed blasting activities, and the approximate location(s) and volume(s) of rock to be removed by blasting. If the request for blasting is not approved by the Engineer for a specific area, then rock must be removed by means other than blasting. If the request for blasting is approved by the Engineer, then the procedures for blasting shall conform to the requirements described herein.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. Record Drawings.

B. Earth Moving.

1.3 REFERENCES

Comply with the applicable rules, regulations and standards established by the Regulatory Agencies, codes and professional societies listed herein, including rules and regulations for storage, transportation, and use of explosives.

A. Whenever blasting operations are in progress, explosives shall be stored, handled and used as provided in: the Federal Occupational Safety and Health Act of 1970 and the Construction Safety Act of 1969, as amended; Safe Explosives Act, Title XI, Subtitle C of Public Law 107-296, Interim Final Rule; and Organized Crime Control Act of 1970, Title XI, Public Law 91-452, Approved October 15, 1970, as amended; and Virginia Department of Mines, Minerals, & Energy (DMME) rules.

B. Ensure that all explosive deliveries to work sites are done in compliance with recent rules and regulations issued by the Department of Transportation (DOT) and the Transportation Security Administration (TSA) on commercial transportation of explosives pursuant to the mandates of the USA PATRIOT ACT of 2001. Under TSA rules, commercial drivers with hazardous materials endorsement shall undergo a personal background records check, training and testing.

C. Comply with all the applicable provisions of OSHA of 1970, 29 U.S.C., Section 651 et seq., including safety and health regulations for construction.

D. U.S. Code of Federal Regulations (CFR)

1. CFR 27, U.S. Department of Justice, Alcohol, Tobacco, Firearms and Explosives Division (ATF). 27 CFR Part 555, Implementation of the Safe Explosives Act, Title XI, Subtitle C of Public Law 107-296; Interim Final Rule.

2. Organized Crime Control Act of 1970, Title XI, Public Law 91-452, Approved October 15, 1970, as amended.

3. CFR 49, Parts 100-177 (DOT RSPA); 301-399 (DOT FHA).

4. Federal Occupational Safety and Health Act of 1970, as amended.

5. Construction Safety Act of 1969, as amended.

6. Uniform Fire Code, Article 77.

E. State Agencies:

1. Code of Virginia

a. Title 45.1, Mines and Mining

F. Non-regulating Industry Support Organizations:

1. Vibration Subcommittee of the International Society of Explosive Engineers (ISEE), blast monitoring equipment operation standards (1999).

2. IME (Institute of Makers of Explosives) Safety Library Publications (SLPs).

1.4 DEFINITIONS

A. Peak Particle Velocity (PPV): The maximum of the three ground vibration velocities measured in the vertical, longitudinal and transverse directions. Velocity units are expressed in inches per second (ips).

B. Air-Overpressure: Temporary changes in ambient air pressure caused by blasting.

1. Air-overpressure is expressed in units of psi or dB or dBL (linear decidel scale). Measurements for blasting are made with microphones having a flat frequency response for over-pressure in the 2 to 200 Hz range. A- weight or C-weight microphones shall not be used for these measurements.

C. Occupied Building: Structure on or off construction limits that is occupied by humans or livestock.

D. Residential Building: Includes single and multiple family dwellings, hotels, motels and any other structure containing sleeping quarters.

E. Scaled Distance: A factor describing relative vibration energy based on distance and charge-per-delay. For ground vibration control and prediction purposes, Scaled Distance (Ds) is obtained by dividing the distance of concern (D) by the square root of the charge-per-delay (W), Ds = D/(W)0.5. Minimum scaled distance limits are used to establish charge weights and the units of scaled distance (Ds) are ft-lb-0.5.

F. Charge-per-Delay: For vibration control, any charges firing within any 8-millisecond time period are considered to have a cumulative effect on vibration and air-overpressure effects. Therefore, the maximum charge-per-delay (W) is the sum of the weight of all charges firing within any 8-millisecond time period. For example, if two 10-lb. Charges fire at 100 ms and one 15-lb charge fires at 105 ms, the maximum charge per delay would be 35 lbs.

G. Production Holes: Blast holes in the main body of the rock mass being removed by drilling and blasting.

H. Stemming: Crushed stone, tamped clay or other inert earth material placed in the unloaded collar area of blastholes for the purpose of confining explosive charges and limiting rock movement and air-overpressure (airblast).

I. Primary Initiation: The method whereby the blaster initiates the blast(s) from a remote and safe location. Primary initiation systems use pneumatic tubing or shock-tubes to convey firing energy from blasters to blast locations.

J. Sub-drilling: The portion of the blasthole that is drilled below or beyond the desired excavation depth or limit. Subdrilling is generally required to prevent the occurrence of high or tight areas of unfractured rock between blastholes.

K. Prohibited Persons: Persons prohibited from handling or possessing explosive materials as defined by the seven categories described in Section 555.11 of 27 CFR (ATF Rules).

L. Delay: A distinct pause of pre-determined time between detonations of single charges or groups of charges.

M. Blaster-in-Charge or Blasting Supervisor: The single designated and licensed person with complete responsibility and total authority over all decisions involving safe handling, use and site storage of explosives.

N. Blast Consultant: A person with extensive knowledge of noise vibration, and visual impacts of blasting operations, and who is specialized in the detonation of explosives. The Blast Consultant shall be provided by the Contractor.

1. The Blast Consultant shall have 10 years of experience in construction blasting. They must be able to demonstrate involvement in at least five (5) projects with blasting within 200 feet of residential structures.

1.5 SUBMITTALS

A. Submit submittal packages in accordance with Section 013300.

B. Submit Safety Plan for the Use of Explosives that meets all requirements of paragraph 1.06.E.

C. Submit Blasting Control Plan meeting requirements of paragraph 1.06.J.

D. Submit after blast reports meeting all requirements of paragraph

1.06.R.

E. Submit copies of all required blasting permits.

F. Qualifications of Blasting Supervisor and Blast Consultant.

1.6 PERMITS, SAFETY ORDERS AND RECORDS

A. No drilling or blasting work shall be performed until the Contractor's Safety Plan and Blasting Control Plan for such operations has been submitted and approved by the Owner and Engineer.

B. Prior to any blasting by the Contractor for the work, obtain the blasting permits required by the local City/County, the State of Virginia, and any applicable agency having jurisdiction. Notify the local sheriff's office, local fire department, and utilities in the general blast area. A copy of all permits required shall be submitted to the Engineer prior to drilling for blasting.

C. The transporting, handling, storage, and use of explosives shall conform to applicable agencies having jurisdiction.

D. Comply with the requirements specified in the Virginia DMME regulations.

E. At a minimum of 14 days prior to the commencement of any work involving explosives, including drilling, submit a complete Safety Plan For The Use Of Explosives. A Blasting Safety Plan simply stating: “all regulations will be followed” will not be acceptable. Blasting Safety Plan shall include:

1. A complete list of all authorities having jurisdiction over operations involving the transportation, storage, handling and use of explosives.

2. A printed copy of all applicable federal, state and local regulations governing the use and storage of explosives for this work shall be attached to the Blasting Safety Plan.

3. Copies of all required blasting permits regarding explosive use and storage.

4. Copies of Virginia Blasting Licenses, including proper initiation system and construction blasting endorsements, for all blasters overseeing blasting operations.

5. A list of at least three previous projects of similar character, successfully completed. List shall include contact names and phone numbers of the owner's responsible project manager or engineer.

6. A complete description of the clearing and guarding procedures that will be employed to ensure personnel, staff, visitors, and all other persons are at safe locations during blasting. This information shall include details regarding visible warning signs or flags, audible warning signals, method of determining blast areas (all areas affected by any potentially harmful blast effects), access blocking methods, guard placement and guard release procedures, primary initiation method, and the system by which the blaster-in-charge will communicate with site security guards.

7. A detailed description of how explosives will be: 1) kept in day-storage-boxes when on site, and 2) transported and used at the various project work areas. Plans shall explain how day-storage magazines and explosive transport vehicles will satisfy all applicable ATF, OSHA, federal, and local regulations. This plan shall also indicate how explosives will be inventoried, secured and guarded to prevent theft or unauthorized use.

8. Include Material Safety Data Sheets (MSDS) and specific details about hazard communication programs for employees.

9. Equipment that will be used to monitor the approach of lightning storms and in the event of such, evacuation and site security plans.

10. Detailed contingency plans for handling of misfires caused by cutoffs or other causes.

F. A minimum of 14 days prior to commencement of any blasting operations, the Contractor shall be responsible for all notification required by his permits, but shall at a minimum notify all residences within 1,000 feet of any blast at least 24 hours prior to the blast. Contractor shall be responsible for inspection of structures as required by his permits and this specification prior to the blast.

G. Pre-Blast Survey

1. At least 30 days before initiation of blasting, the Contractor shall notify, in writing, all residents or owners of dwellings or other structures located within 600 feet of the blasting area of the intent to conduct a pre-blasting survey. The Owner may identify alternate pre-blast survey distances.

2. The method used for the pre-blast survey shall be acceptable to the Contractor's insurance company. The Contractor shall be responsible for any damage resulting from blasting.

3. The Blasting Consultant shall determine the condition of the dwelling or structure and shall document any existing damage and other physical factors that could reasonably be affected by the blasting. The Blasting Consultant shall examine the interior as well as the exterior structure and shall document any damage by means of photographic or digital recording methods.

4. Structures such as pipelines, cables, transmission lines, cisterns, wells, and other water systems warrant special attention. However, the assessment of these structures may be limited to surface conditions and other readily available data.

5. The written report shall be signed by the person who conducted the survey. Copies of the report shall be promptly provided to the Contractor, Owner, and Engineer. All surveys shall be completed by the Blast Consultant before the initiation of blasting. All surveys shall be conducted by an independent third party, regularly engaged in performing pre-blast surveys.

H. A blasting supervisor licensed by the State of Virginia, DMME and acceptable to the Owner shall be on the site, and in immediate charge of the blasting operations. The license of the supervising blaster(s) shall contain endorsements for construction blasting and use of non-electric initiation systems. Such supervisor shall have no less then five years of continuous experience in controlled blasting on projects of similar character. A written description of the education and experience of this supervisor shall be submitted to the Engineer. The description shall be specific and include references that are able to verify the details.

I. The Contractor shall retain the services of an outside Blast Consultant regarding the prediction and control of ground vibration and air-overpressure. Such Blast Consultant shall not be in the employ of the Contractor and shall be subject to the approval of the Owner. Consultant's qualifications shall be submitted to the Owner in writing as part of the Blasting Control Plan.

J. Proper criteria and blast effects limitations for any given location and any given structures, residences, utilities, and any other facilities shall be evaluated and determined by the Contractor and by the approved Blasting Consultant.

K. Submit a Blasting Control Plan to the Engineer. No blasting operation, including drilling, shall start until the Engineer has reviewed and approved the Blasting Control Plan. Allow not less than two weeks for Engineer review of the Plan. In the event that additional or revised Blasting Control Plans are required, provide at least two weeks for the review of each additional plan. Approval of the Contractor's Blasting Control Plan or blasting procedures shall not relieve the Contractor of any of his responsibility for assuring the complete safety of his operations or for the successful completion of the work in conformity with the requirements of the Drawings and Standard Specifications. The Blasting Control Plan shall include:

1. Details of controlled blasting techniques. Include plan and vertical section drawings showing hole locations, spacing, diameter and loading details for typical blastholes charges.

2. All blast plan drawings shall indicate explosive types, amounts, priming method, initiator types, delay periods, and locations, charge firing times, stemming type and quantities, and typical charge weights.

3. Plans for preventing overbreak or ground shifting that could threaten adjacent buried utilities. Plan shall include calculations showing predicted levels of vibration not exceeding 5.0 in/s at the nearest buried pipe.

4. Methods of drilling, including equipment descriptions, and hole placement and alignment techniques.

5. Hole Charging Methods: Primer make-up, placement of charges and inert stemming and method of securing detonators until tie-in.

6. Initiation system hook-up methods and method of primary initiation.

7. Methods for preventing spills or losses of explosives, drilling fluids, oil, or any other pollutants to ground during all handling and hole charging operations. Include details of all containment and contingency plans for quickly and effectively cleaning up any spilled materials.

8. Method of safe and approved disposal of all explosive packaging materials.

9. Copies of: 1) blasting permits, 2) blasters' licenses, and 3) explosive transporters' commercial driver’s licenses with Hazmat endorsements.

10. The Blasting Control Plan shall indicate the type and method of instrumentation proposed to determine the ground motion particle velocity and air blast overpressure. The description shall include the manufacturer and model of the instrumentation, the source of the instrumentation (rented or owned and by whom). Include copies of calibration certificates issued by the equipment maker that confirm the instruments and transducers have been calibrated within the last 12 months.

L. A minimum of two portable seismographs shall be available for use on the project at all times. The seismographs shall be capable of producing a permanent record and shall meet the following technical standards.

1. Equipment for on-site and off-site particle velocity and air overpressure monitoring shall be 4-channel (1 overpressure and 3 seismic channels) units capable of digitally storing collected data. Equipment shall be capable of printing ground motion time histories and summaries of peak motion intensities and frequencies. Printed report records shall also include date, time of recording, operator name, instrument-number and date of last calibration.

2. Instruments shall have a flat frequency response between 2 and 250 Hz for particle velocity and from 2 to 200 Hz for air overpressure.

3. The digitizing sampling rate for peak particle velocity and air overpressure measurements shall be least 1,024 samples per second.

4. Seismographs used for off-site compliance monitoring shall be capable of recording overpressure from 88 to 148 dBL, and particle velocity from 0.05 to 5.0 in/sec.

5. Systems shall be capable of providing printed event reports that include all peak measurements, frequencies and complete waveform plots.

6. Seismographs shall have adequate memory to digitally record events of the blast-induced motion lasting up to five seconds.

7. All seismograph software systems shall be capable of saving back-up copies of all event files on USB disks in file formats supported by software that can open and interpret stored data. Upon request of the Engineer the Contractor shall provide a licensed copy of the appropriate software, and all monitoring data files, to the Owner.

8. Seismographs shall be provided by:

   a. White Industrial Seismology Inc. (303) 324-4116,

   b. Nomis Seismographs. (205) 592-2466,

   c. GeoSonics/Vibr-Tech. (724) 934-2900,

   d. Instantel. (425) 888-5425, or

   e. Approved Equal.

M. All vibration and air-overpressure measuring equipment shall be used in accordance with the standards established by the Vibration Section of The International Society of Explosives Engineers (ISEE). The following standards shall be applied when measuring blast-induced vibration and air-overpressure.

1. General Guidelines for Vibration and Air-Overpressure Measuring Equipment:

   a. Only personnel who have successfully completed a proper training course shall operate monitoring equipment.

   b. The recording units and sensor instruments shall be calibrated. Documenting certificates shall be kept on file and copies shall be provided to Engineer upon request.

   c. When employing instruments to operate in auto-trigger-mode, trigger levels shall be set low enough to record blast effects. If expected levels of blast noise or vibration do not exceed minimum trigger levels, the instrument shall be attended by an operator and turned on manually.

   d. The horizontal distance from the seismograph to the blast shall be known to at least two significant digits. For example, a blast within 1000 feet would be nearest tens of feet and a blast within 10,000 feet would be measured to the nearest hundreds of feet. Where the vertical-to-horizontal ground slope ratio

exceeds 2.5 to1, slant distances or true distance shall be used and recorded in the monitoring records.

e. When instruments are used in auto-trigger and continuous-recording mode to record the effects of multiple blasts, the time between successive blasts shall be at least one (1) minute and seismographs shall be set to NOT automatically print out event records. These procedures shall ensure that instruments have adequate time to save event data for each blast and reset to monitoring mode before subsequent blasts occur.

f. The memory or record capacity of the seismograph shall be sufficient to store the event data from the blast(s) planned during that operating day.

g. Instruments shall be set to save full waveform data for all monitored blast and digitally saved event files shall contain this data for use in further analyses if needed.

h. In order to prevent false triggering, suspended or freely moving cables shall be secured from movement by the wind or other extraneous sources.

2. Ground Vibration Monitoring:

a. Sensor Placement

1) Place the sensor on or in the ground on the side of the structure towards the blast. A structure can be a house, pipeline, telephone pole, etc. Measurements on driveways, walkways, and slabs are to be avoided where possible.

2) Place the sensor within 10 feet of the structure or less than 10% of the distance from the blast, whichever is less.

3) Avoid placing velocity transducers in loose or low-density soils. The density of the ground shall be greater than or equal to the sensor density.

4) Place transducers so they are level or nearly level.

5) Orient sensor blocks so the arrow indicating the longitudinal direction is aimed at the blast location.

6) Where access to a structure is not available, place the transducers at the accessible location closest to the structure of concern and in line with the blast.

b. Sensor Coupling

1) Based on expected acceleration as determined from ISEE Standards (see Table 1 below), use the following methods to couple vibration transducers to the ground or structure to avoid decoupling errors:

a. Less than 0.2 g: No burial or attachment is necessary.

b. Between 0.2 and 1.0 g: Transducer shall be attached to the ground with a spike or covered with a sand bag.

c. Greater than 1.0 g: Transducer shall be buried, bonded to the ground or structure with stiff clay or putty, or some other method that shall achieve firm attachment.

Table 1: Acceleration Intensity (g's) Based on Estimated Particle Velocities and Frequencies

			Maximum Frequency (Hz or cycles-per-second)								
	4	10	15	20	25	30	40	50	100	150	200
PPV (in/s) at Acc. (g) ≥**0.2**	3.0	1.2	0.8	0.6	0.4	0.4	0.3	0.2	0.1	0.0	0.0
PPV (in/s) at Acc. (g) ≥**1.0**	15.	6.1	4.1	3.0	2.4	2.0	1.5	1.2	0.6	0.4	0.3

2) Employ the following methods for sensor burial:

b) Excavate a hole that is no less than three times the height of the sensor (ANSI S2.47-1990, R1997).

c) If possible, spike the sensor to the bottom of the hole.

d) Firmly compact soil around and over the sensor.

3) Employ the following methods for attaching sensors to bedrock or hard structural surfaces:

a. Bolt, clamp or use epoxy or putty to firmly couple the sensor to the hard surface.

b. The sensor may be attached to the foundation of the structure if it is located within +/- 1-foot of ground level (USBM RI 8969). This method shall only be used if burial, spiking or and bagging is not practical.

4) If disturbance of the ground is not possible, cover transducers with sand bags loosely filled with about 10 pounds of sand. When placed over the sensor, the sandbag profile shall be as low and wide as possible with a maximum amount of firm contact with the ground. If possible also spike the sensor to the ground.

a. Programming Considerations for Ground Vibration Monitoring:

1. The PPV ground motion trigger-level shall be programmed low enough to trigger the unit from blast vibrations and high enough to minimize the occurrence of false events. The level

shall be slightly above the expected background vibrations for the area.

2. If PPV is expected to exceed 10 in/s or frequency is expected to exceed 250Hz, special sensors shall be used to measure blast effects. A digital sampling rate shall be used that provides accurate recordings. The approach shall be described in the Blasting Plan.

3. Set the record time for 2 seconds longer than the blast duration plus 1 second for each 1100 feet from the blast.

2. Air-Overpressure Monitoring:

a. Microphone Placement:

1. Place the microphone along the side of the structure nearest the blast.

2. Cover the microphone with a windscreen and mount it near the velocity transducers.

3. The preferred microphone height is 3 feet above the ground or within 1.2 inches of the ground. If other heights are to be used, describe them in the Blasting Plan. (ANSI S12.18-1994, ANSI S12.9-1992/Part2) (USBM RI 8508)

4. If possible, the microphone shall not be shielded from the blast by nearby buildings, vehicles or other large barriers. If such shielding cannot be avoided, the horizontal distance between the microphone and shielding object shall be greater than the height of the shielding object above the microphone.

5. If microphones are placed too close to a structure, the airblast may reflect from the house surface and record higher amplitudes. Structure response noise may also be recorded. Place the microphone near a corner of the structure in order to minimize reflection of over-pressure energy. (USBM RI 508).

b. Programming Considerations for Air-Overpressure Monitoring:

1. When only an airblast measurement is desired, set the trigger level low enough to trigger the unit from the airblast and high enough to minimize the occurrence of false events. The level shall be slightly above the expected background noise for the area.

2. When only recording airblast, set the recording time for at least 2 seconds more than the blast duration. When ground vibrations and air-overpressure measurements are desired on the same record, set the record time for 2 seconds longer than the blast duration plus 1 second for each 1100 feet from the blast.

N. Design of drilling and blasting patterns, explosive types, and quantities shall be at the Contractor's choice; provided, that non-electric initiation devices shall be used and the ground motion limitations as specified herein are met with respect to explosive detonated per delay period; and provided further, that non-nitroglycerin explosive types are used in wet ground conditions, unless the dynamite is phlegmatized (i.e. PowerDitch 1000).

O. Approval of the Contractor's Blasting Control Plan shall not relieve the Contractor of any of his responsibility under the Contract for assuring the complete safety of his operation with respect to adjacent improvements so as to not aggravate the existing structural conditions or cause damage, or for the successful completion of the work in conformity with the requirements of the Drawings and Standard Specifications. Such approval shall not operate to waive any of the requirements of the Standard Specifications nor relieve the Contractor of any regulation or permit obligation thereunder.

P. As production blasting operations progress, the drilling and blasting procedures shall be determined only by satisfactory results achieved. If a drilling and blasting program results in unacceptable results, devise and employ methods which will improve results. The revision may include special methods such as, but not limited to, zone blasting, shorter holes, different delay patterns, reduction in size of individual blasts, smaller diameter blast holes, closer spacing of blast holes, or reduction of explosives as necessary to improve results.

Q. Regardless of the ground motion and air-overpressure limits set forth herein, controlled blasting shall be conducted in a manner which will produce relatively smooth and sound rock faces at the final excavation lines. The type, distribution and quantity of explosive detonated per delay period shall be such that existing rock fractures will neither be opened nor new fractures created outside of the minimum excavation limits. Whenever, in the opinion of the Engineer or Inspector, further blasting is liable to reduce rock stability or damage pipelines or other structures, the Contractor shall cease blasting and continue to excavate the rock by approved mechanical means. Excessive blasting or "overshooting" will not be permitted, and any material outside the authorized cross-section which may be shattered or loosened by blasting shall be removed and replaced with acceptable materials at the Contractor's expense.

R. Blasting shall be done only by properly trained workers under the direct supervision of a State-licensed Blasting Supervisor. Blasting shall be done only when proper precautions are taken for the protection of persons, the work, and existing structures. Any damage done to persons, private property, the work, or existing structures shall be the responsibility of the Contractor.

S. Blasting Signs, Warnings, and Access Control

1. Conspicuously place signs reading “Blasting Area” along the edge of any blasting area that comes within 200 feet of any road, and at the point where any other road provides access to the blasting area.

2. Conspicuously place signs reading “Blasting Area – Turn Off Two-Way Radios” along the edge of any blasting area that comes within 1,000 feed to any public road and on either end of the blasting area.

3. At all entrances to the permit area from public roads or highways, place conspicuous signs that state “Warning! Explosives In Use”, which clearly list and describe the meaning of the audible blast warning and all-clear signals that are in use, and which explain the marking of blasting areas and charged holes awaiting firing within the permit area.

4. Warnings and all-clear signals of different character or pattern that are audible within a range of 1,000 feet from the point of the blast shall be given. Each person within the permit area and each person who resides or regularly works within 1,000 feet of the permit area shall be notified of the meaning of the signals.

5. Access within the blasting area shall be controlled to prevent the presence of livestock or unauthorized persons during blasting and until an authorized representative of the Contractor has reasonably determined that no unusual hazards, such as imminent slides or un-detonated charges, exist.

T. Keep accurate records of each blast. Blasting records shall be available to the Engineer and Owner at all times and shall contain the following data as a minimum:

1. Blast identification by numerical and chronological sequence.

2. Location (referenced to pipeline stationing), date and time of blast.

3. Type of material blasted.

4. Number of holes, burden and spacing.

5. Diameter and depth of holes.

6. Height or length of stemming.

7. Types of explosives used.

8. Types of caps and delay periods used.

9. Total amount of explosives used.

10. Maximum amount of explosives per delay period of 9 milliseconds or greater.

11. Powder factor (pounds of explosive per cubic yard of material blasted).

12. Method of firing and type of circuit.

13. Weather conditions (including wind direction).

14. Direction and distance to nearest structure or position of concern.

15. Type and method of instrumentation.

16. Location and placement of instruments by plotting numbered locations on scaled maps to within +/- 1 foot where the equipment was placed.

17. Instrumentation records and calculations for determination of ground motion particle velocity or for charge size based on scaled distance.

18. An ongoing log-log plot of both vibration and air blast data. The Contractor or his Blast Consultant shall maintain an ongoing log-log plot of both ground vibration and air blast overpressures, and shall submit an updated plot to the Engineer after each blast, highlighting the newest data.

19. Measures taken to limit air overpressure and fly rock.

20. Any unusual circumstances or occurrences during blast.

21. Name of Contractor.

22. Name, license number and signature of responsible Blasting Supervisor.

23. Summary report of all complaints including complaints regarding blasting-related damage.

24. Method to notify other contractors, personnel on-site of a scheduled blast.

25. Provide a summary report of all complaints, including complaints regarding blast-related damage.

26. Within 24 hours after each blast, Contractor shall submit to the Engineer a summary report addressing items 1 through 25 above for compilation in a three-ring binder and have the Contractor's current blast reports so compiled and available for immediate review by authorities having jurisdiction, including the Owner and the Engineer.

PART 2 - MATERIALS

Furnish materials and equipment required for blasting operations and monitoring. Material usage, including transportation and storage, shall conform to all applicable regulatory agency and permit requirements.

PART 3 - EXECUTION

3.1 BLASTING HOURS

Blast only between the hours of 9 a.m. and 3 p.m. during any workday, Monday through Friday, unless special circumstances warrant another time or day and special approval is granted in writing by the Owner and the agency having jurisdiction.

3.2 BLASTING PROCEDURES

A. The Contractor is forewarned that existing residential and commercial properties may be located in close proximity of the blast and that these properties shall be protected. The Contractor shall be responsible for all damage to these properties, including providing suitable temporary housing to residents or business occupants until repair work is completed.

B. Control fly rock and debris to prevent damage to persons, structures, existing improvements, or vegetation. Clean the blasting site of debris associated with the blasting operation at the end of each working day. Use blasting mats in developed areas. Equipment used for drilling of holes shall have a positive means of dust control.

C. No blast shall exceed an in-place volume of 750 cubic yards unless approved by Engineer.

D. Do not perform blasting closer than 50 feet to existing water, sewer, or other buried utilities. Any proposed blasting within 300 linear feet of any gas line must have the proposed blast plan submitted to the gas utility for review and approval.

E. Use controlled blasting techniques to keep the air blast overpressure, vibrations, and noise within the limits herein specified. Use controlled blasting techniques to minimize overbreak or fracturing of rock beyond the designated excavation boundaries. Excessive blasting will not be permitted. Material outside the authorized cross-section, which may be shattered or loosened because of blasting, shall be removed at the Contractor's expense and the area repaired to the satisfaction of the Engineer. Discontinue any method of blasting which leads to overshooting, is hazardous in any way to persons, or destructive to property or habitat.

F. Notify the Engineer at least seven workdays before all blasting and if blasting will occur within 1,000 feet of a residence or commercial structure or utility.

G. Fifteen minutes prior to each blast, sound an audible siren or horn capable of being heard within one-half mile of the blasting site.

H. Blasting operations may be suspended by the Engineer, Owner, or authorized agencies for any one or more of the following:

1. Safety precautions are inadequate.

2. Ground motion vibration levels exceed specified limits of particle velocity or frequency.

3. Existing structural conditions are aggravated or adjacent improvements are damaged as a result of blasting.

4. Blasting methods adversely impact the stability of intact rock outside the prescribed limits of excavation.

5. Skilled operators and/or licensed foreman are not present.

Blasting operations shall not resume until modifications have been made to correct the conditions that resulted in the suspension.

I. Repair or replace any damage caused by blasting. Repair or replace any damage resulting from possession or use of explosives for the Work. All repairs and/or replacements will be at the cost of the Contractor.

3.3 MAXIMUM PARTICLE VELOCITIES

Monitor vibrations by measuring the peak particle velocity in the vicinity of work. Peak particle velocity is defined as a maximum of the three velocity components, measured in three mutually perpendicular directions at any point by an instrument. The peak particle velocity of any individual components as measured on or at the locations as specified in the submitted vibration and frequency's monitoring plan, for all blasting, or other vibration-inducing operations, shall not exceed the following levels:

Point of Concern	**Maximum Allowable Peak Particle Velocity, PPV (in/sec)**	**Frequency Range (Hz)**
Surface Structures	0.5	2-250
Buried Pipes or Utility Cables	1.0	2-250

3.4 AIR-OVERPRESSURE

Blast induced air-overpressure at the property or right of way lines or structures within 300 feet of the blast area shall not exceed 0.03 psi (140 dBL). Air-overpressure at residential or other occupied structures shall not exceed 0.012 psi (133 dBL).

3.5 CONSEQUENCES OF BLASTING SPECIFICATION VIOLATIONS

Any violations of Section 3.3 Maximum Particle Velocities or Section 3.4 Air- Overpressure shall obligate the Contractor to pay for all costs to the Owner caused by the violation, including but not limited to: Owner staff and consultant's time and expenses that are required, as solely determined by the Engineer, to investigate such violations. This includes, but is not limited to, reviews of resubmittals by the Contractor, analyses of subsequent Blasting Control Plans submitted by the Contractor, meetings with the Contractor and his Blasting Consultant, and investigations into the condition of existing pipeline, wells, structures, etc. These costs shall be actual cost to the Owner without additional mark-up, and the Owner's decision to charge the Contractor shall be final.

3.6 PUBLIC MEETINGS

The Contractor shall make their qualified Blasting Consultant and other critical personnel available for one (1) day to conduct a public meeting to better inform the public about anticipated drilling and blasting operations. The specialists shall be prepared to answer any questions dealing with the magnitude of seismic motion, air blast overpressure, and fly rock expected to impact the public.

END OF SECTION 312318

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SECTION 312319 - DEWATERING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and all general provisions of the Contract, including General Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes construction dewatering within the site of Air Traffic Control Tower to facilitate grading, drainage, sitework, and building construction.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Verify availability of Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
2. Review condition of site to be dewatered including coordination with temporary erosion-control measures and temporary controls and protections.
3. Review geotechnical report.
4. Review proposed site clearing and excavations.
5. Review existing utilities and subsurface conditions.
6. Review observation and monitoring of dewatering system.

1.4 ACTION SUBMITTALS

A. Shop Drawings: For dewatering system, prepared by or under the supervision of a qualified professional engineer.

1. Include plans, elevations, sections, and details.
2. Show arrangement, locations, and details of wells and well points; locations of risers, headers, filters, pumps, power units, and discharge lines; and means of discharge, control of sediment, and disposal of water.
3. Include layouts of piezometers and flow-measuring devices for monitoring performance of dewatering system.
4. Include written plan for dewatering operations including sequence of well and well-point placement coordinated with excavation shoring and bracings and control procedures to be adopted if dewatering problems arise.

1.5 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

B. Existing Conditions: Using photographs show existing conditions of adjacent construction and site improvements that might be misconstrued as damage caused by dewatering operations. Submit before Work begins.

C. Record Drawings: Identify locations and depths of capped wells and well points and other abandoned-in-place dewatering equipment.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer that has specialized in design of dewatering systems and dewatering work.

1.7 FIELD CONDITIONS

A. Project-Site Information: A geotechnical report has been prepared for this Project and is available for information only. The opinions expressed in this report are those of a geotechnical engineer and represent interpretations of subsoil conditions, tests, and results of analyses conducted by a geotechnical engineer. Owner is not responsible for interpretations or conclusions drawn from this data.

1. Make additional test borings and conduct other exploratory operations necessary for dewatering according to the performance requirements.
2. The geotechnical report is included in Project Manual.

B. Survey Work: Engage a qualified land surveyor or professional engineer to survey adjacent existing buildings, structures, and site improvements; establish exact elevations at fixed points to act as benchmarks. Clearly identify benchmarks and record existing elevations.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Dewatering Performance: Design, furnish, install, test, operate, monitor, and maintain dewatering system of sufficient scope, size, and capacity to control hydrostatic pressures and to lower, control, remove, and dispose of ground water and permit excavation and construction to proceed on dry, stable subgrades.

1. Design dewatering system, including comprehensive engineering analysis by a qualified professional engineer.
2. Continuously monitor and maintain dewatering operations to ensure erosion control, stability of excavations and constructed slopes, prevention of flooding in excavation, and prevention of damage to subgrades and permanent structures.
3. Prevent surface water from entering excavations by grading, dikes, or other means.
4. Accomplish dewatering without damaging existing buildings, structures, and site improvements adjacent to excavation.
5. Remove dewatering system when no longer required for construction.

B. Regulatory Requirements: Comply with governing EPA notification regulations before beginning dewatering. Comply with water- and debris-disposal regulations of authorities having jurisdiction.

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by dewatering operations.

1. Prevent surface water and subsurface or ground water from entering excavations, from ponding on prepared subgrades, and from flooding site or surrounding area.
2. Protect subgrades and foundation soils from softening and damage by rain or water accumulation.

B. Install dewatering system to ensure minimum interference with roads, streets, walks, and other adjacent occupied and used facilities.

1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.

C. Provide temporary grading to facilitate dewatering and control of surface water.

D. Protect and maintain temporary erosion and sedimentation controls during dewatering operations.

3.2 INSTALLATION

A. Install dewatering system utilizing wells, well points, or similar methods complete with pump equipment, standby power and pumps, filter material gradation, valves, appurtenances, water disposal, and surface-water controls.

1. Space well points or wells at intervals required to provide sufficient dewatering.
2. Use filters or other means to prevent pumping of fine sands or silts from the subsurface.

B. Place dewatering system into operation to lower water to specified levels before excavating below ground-water level.

C. Provide sumps, sedimentation tanks, and other flow-control devices as required by authorities having jurisdiction.

D. Provide standby equipment on-site, installed and available for immediate operation, to maintain dewatering on continuous basis if any part of system becomes inadequate or fails.

3.3 OPERATION

A. Operate system continuously until drains, sewers, and structures have been constructed and fill materials have been placed or until dewatering is no longer required.

B. Operate system to lower and control ground water to permit excavation, construction of structures, and placement of fill materials on dry subgrades. Drain water-bearing strata above and below bottom of foundations, drains, sewers, and other excavations.

1. Do not permit open-sump pumping that leads to loss of fines, soil piping, subgrade softening, and slope instability.
2. Reduce hydrostatic head in water-bearing strata below subgrade elevations of foundations, drains, sewers, and other excavations.
3. Maintain piezometric water level a minimum of 12 inches below bottom of excavation and at least 24 inches below the surface of any vibratory compaction operations.

C. Dispose of water removed by dewatering in a manner that avoids endangering public health, property, and portions of work under construction or completed. Dispose of water and sediment in a manner that avoids inconvenience to others.

D. Remove dewatering system from Project site on completion of dewatering. Plug or fill well holes with sand or cut off and cap wells a minimum of 36 inches below overlying construction.

3.4 FIELD QUALITY CONTROL

A. Observation Wells: Provide observation wells or piezometers, take measurements, and maintain at least the minimum number indicated; additional observation wells may be required by authorities having jurisdiction.

1. Observe and record daily elevation of ground water and piezometric water levels in observation wells.
2. Repair or replace, within 24 hours, observation wells that become inactive, damaged, or destroyed. In areas where observation wells are not functioning properly, suspend construction activities until reliable observations can be made. Add or remove water from observation-well risers to demonstrate that observation wells are functioning properly.
3. Fill observation wells, remove piezometers, and fill holes when dewatering is completed.

B. Survey-Work Benchmarks: Resurvey benchmarks regularly during dewatering and maintain an accurate log of surveyed elevations for comparison with original elevations. Promptly notify Architect if changes in elevations occur or if cracks, sags, or other damage is evident in adjacent construction.

C. Provide continual observation to ensure that subsurface soils are not being removed by the dewatering operation.

D. Prepare reports of observations.

3.5 PROTECTION

A. Protect and maintain dewatering system during dewatering operations.

B. Promptly repair damages to adjacent facilities caused by dewatering.

PART 4 - MEASUREMENT AND PAYMENT

4.1 METHOD OF MEASUREMENT

A. Payment will be made at the lump sum price bid for this Section.

B. The lump sum price bid shall include the cost of furnishing all labor, equipment, instruments, cofferdams, earthwork, and all other material necessary to satisfactorily complete dewatering of the Air Traffic Control Tower site.

Payment will be made under

Section 312319 - 1	Dewatering - Per Lump Sum.

END OF SECTION 312319

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SECTION 312513 - EROSION CONTROLS

PART 1 – GENERAL

1.1 DESCRIPTION

1. Work Included: Furnish all labor, materials, supplies, equipment, and appurtenances necessary for the complete and satisfactory construction and maintenance of the erosion control measures shown on the plans. Properties and natural waterways adjacent to the site of land disturbance shall be protected from sedimentation by the use of the erosion control and storm water drainage measures shown on the plans and as may be deemed necessary by the Owner during construction.

2. Related Sections: Additional Sections of the Documents which are referenced in this Section include:

   1) Section 013300 – Submittal Procedures

   2) Section 016600 – Delivery, Storage, and Handling

   3) Section 329200 – Lawns and Grasses

3. Temporary Measures: Temporary erosion and sediment control shall be achieved by using the stated measures where indicated on the plans or as required for erosion control. Said measures shall be constructed and made workable prior to beginning site excavation and grading work. Refer to the VESCH for descriptions of additional measures.

4. Permanent Measures: Permanent erosion and sediment control shall be achieved by seeding and landscaping as detailed in Section 329200 – Lawns and Grasses. The Contractor shall schedule excavation, fill, finish grading, and seeding work in such a manner as to minimize exposure to erosive forces. Seeding of exposed areas shall commence as soon as possible after excavating, backfilling, grading, or other operations have been completed and shall be maintained until an acceptable stand of turf has been developed. Slope protection along indicated areas shall be installed as soon as the grading is complete.

1.2 REFERENCES

1. General: The work shall comply with the most recent standards or tentative standards as published at the date of the contract and as listed in this specification using the abbreviation shown.

2. American Society for Testing and Materials (ASTM):

   1) D 448 — Standard Classification for Sizes of Aggregate for Road and Bridge Construction

3. Virginia Department of Conservation and Recreation Virginia Erosion and Sediment Control Handbook (VESCH):

1) 3.02 Construction Entrance

2) 3.03 Construction Road Stabilization

3) 3.09 Temporary Diversion Dike

4) 3.13 Temporary Sediment Trap

5) 3.17 Storm Water Conveyance Channel

6) 3.19 Riprap

7) 3.29 Surface Roughening

8) 3.31 Temporary Seeding

9) 3.32 Permanent Seeding

10) 3.36 Soil Stabilization Blankets & Matting

4. Virginia Department of Transportation - Road and Bridge Specifications (VDOT):

1) 414 Riprap

1.3 QUALITY ASSURANCE

1. General: All erosion control measures shall be in accordance with the Virginia Erosion and Sediment Control Handbook (VESCH), and all revisions and addenda. Methods used on site shall include, but shall not be limited to VESCH Standard and Specifications, Chapter 3.

2. Performance Requirements: The erosion control measures shall be installed such that the erosion of disturbed ground and the siltation of storm drain pipes and inlets will be prevented.

3. Regulatory Requirements: All phases of the construction work shall comply with or exceed the minimum state requirements for controlling erosion and sedimentation from "land disturbing activities" as outlined in the "Virginia Erosion and Sediment Control Handbook" (VESCH), and all revisions and addenda thereto.

1.4 MAINTENANCE

1. Maintenance Service: The erosion control measures shall be maintained by the Contractor until a vegetative groundcover is achieved, which in the opinion of the Owner, is mature enough to control soil erosion and to survive severe weather conditions.

1.5 SUBMITTALS

1. General: Shall be in accordance with Section 013300 – Submittal Procedures.

2. Materials: The Contractor shall submit to the Owner or to the Engineer shop plans or catalog cuts for:

1) Materials list of items proposed to be provided under this Section.

2) Manufacturer's specifications and other data needed to prove compliance with the specified requirements.

1.6 PRODUCT HANDLING

1. General: Shall be in accordance with Section 016600 - Delivery, Storage, and Handling.

1.7 SITE CONDITIONS

1. Environmental Requirements: Properties and natural waterways adjacent to the site of land disturbance shall be protected from sedimentation by the use of the erosion control measures shown on the plans and in compliance with pertinent erosion and sediment control practices.

2. Vegetation: When conditions detrimental to plant growth are encountered such as rubble fill, adverse drainage conditions or obstructions, the Contractor shall notify the Owner before planting.

3. Planting Time: See VESCH 3.32 and Section 329200 – Lawns and Grasses.

PART 2 - PRODUCTS

2.1 MATERIALS

1. Silt Fence: The silt fence used as a sediment barrier shall utilize extra strength synthetic filter fabrics.

2. Stone: Stone used to construct the temporary construction entrance shall be ASTM D 448 #1 or #2 stone as shown on the plans.

3. Soil Stabilization Mat: Mat shall be a degradable multi-layered soil stabilization blanket consisting of a netting of polyethylene, nylon, vinyl, or other material intertwined with a natural organic or manmade mulch, a jute mesh or excelsoir mat specifically manufactured for maintaining soil slopes until vegetation becomes established. Soil stabilization mat shall be provided by a manufacturer from VDOT's "Approved Products List" as described in VESCH 3.36.

4. Riprap: Riprap shall be a rubble stone riprap, 50 to 150 pounds each, similar to VDOT 414 Class I (50 to 150 pounds) unless otherwise noted on the plans. Stone shall be placed to the depth indicated in accordance with VDOT 414

5. Gravel Outlet Structures: Gravel outlet structures shall be constructed of ASTM D 448 #2 stone or its equivalent.

6. Permanent Seeding: Seeding shall be in accordance with Section 329200 – Lawns and Grasses.

PART 3 - EXECUTION

3.1 PREPARATION

1. General: See Virginia Erosion and Sediment Control Handbook for appropriate installation procedures.

2. Surface Preparation for Stabilization Mat: Any storm drainage channel in which soil stabilization mat is to be installed shall be prepared for installation of the mat according to the mat manufacturer's recommendations.

   Any areas which are to be covered with a soil stabilization mat shall be protected from erosion prior to the installation of the mat. The protection shall include, but not be limited to, the installation and maintenance of silt fences, straw bale barriers, and temporary diversion dikes.

3. Rip Rap: Excavation of slopes, ditches, or roadways where riprap is to be placed shall be of sufficient depth to achieve finished grades shown on the plans or details. Rip Rap shall be installed in accordance with VESCH 3.19.

4. Cut and Fill Slope Preparation: Cut and fill slopes shall be constructed in a manner which will minimize erosion, in accordance with the following:

   1) All slopes steeper than 3:1 shall require surface roughening, either stair-step grading, grooving, furrowing, or tracking, if stabilized with vegetation, in accordance with VESCH 3.29.

   2) Areas with grades less than 3:1 shall have the soil surface lightly roughened and loosened to a depth of 4 inches prior to seeding.

   3) Areas which have been graded and will not be stabilized immediately shall be roughened to reduce runoff velocity until seeding takes place.

   4) Slopes with a stable rock face do not require roughening or stabilization.

3.2 INSTALLATION AND APPLICATION

1. Silt Fence: Silt fences shall be installed in accordance with the following:

   1) Installed height of silt fence shall not exceed 36 inches.

   2) Filter fabric splice joints shall occur only at a support post, minimum 6 inch overlap, and securely sealed.

   3) Posts shall be spaced a maximum of 10 feet on centers at the barrier location and driven securely into the ground (minimum of 12 inches). When extra strength fabric is used without wire support fence, post spacing shall not exceed 6 feet on centers.

   4) A trench shall be excavated approximately 4 inches wide and 4 inches deep along the line of posts and upslope from the barrier. Eight inches of fabric shall be extended into the trench. The trench shall be backfilled and the soil compacted over the filter fabric.

   5) For extra strength filter fabric installation utilizing closer post spacing, the wire mesh support fence may be eliminated. In such case, the fabric is attached to the upslope side of the posts using heavy-duty wire staples, minimum 1 inch long, or tie wires.

   6) Filter fabric shall not be stapled to existing trees.

7) Silt fences shall be removed when they have served their useful purpose, but not before the upslope area has been permanently stabilized.

2. Stone and Riprap:

1) Stone on the temporary construction entrance shall be installed to a minimum depth of 1 foot.

2) Rirprap shall be installed to the depth of 18 inches or as indicated on the plans, in accordance with VDOT 414. Stone shall be placed such that top of stone be within +/-2 inches of the finished grades shown on the plans or details.

3. Temporary Diversion Dike:

1) A temporary diversion ridge of compacted soil shall be located at the top and/or base of sloping disturbed areas in accordance with VESCH 3.09. Dike shall divert storm runoff from higher drainage areas away from unprotected slopes to a sediment trapping facility or to a stabilized outlet.

2) The minimum allowable height measured from the upslope side of the dike shall be 18 inches (except where dike is part of the proposed silt trap).

3) Sideslopes shall be 1.5:1 or flatter. Minimum base width is 4.5 feet.

4) The channel behind the dike shall have positive grade to a stabilized outlet. Channel slope less than or equal to 2 percent shall require no stabilized outlet. Slope greater than 2 percent shall be stabilized in accordance with VESCH 3.17.

4. Temporary Sediment Trap:

1) A small temporary ponding area shall be constructed of earthen embankment with a gravel outlet across a drainage swale to detain sediment laden runoff from the disturbed areas to allow the majority of the sediment to settle out, as per VESCH 3.13. The sediment trap shall be constructed independently or in conjunction with temporary diversion dike.

2) The sediment trap shall have an initial storage volume as indicated on the plans, half of which shall be in the form of a permanent pool (see erosion control plan for required grading).

3) If excavation is required to attain the required storage volume, side slopes shall not exceed 2:1 except for the excavated wet storage area which may be at a maximum 1:1 grade.

4) The outlet for the sediment trap shall consist of a crushed stone section of the embankment located at the low point in the basin. The crest of the outlet shall be at least 1.0 feet below the top of the embankment during peak flow conditions. The outlet shall be constructed as shown in VESCH 3.13.

5) Sediment shall be removed and the trap restored to its original dimensions when the sediment has accumulated to 1/2 the designed volume of the trap. Sediment removed from the basin shall be deposited in a suitable area and in such a manner that it will not erode.

6) The structure shall be checked regularly to insure that it is structurally sound and has not been damaged by erosion or construction equipment. The height of the outlet shall be checked to insure that its center is at least one foot below the top of the embankment.

5. Sediment Trap Embankments:

1) The maximum height of the sediment trap embankment shall be measured from the low point. Minimum top widths and outlet heights for various embankment heights shall be in accordance with VESCH 3.13.

2) Sediment traps shall be removed after the contributing drainage area is stabilized. Sediment trap areas shall be restored to original or proposed final grades.

3) The area under the embankment shall be cleared, grubbed, and stripped of any vegetation and root mat to facilitate cleanout. The pool area shall be cleared.

4) Fill material for the embankments shall be free of roots or other woody vegetation, organic materials, large stones, and other objectionable material. The embankment shall be compacted in 8-inch layers by transversing with construction equipment.

5) The earthen embankment shall be seeded with temporary or permanent vegetation (VESCH 3.31 and 3.32) within 15 days of construction.

6) Construction operations shall be implemented in such a manner that erosion and water pollution are minimized.

7) All cut and fill slopes shall be 2:1 or flatter.

6. Construction Access Routes: Wherever construction vehicle access routes intersect paved public roads, provisions must be made to minimize the transport of sediment (mud) by runoff or vehicle tracking onto the paved surface (VESCH 3.02 and 3.03). Where sediment is transported onto a public road surface, the roads shall be cleaned thoroughly at the end of each day. Sediment shall be removed from roads by shoveling or sweeping and be transported to a sediment controlled disposal area. Street washing shall be allowed only after sediment is removed in this manner.

7. Temporary Seeding; Provide temporary seeding in accordance with Section 329200 – Lawns and Grasses.

1) Provide temporary seeding of any areas when planting time does not permit permanent seeding within 30 days after completion of subgrades and on soil stockpiles.

8. Straw Bale Barriers: Straw bale barriers shall be placed in a single row, lengthwise, along the contour and embedded in the soil to a depth of three inches. Bales must be securely anchored in place by stakes or steel reinforcing-bars to prevent displacement. Barriers shall be inspected frequently and repair or replacement must be made promptly if needed.

9. Silt Fence: Burlap or geotechnical fabric filter barriers shall be constructed by setting 1 inch x 2 inches x 3 feet stakes and excavating a 4 inches x 4 inches trench along the line of stakes. Staple fabric to stakes and extend into trench. Backfill and compact excavated soil, anchoring fabric.

10. Gravel Outlet Structures: The bases and side slopes of the gravel shall be placed so as to conform to the dike configuration. The invert of the outlet shall be not less than six inches lower than the top of the adjoining earth dike, and the gravel shall extend to the top of the dike. Discharge from the outlet structure shall be onto an already stabilized area or watercourse. The gravel outlet structure shall be inspected for silt accumulation after each runoff-producing rain. If structure ceases to function properly due to silt accumulation, the silt shall be removed and gravel shall be replaced.

11. Temporary Interceptor Dikes: Temporary interceptor dikes shall be machine compacted and have a positive grade draining to the gravel outlet structure. Periodic inspection and maintenance of the dike shall be provided to insure proper functioning of the dike.

3.3 MAINTENANCE

1. Maintenance Service: The erosion control measures shall be maintained by the Contractor until all work covered by this contract is completed and permanent stabilization of disturbed areas has been achieved.

3.4 FIELD QUALITY CONTROL

1. Silt Fence Inspection: Silt fences and filter barriers shall be inspected by the Contractor immediately after each rainfall and at least daily during prolonged rainfall. Any required repairs shall be made immediately.

    1) Decomposed or ineffective silt fence or filter barriers shall be replaced promptly.

    2) Sediment deposits shall be removed when deposits reach approximately one-half the height of the barrier. Sediment shall be removed from the site and disposed at an approved waste area.

    3) Any sediment deposits remaining in place after the silt fence or filter barrier is no longer required shall be dressed to conform with the existing grade, then prepared and seeded.

2. Construction Entrance Inspection: The Contractor shall inspect the construction entrance periodically. The stone in the construction entrance shall be replaced when, in the opinion of the Owner, an excessive amount of mud is being carried into the public right-of-way.

3. Disposal: All temporary erosion and sediment control measures shall be disposed of within 30 days after final site stabilization is achieved or after the temporary measures are no longer needed, unless otherwise authorized by the Owner. Trapped sediment and other disturbed soil areas resulting from disposition of temporary measure shall be permanently stabilized to prevent further erosion and sedimentation.

END OF SECTION 312513

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SECTION 313000 - EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES

PART 1-GENERAL

1.1 DESCRIPTION

A. Work Included: Excavation and preparation of trenches as shown on the plans and specified herein, backfilling and site restoration.

B. Related Sections: Additional Sections of the Documents which are referenced in this Section include:

1. Section 329200 – Turf and Grasses

1.2 REFERENCES

A. General: The work shall comply with the most recent standards or tentative standards as published at the date of the contract and as listed in this specification using the abbreviation shown.

B. American Society for Testing and Materials Publications (ASTM) :

1. D 448-Standard Classification for Sizes of Aggregate for Road and Bridge Construction
2. D 698-Test Method for Laboratory Compaction Characteristics of Soils Using Standard Effort (12,400 ft-lbf/ft)
3. D 1556-Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method
4. D 2167-Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method
5. D 2487-Standard Classification of Soils for Engineering Purposes (unified Soil Classification System)

C. Virginia Department of Labor and Industry - Occupational Safety and Health Standards for the Construction Industry

1. Subpart P-Excavations, Trenching, and Shoring
2. Subpart U-Blasting and the Use of Explosives

1.3 DEFINITIONS

A. Controlled Fill: Controlled fill is required beneath all areas on which final grade is not placed on original excavated soil.

B. Classified Excavation: For the purposes of payment, material shall not be classified.

C. Satisfactory Materials: Materials classified by ASTM D 2487 as GW, GP, GM, GC, SW, SP, SM, SC, ML, and CL are satisfactory as fill for overlot grading and are satisfactory in-situ.

D. Unsatisfactory Materials: Materials classified by ASTM D 2487 as OL, OH, MH, CH, and PT are unsatisfactory in-situ and as fill. Unsatisfactory materials also include those

materials containing roots and other organic matter, trash, debris, frozen materials, and stones larger than 6 inches. Unsatisfactory materials also include man-made fills, refuse, or backfills from previous construction.

E. Cohesionless and Cohesive Materials: Cohesive materials include materials classified as GC, SC, ML, CL, MH, and CH. Cohesionless materials include materials classified in ASTM D 2487 as GW, GP, SW, and SP. Materials classified as GM and SM will be identified as cohesionless only when the fines have plasticity index of zero.

F. Degree of Compaction: Degree of compaction is a percentage of the maximum density obtained by the test procedure presented in ASTM D 698, abbreviated below as a percent of laboratory maximum density.

G. Topsoil: Material obtained from excavations, suitable for topsoils, is defined as the upper 6 inches of existing soil cover. Topsoil shall consist of friable clay loam, free from roots, stones, and other undesirable material and shall be capable of supporting a good growth of grass.

H. Rock: Rock shall consist of boulders measuring 1/2 cubic yard or more and materials that cannot be removed without systematic drilling and blasting such as rock material in ledges, bedded deposits, unstratified masses and conglomerate deposits, and below ground concrete or masonry structures, exceeding 1/2 cubic yard in volume. Pavements will not be considered as rock. All excavation is unclassified. No payment will be made for rock excavation

I. Unyielding Material: Unyielding material shall consist of rock and gravelly soils with stones greater than 18 inches in any dimension or as defined by the pipe manufacturer, whichever is smaller.

J. Unstable Material: Unstable material shall consist of materials too wet to properly support the utility pipe, conduit, or appurtenant structure.

K. Select Granular Material: Select granular material shall consist of well-graded sand, gravel, crushed stone or crushed slag composed of hard, tough and durable particles, and shall not contain more than 10 percent by weight of material passing a No. 200 mesh sieve. The maximum allowable aggregate size shall be 1 inch, or the maximum size recommended by the pipe manufacturer, whichever is smaller.

L. Initial Backfill Material: Initial backfill material shall consist of select granular material or satisfactory materials free from rocks 1 inch or larger in any dimension or free from rocks of such size as recommended by the pipe manufacturer, whichever is smaller.

1.4 QUALITY ASSURANCE

A. Testing Results: Copies of all laboratory and field test reports shall be submitted to the OWNER and ENGINEER within 72 hours of the completion of the test.

PART 2-PRODUCTS

2.1 PLASTIC MARKING TAPE

A. General: Plastic marking tape shall be acid and alkali-resistant polyethylene film, 2-inches wide with minimum thickness of 0.004-inches. The tape shall be installed directly above the pipe, at a depth of 12 to 18 inches below finished grade unless otherwise shown. The tape shall not be made of any metallic materials. Tape color shall be as specified in Table 1 and shall bear a continuous printed inscription describing the specific utility.

TABLE 1.
Tape Color

Red:	Electric
Yellow:	Gas, Oil, Dangerous Materials
Orange:	Telephone, Telegraph, Television, Police, and Fire Communications
Blue:	Water Systems
Green:	Sewer Systems (including sewer force main)

2.2 TRACER WIRE

A. General: Tracer wire shall be solid (not stranded) # 12 A.W.G. or larger insulated wire. Where insulation is compromised and will be buried, wire should be encapsulated in pure silicone caulk and wrapped with electrical tape.

PART 3-EXECUTION

3.1 GENERAL

A. Classification: Excavation and material shall be unclassified for purposes of payment. No extra payment will be considered for any excavation regardless of the type of material encountered including rock.

3.2 CLEARING

A. General: Only that portion of the work area actually needed for construction shall be cleared or used by heavy equipment unless directed otherwise by the OWNER. In no case shall clearing or debris from clearing operations be taken past right-of-way lines or permanent easement lines onto private property. Areas disturbed by construction operations shall be protected from erosion by suitable methods outlined in the Virginia Erosion and Sediment Control Handbook. Equipment and materials shall be stored only in approved areas.

3.3 EXCAVATION AND PREPARATION OF TRENCH

A. General: Depth of trenches shall provide a minimum of 36” cover, measured from the top of pipe, unless otherwise noted on the plans and cut sheets. Depth of cover in VDOT right-of-way may be as required by VDOT.

B. Gravity Sewer Trench: The trench shall be excavated to allow for a depth of ¼ of the pipes outside diameter or a minimum of 4 inches of ASTM D 448 #68 aggregate bedding in earth and 6 inches of aggregate bedding in rock.

C. Pressure Pipe Trench: For force main and water main, the trench shall be excavated so as to provide a uniform and continuous bearing and support for the pipe on solid and undisturbed ground between bell holes. Bell holes shall be excavated to accommodate each bell. Any part of the bottom of the trench excavated below the specified grade shall be brought back to grade with approved material and compacted in accordance with the specifications. The finished subgrade shall be prepared accurately by means of hand tools. If PVC pressure pipe is used, 4-inches of ASTM D 448 #68 stone shall be required for bedding. Where the pipe is in rock, 6 inches of bedding, #68 stone, will be required.

D. Width: Width shall be sufficient to allow pipe installation without walking or standing on pipe. The trench width at a point 12 inches above the top of the pipe shall not be less that 6 inches not more than 12 inches on each side of the pipe's largest diameter unless otherwise directed.

E. Unsuitable Material: Wet or otherwise unsuitable soil at the subgrade shall be removed and replaced with approved sound materials at no cost to the OWNER. Excess or unsuitable materials shall be disposed of by the CONTRACTOR.

F. Rock Excavation: Ledge rock, boulders, and large stones shall be removed to provide a clearance of at lease 6-inches below and on each side of all pipe, manholes, valves or other appurtenances and overdepth shall be backfilled with 6-inches of ASTM D 448 #10 (PVC) or #26 (Ductile Iron) aggregate bedding.

G. Topsoil: Topsoil shall be stripped from excavation area and stockpiled separately from other backfill material in approved area until needed for finish backfill and grading.

H. Trench Protection: The CONTRACTOR shall furnish and erect such sheathing, bracing and shoring, and shall furnish necessary signs, barricades, and temporary lighting as may be pertinent for the protection of his work, employees, the public, adjacent structures, and to guard against contingencies which might give rise to delays in the work. Sheathing left in place shall be at the CONTRACTOR's expense. Responsibility for preservation of trench banks and other excavated spaces and the prevention of injury to any persons or property shall rest entirely with the CONTRACTOR. Normally, a maximum of 200 feet of trench will be allowed open at any one time. Trench construction and safety shall be governed by the Virginia Occupational Safety and Health Standards for the Construction Industry, Subpart P. No excavation within the VDOT right-of-way or otherwise will be allowed to remain open overnight unless special permission is obtained.

I. Pumping, Bailing, and Draining: The CONTRACTOR shall remove by appropriate means any water which may accumulate or be found in the trenches or other excavations and shall keep the excavations clear of water while work is being installed, unless approval to the contrary is granted by the OWNER.

J. Roadway Protection: No cleated equipment shall be used on pavements. Road drainage shall not be clogged, and shoulders, ditches, roadside drainage facilities and pavement affected by trenching operations shall be maintained in condition satisfactory to VDOT. Entrances shall not be blocked except for short periods as arranged with the property owner, and ingress and egress to adjacent property shall be maintained at all times. The CONTRACTOR shall be responsible for the repair of any damaged drainage structures. Private roads shall be restored to an equal or better condition of that prior to construction.

3.4 WORK WITHIN ROAD RIGHT-OF-WAY

A. General: CONTRACTOR shall work within VDOT right-of-way as required by the OWNER and approved by VDOT. Placement of excavated material on existing pavement shall be avoided if possible. Placement of excavated material on existing pavement shall be permitted upon approval of a written request to the VDOT and provided a stone dust or sand layer is first placed on the pavement.

B. Traffic Control: All traffic control and directional signs shall be supplied by the CONTRACTOR. Typical traffic control for utility work on road rights-of-way shall comply with VDOT traffic control details. See Appendix D – VDOT Traffic Control.

C. Traffic Routing: Traffic shall not be blocked or re-routed without permission from the VDOT. Where one way traffic is permitted to be maintained, it shall be flagged 24 hours per day. Traffic shall at all times be properly protected by adequate lights, barricades and signs, and also flagmen when needed.

D. Erosion and Siltation Control: At all locations straw barriers, silt fences, silt settlement basins, brush barriers or other measures are to be utilized in prevention of erosion and siltation control.

E. Trenches: No trench within VDOT right-of-way can remain open overnight.

F. Roadway Crossings: Except where specifically noted on the plans, cutting of existing road pavement will not be allowed. All crossings of VDOT roads shall be made by boring, jacking, or tunneling unless otherwise noted. If the crossing cannot be made by any of the above methods, the permittee must contact the local VDOT Residency. In cases where the OWNER is the permittee, the CONTRACTOR shall contact the OWNER, and the OWNER will contact VDOT. In the event of a failed bore attempt, casing shall be left in place and ends sealed with concrete, or if casing is not abandoned in place the excavation shall be pumped full with a portland cement grout. Wherever pavement is permitted to be cut, not over one-half width shall be disturbed at one time; and on crossings, the first opening shall be completely restored to satisfactory travelable condition before the second half can be opened. Where the pavement is disturbed, or deemed weakened, it, in its entirety, or such portions of it as deemed desirable by the VDOT shall be restored or replaced in a manner directed by and to the satisfaction of the VDOT. When pavement must be cut, the cuts shall be made in a straight line, parallel to the pipe, and 6-inches wider than the trench, on each side, so that an undisturbed shoulder will be provided under the new work. Sidewalks or curb and gutter disturbed by construction shall be removed and replaced at existing joints. Cutting shall be done neatly so that a uniform, straight joint will result to provide a bond with the original concrete or pavement.

G. Roadway Crossings Through Casings: When special conditions require use of casings, care shall be taken to maintain the proposed plan grade. Before pushing the pipe through casing, chocks or skids shall be attached to the pipe to keep the pipe centered in the casing and to prevent damage when installation is made. Care shall be taken to ensure that the installed pipeline is well secured to prevent movement as detailed in the project details.

3.5 UNDERGROUND UTILITIES

A. General: The CONTRACTOR shall contact the appropriate utility companies and have utilities located prior to starting construction. Locations of existing facilities should be determined by the CONTRACTOR far enough in advance of the construction to provide for modification in design, if required.

3.6 COORDINATION

A. General: The CONTRACTOR shall notify the property owner in advance of commencing work and in the event of the necessity of disrupting utility or other services to such property, he shall notify the owner or responsible person in charge of such utility or other services and arrange for the disruption and restoration or such service in a manner which will result in a minimum of inconvenience to parties concerned.

3.7 BACKFILLING

A. Materials: All backfill materials shall be free from mud, refuse, construction debris, organic material, boulders, frozen or otherwise unsuitable material, select initial backfill shall be free from stones over 1-1/2 – inch. From one foot above the top of the pipe to the original ground elevation, however, material containing stones up to 5-inches in their greatest dimension may be used, unless otherwise specified. The CONTRACTOR may backfill with the excavated material, provided it meets the conditions as stated above.

B. Gravity Sewer Bedding: Bedding shall be required on all gravity sewer lines, and shall be in accordance with the project details. Bedding material shall extend from the excavated trench bottom to the pipe springline (midpoint). Bedding material shall be compacted to 95 percent of maximum density as measured by ASTM D 698. Special care shall be taken to backfill under the pipe and to tamp this material into place to provide a firm bed. Material shall be deposited on both sides of the pipe simultaneously and compacted into place by tamping. From the centerline of the pipe to a depth of one-foot above the top of the pipe, the trench shall be backfilled with approved material in 6-inch layers and compacted in accordance with the specifications. Mechanical or pneumatic tampers must be used in this operation. Compaction equipment must not come into contact with the pipe.

C. Pressure Pipe Bedding: Bedding for ductile iron pressure pipe shall only be required when trench is in rock, unless shown otherwise on plans, and shall be in accordance with the project details. Bedding material for ductile iron pipe in rock shall be 6-inches of compacted VDOT #10 OR #26 aggregate beneath the pipe. Where PVC pressure pipe is used, bedding material shall extend from the excavated trench bottom to the pipe springline (midpoint) unless otherwise approved by the OWNER. Bedding material shall be compacted to 95 percent of maximum density as measured by ASTM D 698. Special care shall be taken to backfill under the pipe and to tamp this material into place to provide a firm bed. Material shall be deposited on both sides of the pipe simultaneously, and compacted into place by tamping. From the initial bedding to a depth of one foot above the top of the pipe, the trench shall be backfilled with approved material in 6-inch layers and compacted in accordance with the specifications. Mechanical or pneumatic tampers must be used in this operation. Compaction equipment must not come into contact with the pipe.

D. Backfilling to Grade: Initial backfill shall be with select material as stated above and compacted prior to placement of remaining backfill. Backfilling shall be carried up evenly in increments of one foot. Minimum required density shall be the density of the adjacent undisturbed material. Backfill in trenches outside of proposed pavement areas or street

rights-of-way, or in other areas when allowed, shall be compacted to a dry density equal to or greater than the density of the undisturbed soil surrounding the trench. Each layer of earth shall be compacted into place by tamping before the next layer is applied. A hydro-hammer shall not be used for compaction. All pipelines shall have a minimum of 18-inches of cover before any rolling equipment is used. Care shall be taken to prevent damage to pipe or other structures during compaction. Damage to pipelines or other structures resulting from compaction shall be corrected by the CONTRACTOR without expense to the OWNER.

E. Backfilling in Controlled Areas: Backfill under pavement, proposed pavement, or in areas within VDOT right-of-way shall be in layers of selected earth not more than 6-inches in thickness, and each layer shall be compacted to a minimum of 95 percent of maximum density when tested in accordance with ASTM D 698. Compaction shall be by pneumatic tampers or by hand and in accordance with instructions in this Section as modified herein. All pipelines shall have a minimum of 18-inches of cover before any rolling equipment is used. The top course of backfill directly under pavement shall consist of aggregate base material meeting the requirements of VDOT #21 A stone. The depth of this course shall be at least 12-inches, except where otherwise required by VDOT. Moisture content shall be within 20 percent of optimum.

F. Marking of Pipelines: A plastic marking tape (see PART 2 of this section) of the appropriate color shall be required on all pipe lines. The marking tape shall be buried 12 to 18-inches below the finished surface in accordance with the project details. As required by the contract drawings, a copper wire (size #12 - encased in a protective jacket to protect it from corrosion) will be installed parallel to (see 2.2 – Tracer Wire), and at the same depth as, all pipe (PVC and Ductile Iron Pipe) and looped up through all valve boxes, air release valve boxes, blow-off boxes, and around manholes with excess wire brought up to the top of the valve boxes and manholes (for use in connecting locating equipment to the wire). The copper wire shall be one continuous run with no splicing permitted unless two spools of wire are being spliced together. The wires shall be stripped on each connecting end of the protective jacket or coating, and wire ends shall be connected with appropriate sized wire nuts. Silicone shall be used to fill in the void inside the wire nut after splicing the copper wire, and the wire nut shall be wrapped with electrical tape.

G. Fill: Materials for fill areas shown on the plans shall be secured from excavation after rejection of any unsuitable materials. Rock or rocky material may be incorporated into fills if size and shape permit, if placed in lower portion of fills where the stability will not be affected, and if placed in such a manner that the perviousness will not be increased. Material shall be spread in layers with moisture controlled and then compacted to a minimum density as stated above.

H. Finished Surfaces: Uniformly smooth grading of disturbed areas shall be required after backfill and compaction. Road shoulders shall have a minimum depth of 6-inches of VDOT #25 or #26 crusher run aggregate, compacted to a minimum of 95 percent of maximum density as measured by ASTM D 698. Ditches and gutters shall be finished to drain readily. In grass or lawn areas, the last 4-inches of compacted fill will consist of topsoil or an approved soil which will support turf growth after fertilizing and seeding. Settlement or other damage that occurs prior to acceptance of this work shall be repaired and grades satisfactorily re-established.

I. Quality Assurance: The CONTRACTOR will be responsible for and shall repair any settlement in the backfill or pavement for a period of one year after completion of the work.

3.8 BACKFILL TESTING

A. General: Normal testing frequency of compaction testing performed by an independent laboratory shall be at the expense of the CONTRACTOR. Projects initiated and/or funded by the OWNER shall have compaction testing performed at the expense of the CONTRACTOR unless otherwise noted in the project contract.

B. Testing Requirements: The CONTRACTOR shall demonstrate the adequacy of backfill compaction by performing density testing of the completed trench in backfill areas as designated by the OWNER. Density testing shall be performed at three depths for each test location: surface, mid-depth, and near maximum trench depth. In grass and lawn areas outside of VDOT right-of-way the testing shall be performed at two depths for each test location: under the topsoil backfill, and near the maximum trench depth. The character of the backfill material will be observed during the excavation for density testing to determine conformance with the specifications. Density testing shall be performed using nuclear field density equipment or conventional weight-volume methods. If the weight-volume method is used, volume shall be determined by using the sand replacement test (ASTM D 1556) or liquid displacement methods (ASTM D 2167). If nuclear methods are used, the trench correction effect shall be accounted for by recalibrating the nuclear gauge on its calibration block at the location of each test prior to taking the density measurement. Backfill in roadway or parking areas such as VDOT rights-of-way or in areas designated by the OWNER shall be compacted to a minimum of 95% density as measured by ASTM D 698. The density of the backfill outside of VDOT right-of-way or other controlled areas shall be equal to or greater than the density of the undisturbed material in the immediate area adjacent to the area under test. The CONTRACTOR shall furnish all equipment, tools, and labor to conduct the testing. Testing shall be performed by an independent testing laboratory qualified to perform such tests and approved by the OWNER. All testing shall be witnessed by the OWNER. The test shall be repeated until satisfactory results are obtained. The CONTRACTOR shall be charged for all retests at the normal rates for inspection services.

1. Normal Testing Frequency: One test shall be performed within the first 500-feet of pipe installed by each crew. This test will be used as an initial evaluation of the compaction methods being used. Beyond the initial 500-feet, one test shall be performed in each 1,000-foot section of pipe installed or fraction thereof. Testing shall progress as each 1,000-foot section is completed. The location of the test within each section shall be selected by the Inspector. Testing which indicated that unacceptable material has been incorporated into the backfill, or that insufficient compaction is being obtained shall be followed by expanded testing to determine the limits of the unacceptable backfill. Normal testing shall be performed at the CONTRACTOR’s expense.

2. Expanded Testing Requirements: If normal testing within a test section indicated unacceptable backfill, the OWNER may require additional testing within the same test section to determine the limits of unacceptable backfill. Additional testing required by the OWNER shall not exceed testing of 4 additional locations within the test section. Unacceptable backfill within the limits established by the testing shall be removed and replaced by the CONTRACTOR at no additional cost to the OWNER. If the CONTRACTOR fails to schedule testing on a consistent basis

(as per the satisfaction of the OWNER), then payment for work performed will be withheld until such testing is completed. Additional testing beyond that required may be performed by the CONTRACTOR at his expense to further delineate limits of unacceptable backfill.

3. Additional Testing: Testing beyond the normal frequency or expanded testing required which is requested by the OWNER, shall be at the OWNER's expense.

3.9 SITE RESTORATION

A. Replacement of Property: The CONTRACTOR shall restore all pavement, sidewalks, curbing, gutter, fences, poles, culverts, utilities or other such property and surface structures removed or disturbed as a part of the work to a condition equal or better to that before the work began.

B. Pavement Repair and Replacement: Pavement, if disturbed, shall be repaired or replaced in accordance with the technical details.

C. Drainage Improvements: The CONTRACTOR shall restore and/or repair all drainage ways and swales including paved or concrete channels as part of this work to a condition equal to that before the work began. Damaged drainage facilities shall be replaced. Restored ditches and swales shall provide positive drainage from roadways. Drainage restoration within VDOT rights-of-way shall be to the satisfaction of the Virginia Department of Transportation.

D. Cleanup: The CONTRACTOR shall at all times keep the site cleaned to the satisfaction of the Inspector. In all cases, the CONTRACTOR shall "broom" the surfaces of paved streets immediately following backfilling. All surplus materials shall be removed and disposed of from the site of the work unless directed otherwise by the OWNER. Where material is placed on the pavement, a layer of stone dust or sand shall be applied first to facilitate clean-up.

E. Seeding: Shall be in accordance with Section 329200 – Turf and Grasses.

END OF SECTION 313000

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SECTION 315000 - EXCAVATION SUPPORT AND PROTECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes temporary excavation support and protection systems.

B. Related Requirements:
   1. Section 312000 "Earth Moving" for excavating and backfilling and for controlling surface-water runoff and ponding.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

   1. Review geotechnical report.
   2. Review existing utilities and subsurface conditions.
   3. Review coordination for interruption, shutoff, capping, and continuation of utility services.
   4. Review proposed excavations.
   5. Review proposed equipment.
   6. Review monitoring of excavation support and protection system.
   7. Review coordination with waterproofing.
   8. Review abandonment or removal of excavation support and protection system.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

   1. Include construction details, material descriptions, performance properties, and dimensions of individual components and profiles, and calculations for excavation support and protection system.

B. Shop Drawings: For excavation support and protection system, prepared by or under the supervision of a qualified professional engineer.

   1. Include plans, elevations, sections, and details.

2. Show arrangement, locations, and details of soldier piles, piling, lagging, tiebacks, bracing, and other components of excavation support and protection system according to engineering design.
3. Indicate type and location of waterproofing.
4. Include a written plan for excavation support and protection, including sequence of construction of support and protection coordinated with progress of excavation.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For professional engineer.

B. Contractor Calculations: For excavation support and protection system. Include analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

C. Existing Conditions: Using photographs or video recordings, show existing conditions of adjacent construction and site improvements that might be misconstrued as damage caused by inadequate performance of excavation support and protection systems. Submit before Work begins.

D. Record Drawings: Identify locations and depths of capped utilities, abandoned-in-place support and protection systems, and other subsurface structural, electrical, or mechanical conditions.

1.6 FIELD CONDITIONS

A. Interruption of Existing Utilities: Do not interrupt any utility serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility according to requirements indicated:

1. Notify Owner no fewer than two (2) days in advance of proposed interruption of utility.
2. Do not proceed with interruption of utility without Owner's written permission.

B. Project-Site Information: A geotechnical report has been prepared for this Project and is available for information only. The opinions expressed in this report are those of a geotechnical engineer and represent interpretations of subsoil conditions, tests, and results of analyses conducted by a geotechnical engineer. Owner is not responsible for interpretations or conclusions drawn from the data.

1. Make additional test borings and conduct other exploratory operations necessary for excavation support and protection according to the performance requirements.
2. The geotechnical report is included elsewhere in Project Manual.

C. Survey Work: Engage a qualified land surveyor or professional engineer to survey adjacent existing buildings, structures, and site improvements; establish exact

elevations at fixed points to act as benchmarks. Clearly identify benchmarks and record existing elevations.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Provide, design, monitor, and maintain excavation support and protection system capable of supporting excavation sidewalls and of resisting earth and hydrostatic pressures and superimposed and construction loads.

1. Contractor Design: Design excavation support and protection system, including comprehensive engineering analysis by a qualified professional engineer.
2. Prevent surface water from entering excavations by grading, dikes, or other means.
3. Install excavation support and protection systems without damaging existing buildings, structures, and site improvements adjacent to excavation.
4. Continuously monitor vibrations, settlements, and movements to ensure stability of excavations and constructed slopes and to ensure that damage to permanent structures is prevented.

2.2 MATERIALS

A. General: Provide materials that are either new or in serviceable condition.

B. Structural Steel: ASTM A 36/A 36M, ASTM A 690/A 690M, or ASTM A 992/A 992M.

C. Steel Sheet Piling: ASTM A 328/A 328M, ASTM A 572/A 572M, or ASTM A 690/A 690M; with continuous interlocks.

1. Corners: Site-fabricated mechanical interlock.

D. Wood Lagging: Lumber, mixed hardwood, nominal rough thickness of size and strength required for application.

E. Shotcrete: Comply with Section 033713 "Shotcrete" for shotcrete materials and mixes, reinforcement, and shotcrete application.

F. Cast-in-Place Concrete: ACI 301, of compressive strength required for application.

G. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), deformed.

H. Tiebacks: Steel bars, ASTM A 722/A 722M.

I. Tiebacks: Steel strand, ASTM A 416/A 416M.

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards that could develop during excavation support and protection system operations.

1. Shore, support, and protect utilities encountered.

B. Install excavation support and protection systems to ensure minimum interference with roads, streets, walks, and other adjacent occupied and used facilities.

1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.

C. Locate excavation support and protection systems clear of permanent construction so that construction and finishing of other work is not impeded.

3.2 SOLDIER PILES AND LAGGING

A. Install steel soldier piles before starting excavation. Extend soldier piles below excavation grade level to depths adequate to prevent lateral movement. Space soldier piles at regular intervals not to exceed allowable flexural strength of wood lagging. Accurately align exposed faces of flanges to vary not more than 2 inches (50 mm) from a horizontal line and not more than 1:120 out of vertical alignment.

B. Install wood lagging within flanges of soldier piles as excavation proceeds. Trim excavation as required to install lagging. Fill voids behind lagging with soil, and compact.

C. Install wales horizontally at locations indicated on Drawings and secure to soldier piles.

3.3 SHEET PILING

A. Before starting excavation, install one-piece sheet piling lengths and tightly interlock vertical edges to form a continuous barrier.

B. Accurately place the piling, using templates and guide frames unless otherwise recommended in writing by the sheet piling manufacturer. Limit vertical offset of adjacent sheet piling to 60 inches (1500 mm). Accurately align exposed faces of sheet piling to vary not more than 2 inches (50 mm) from a horizontal line and not more than 1:120 out of vertical alignment.

C. Cut tops of sheet piling to uniform elevation at top of excavation.

3.4 TIEBACKS

A. Drill, install, grout, and tension tiebacks.

B. Test load-carrying capacity of each tieback and replace and retest deficient tiebacks.

1. Have test loading observed by a qualified professional engineer responsible for design of excavation support and protection system.

C. Maintain tiebacks in place until permanent construction is able to withstand lateral earth and hydrostatic pressures.

3.5 BRACING

A. Bracing: Locate bracing to clear columns, floor framing construction, and other permanent work. If necessary to move brace, install new bracing before removing original brace.

1. Do not place bracing where it will be cast into or included in permanent concrete work unless otherwise approved by Architect.
2. Install internal bracing if required to prevent spreading or distortion of braced frames.
3. Maintain bracing until structural elements are supported by other bracing or until permanent construction is able to withstand lateral earth and hydrostatic pressures.

3.6 FIELD QUALITY CONTROL

A. Survey-Work Benchmarks: Resurvey benchmarks regularly during installation of excavation support and protection systems, excavation progress, and for as long as excavation remains open. Maintain an accurate log of surveyed elevations and positions for comparison with original elevations and positions. Promptly notify Architect if changes in elevations or positions occur or if cracks, sags, or other damage is evident in adjacent construction.

B. Promptly correct detected bulges, breakage, or other evidence of movement to ensure that excavation support and protection system remains stable.

C. Promptly repair damages to adjacent facilities caused by installation or faulty performance of excavation support and protection systems.

3.7 REMOVAL AND REPAIRS

A. Remove excavation support and protection systems when construction has progressed sufficiently to support excavation and earth and hydrostatic pressures. Remove in stages to avoid disturbing underlying soils and rock or damaging structures, pavements, facilities, and utilities.

1. Remove excavation support and protection systems to a minimum depth of 48 inches (1200 mm) below overlying construction and abandon remainder.
2. Fill voids immediately with approved backfill compacted to density specified in Section 312000 "Earth Moving."
3. Repair or replace, as approved by Architect, adjacent work damaged or displaced by removing excavation support and protection systems.

B. Leave excavation support and protection systems permanently in place.

END OF SECTION 315000

SECTION 321216 - ASPHALT PAVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Cold milling of existing asphalt pavement.
2. Hot-mix asphalt patching.
3. Hot-mix asphalt paving.
4. Hot-mix asphalt overlay.
5. Asphalt curbs.
6. Asphalt traffic-calming devices.
7. Asphalt surface treatments.

B. Related Requirements:

1. Section 024119 "Selective Demolition" for demolition and removal of existing asphalt pavement.
2. Section 312000 "Earth Moving" for subgrade preparation, fill material, unbound-aggregate subbase and base courses, and aggregate pavement shoulders.
3. Section 321273 "Asphalt Paving Joint Sealants" for joint sealants and fillers at pavement terminations.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review methods and procedures related to hot-mix asphalt paving including, but not limited to, the following:

a. Review proposed sources of paving materials, including capabilities and location of plant that will manufacture hot-mix asphalt.
b. Review requirements for protecting paving work, including restriction of traffic during installation period and for remainder of construction period.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include technical data and tested physical and performance properties.
2. Job-Mix Designs: Certification, by authorities having jurisdiction, of approval of each job mix proposed for the Work.
3. Job-Mix Designs: For each job mix proposed for the Work.

B. Samples for Verification: For the following product, in manufacturer's standard sizes unless otherwise indicated:

1. Paving Fabric: 12 by 12 inches (300 by 300 mm) minimum.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer.

B. Material Certificates: For each paving material.

C. Material Test Reports: For each paving material, by a qualified testing agency.

D. Field quality-control reports.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: A paving-mix manufacturer registered with and approved by authorities having jurisdiction or the DOT of state in which Project is located.

B. Testing Agency Qualifications: Qualified according to ASTM D 3666 for testing indicated.

C. Regulatory Requirements: Comply with materials, workmanship, and other applicable requirements of Virginia DOT for asphalt paving work.

1. Measurement and payment provisions and safety program submittals included in standard specifications do not apply to this Section.

1.7 FIELD CONDITIONS

A. Environmental Limitations: Do not apply asphalt materials if subgrade is wet or excessively damp, if rain is imminent or expected before time required for adequate cure, or if the following conditions are not met:

1. Prime Coat: Minimum surface temperature of 60 deg F (15.6 deg C).
2. Tack Coat: Minimum surface temperature of 60 deg F (15.6 deg C).
3. Slurry Coat: Comply with weather limitations in ASTM D 3910.
4. Asphalt Base Course: Minimum surface temperature of 40 deg F (4.4 deg C) and rising at time of placement.
5. Asphalt Surface Course: Minimum surface temperature of 60 deg F (15.6 deg C) at time of placement.

PART 2 - PRODUCTS

2.1 AGGREGATES

A. General: Use materials and gradations that have performed satisfactorily in previous installations.

B. Coarse Aggregate: ASTM D 692/D 692M, sound; angular crushed stone, crushed gravel, or cured, crushed blast-furnace slag.

C. Fine Aggregate: ASTM D 1073, sharp-edged natural sand or sand prepared from stone, gravel, cured blast-furnace slag, or combinations thereof.

1. For hot-mix asphalt, limit natural sand to a maximum of 20 percent by weight of the total aggregate mass.

D. Mineral Filler: ASTM D 242/D 242M, rock or slag dust, hydraulic cement, or other inert material.

2.2 ASPHALT MATERIALS

A. Asphalt Binder: AASHTO M 320, PG 64-22.

B. Asphalt Cement: ASTM D 3381/D 3381M for viscosity-graded material.

C. Cutback Prime Coat: ASTM D 2027, medium-curing cutback asphalt, MC-30 or MC-70.

D. Emulsified Asphalt Prime Coat: ASTM D 977 emulsified asphalt, slow setting, diluted in water, of suitable grade and consistency for application.

E. Tack Coat: ASTM D 977 emulsified asphalt, or ASTM D 2397 cationic emulsified asphalt, slow setting, diluted in water, of suitable grade and consistency for application.

F. Fog Seal: ASTM D 977 emulsified asphalt, or ASTM D 2397 cationic emulsified asphalt, slow setting, factory diluted in water, of suitable grade and consistency for application.

G. Water: Potable.

H. Undersealing Asphalt: ASTM D 3141/D 3141M; pumping consistency.

2.3 AUXILIARY MATERIALS

A. Recycled Materials for Hot-Mix Asphalt Mixes: Reclaimed asphalt pavement; reclaimed, unbound-aggregate base material; and recycled tires, asphalt shingles, or glass from sources and gradations that have performed satisfactorily in previous installations, equal to performance of required hot-mix asphalt paving produced from all new materials.

B. Herbicide: Commercial chemical for weed control, registered by the EPA, and not classified as "restricted use" for locations and conditions of application. Provide in granular, liquid, or wettable powder form.

C. Sand: ASTM D 1073, Grade No. 2 or No. 3.

D. Paving Geotextile: AASHTO M 288 paving fabric; nonwoven polypropylene; resistant to chemical attack, rot, and mildew; and specifically designed for paving applications.

E. Joint Sealant: ASTM D 6690, Type I, hot-applied, single-component, polymer-modified bituminous sealant.

2.4 MIXES

A. Recycled Content of Hot-Mix Asphalt: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 10 percent or more than 15 percent by weight.

1. Surface Course Limit: Recycled content no more than 10 percent by weight.

B. Hot-Mix Asphalt: Dense-graded, hot-laid, hot-mix asphalt plant mixes approved by authorities having jurisdiction and designed according to procedures in AI MS-2, "Mix Design Methods for Asphalt Concrete and Other Hot-Mix Types"; and complying with the following requirements:

1. Provide mixes with a history of satisfactory performance in geographical area where Project is located.
2. Base Course: 6 inch.
3. Surface Course: 2 inch.

C. Emulsified-Asphalt Slurry: ASTM D 3910, Type 1.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that subgrade is dry and in suitable condition to begin paving.

B. Proof-roll subgrade below pavements with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.

1. Completely proof-roll subgrade in one direction, repeating proof-rolling in direction perpendicular to first direction. Limit vehicle speed to 3 mph (5 km/h).
2. Proof roll with a loaded 10-wheel, tandem-axle dump truck weighing not less than 15 tons (13.6 tonnes).
3. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Architect, and replace with compacted backfill or fill as directed.

C. Proceed with paving only after unsatisfactory conditions have been corrected.

3.2 COLD MILLING

A. Clean existing pavement surface of loose and deleterious material immediately before cold milling. Remove existing asphalt pavement by cold milling to grades and cross sections indicated.

1. Mill to a depth of 1-1/2 inches (38 mm).
2. Mill to a uniform finished surface free of excessive gouges, grooves, and ridges.
3. Control rate of milling to prevent tearing of existing asphalt course.
4. Repair or replace curbs, manholes, and other construction damaged during cold milling.
5. Excavate and trim unbound-aggregate base course, if encountered, and keep material separate from milled hot-mix asphalt.
6. Patch surface depressions deeper than 1 inch (25 mm) after milling, before wearing course is laid.
7. Handle milled asphalt material according to approved waste management plan required in Section 017419 "Construction Waste Management and Disposal."
8. Keep milled pavement surface free of loose material and dust.
9. Do not allow milled materials to accumulate on-site.

3.3 PATCHING

A. Asphalt Pavement: Saw cut perimeter of patch and excavate existing pavement section to sound base. Excavate rectangular or trapezoidal patches, extending 12 inches (300 mm) into perimeter of adjacent sound pavement, unless otherwise indicated. Cut excavation faces vertically. Remove excavated material. Recompact existing unbound-aggregate base course to form new subgrade.

B. Portland Cement Concrete Pavement: Break cracked slabs and roll as required to reseat concrete pieces firmly.

1. Pump hot undersealing asphalt under rocking slab until slab is stabilized or, if necessary, crack slab into pieces and roll to reseat pieces firmly.
2. Remove disintegrated or badly cracked pavement. Excavate rectangular or trapezoidal patches, extending into perimeter of adjacent sound pavement, unless otherwise indicated. Cut excavation faces vertically. Recompact existing unbound-aggregate base course to form new subgrade.

C. Tack Coat: Before placing patch material, apply tack coat uniformly to vertical asphalt surfaces abutting the patch. Apply at a rate of 0.05 to 0.15 gal./sq. yd. (0.2 to 0.7 L/sq. m).

1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.
2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.

D. Placing Patch Material: Fill excavated pavement areas with hot-mix asphalt base mix for full thickness of patch and, while still hot, compact flush with adjacent surface.

E. Placing Patch Material: Partially fill excavated pavements with hot-mix asphalt base mix and, while still hot, compact. Cover asphalt base course with compacted, hot-mix surface layer finished flush with adjacent surfaces.

3.4 REPAIRS

A. Leveling Course: Install and compact leveling course consisting of hot-mix asphalt surface course to level sags and fill depressions deeper than 1 inch (25 mm) in existing pavements.

1. Install leveling wedges in compacted lifts not exceeding 3 inches (75 mm) thick.

B. Crack and Joint Filling: Remove existing joint filler material from cracks or joints to a depth of 1/4 inch (6 mm).

1. Clean cracks and joints in existing hot-mix asphalt pavement.
2. Use emulsified-asphalt slurry to seal cracks and joints less than 1/4 inch (6 mm) wide. Fill flush with surface of existing pavement and remove excess.
3. Use hot-applied joint sealant to seal cracks and joints more than 1/4 inch (6 mm) wide. Fill flush with surface of existing pavement and remove excess.

3.5 SURFACE PREPARATION

A. General: Immediately before placing asphalt materials, remove loose and deleterious material from substrate surfaces. Ensure that prepared subgrade is ready to receive paving.

B. Herbicide Treatment: Apply herbicide according to manufacturer's recommended rates and written application instructions. Apply to dry, prepared subgrade or surface of compacted-aggregate base before applying paving materials.

1. Mix herbicide with prime coat if formulated by manufacturer for that purpose.

C. Cutback Prime Coat: Apply uniformly over surface of compacted unbound-aggregate base course at a rate of 0.15 to 0.50 gal./sq. yd. (0.7 to 2.3 L/sq. m). Apply enough material to penetrate and seal, but not flood, surface. Allow prime coat to cure.

1. If prime coat is not entirely absorbed within 24 hours after application, spread sand over surface to blot excess asphalt. Use enough sand to prevent pickup under traffic. Remove loose sand by sweeping before pavement is placed and after volatiles have evaporated.
2. Protect primed substrate from damage until ready to receive paving.

D. Emulsified Asphalt Prime Coat: Apply uniformly over surface of compacted unbound-aggregate base course at a rate of 0.10 to 0.30 gal./sq. yd. per inch depth (0.5 to

1.40 L/sq. m per 25 mm depth). Apply enough material to penetrate and seal, but not flood, surface. Allow prime coat to cure.

1. If prime coat is not entirely absorbed within 24 hours after application, spread sand over surface to blot excess asphalt. Use enough sand to prevent pickup under traffic. Remove loose sand by sweeping before pavement is placed and after volatiles have evaporated.
2. Protect primed substrate from damage until ready to receive paving.

E. Tack Coat: Apply uniformly to surfaces of existing pavement at a rate of 0.05 to 0.15 gal./sq. yd. (0.2 to 0.7 L/sq. m).

1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.
2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.

3.6 PAVING GEOTEXTILE INSTALLATION

A. Apply tack coat uniformly to existing pavement surfaces at a rate of 0.20 to 0.30 gal./sq. yd. (0.8 to 1.2 L/sq. m).

B. Place paving geotextile promptly according to manufacturer's written instructions. Broom or roll geotextile smooth and free of wrinkles and folds. Overlap longitudinal joints 4 inches (100 mm) and transverse joints 6 inches (150 mm).

C. Protect paving geotextile from traffic and other damage, and place hot-mix asphalt overlay the same day.

3.7 PLACING HOT-MIX ASPHALT

A. Machine place hot-mix asphalt on prepared surface, spread uniformly, and strike off. Place asphalt mix by hand in areas inaccessible to equipment in a manner that prevents segregation of mix. Place each course to required grade, cross section, and thickness when compacted.

1. Place hot-mix asphalt base course in number of lifts and thicknesses indicated.
2. Place hot-mix asphalt surface course in single lift.
3. Spread mix at a minimum temperature of 250 deg F (121 deg C).
4. Begin applying mix along centerline of crown for crowned sections and on high side of one-way slopes unless otherwise indicated.
5. Regulate paver machine speed to obtain smooth, continuous surface free of pulls and tears in asphalt-paving mat.

B. Place paving in consecutive strips not less than 10 feet (3 m) wide unless infill edge strips of a lesser width are required.

1. After first strip has been placed and rolled, place succeeding strips and extend rolling to overlap previous strips. Overlap mix placement about 1 to 1-1/2 inches

(25 to 38 mm) from strip to strip to ensure proper compaction of mix along longitudinal joints.

2. Complete a section of asphalt base course before placing asphalt surface course.

C. Promptly correct surface irregularities in paving course behind paver. Use suitable hand tools to remove excess material forming high spots. Fill depressions with hot-mix asphalt to prevent segregation of mix; use suitable hand tools to smooth surface.

3.8 JOINTS

A. Construct joints to ensure a continuous bond between adjoining paving sections. Construct joints free of depressions, with same texture and smoothness as other sections of hot-mix asphalt course.

1. Clean contact surfaces and apply tack coat to joints.
2. Offset longitudinal joints, in successive courses, a minimum of 6 inches (150 mm).
3. Offset transverse joints, in successive courses, a minimum of 24 inches (600 mm).
4. Construct transverse joints at each point where paver ends a day's work and resumes work at a subsequent time. Construct these joints using either "bulkhead" or "papered" method according to AI MS-22, for both "Ending a Lane" and "Resumption of Paving Operations.".
5. Compact joints as soon as hot-mix asphalt will bear roller weight without excessive displacement.
6. Compact asphalt at joints to a density within 2 percent of specified course density.

3.9 COMPACTION

A. General: Begin compaction as soon as placed hot-mix paving will bear roller weight without excessive displacement. Compact hot-mix paving with hot, hand tampers or with vibratory-plate compactors in areas inaccessible to rollers.

1. Complete compaction before mix temperature cools to 185 deg F (85 deg C).

B. Breakdown Rolling: Complete breakdown or initial rolling immediately after rolling joints and outside edge. Examine surface immediately after breakdown rolling for indicated crown, grade, and smoothness. Correct laydown and rolling operations to comply with requirements.

C. Intermediate Rolling: Begin intermediate rolling immediately after breakdown rolling while hot-mix asphalt is still hot enough to achieve specified density. Continue rolling until hot-mix asphalt course has been uniformly compacted to the following density:

1. Average Density: 96 percent of reference laboratory density according to AASHTO T 245, but not less than 94 percent or greater than 100 percent.

2. Average Density: 92 percent of reference maximum theoretical density according to ASTM D 2041, but not less than 90 percent or greater than 96 percent.

D. Finish Rolling: Finish roll paved surfaces to remove roller marks while hot-mix asphalt is still warm.

E. Edge Shaping: While surface is being compacted and finished, trim edges of pavement to proper alignment. Bevel edges while asphalt is still hot; compact thoroughly.

F. Repairs: Remove paved areas that are defective or contaminated with foreign materials and replace with fresh, hot-mix asphalt. Compact by rolling to specified density and surface smoothness.

G. Protection: After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened.

H. Erect barricades to protect paving from traffic until mixture has cooled enough not to become marked.

3.10 ASPHALT CURBS

A. Construct hot-mix asphalt curbs over compacted pavement surfaces. Apply a light tack coat unless pavement surface is still tacky and free from dust. Spread mix at a minimum temperature of 250 deg F (121 deg C).

1. Asphalt Mix: Same as pavement surface-course mix.

B. Place hot-mix asphalt to curb cross section indicated or, if not indicated, to local standard shapes, by machine or by hand in wood or metal forms. Tamp hand-placed materials and screed to smooth finish. Remove forms after hot-mix asphalt has cooled.

3.11 ASPHALT TRAFFIC-CALMING DEVICES

A. Construct hot-mix asphalt speed bumps, humps, cushions, and tables over compacted pavement surfaces. Apply a tack coat unless pavement surface is still tacky and free from dust. Spread mix at a minimum temperature of 250 deg F (121 deg C).

1. Tack Coat Application: Apply uniformly to surfaces of existing pavement at a rate of 0.05 to 0.15 gal./sq. yd. (0.2 to 0.7 L/sq. m.)
2. Asphalt Mix: Same as pavement surface-course mix.
3. Before installation, mill pavement that will be in contact with bottom of traffic-calming device. Mill to a depth of 1 inch (25 mm) from top of pavement to a clean, rough profile.

B. Place and compact hot-mix asphalt to cross section indicated, by machine or by hand in wood or metal forms. Tamp hand-placed materials and screed to smooth finish. Remove forms after hot-mix asphalt has cooled.

3.12 INSTALLATION TOLERANCES

A. Pavement Thickness: Compact each course to produce the thickness indicated within the following tolerances:

1. Base Course: Plus or minus 1/2 inch (13 mm).
2. Surface Course: Plus 1/4 inch (6 mm), no minus.

B. Pavement Surface Smoothness: Compact each course to produce a surface smoothness within the following tolerances as determined by using a 10-foot (3-m) straightedge applied transversely or longitudinally to paved areas:

1. Base Course: 1/4 inch (6 mm).
2. Surface Course: 1/8 inch (3 mm).
3. Crowned Surfaces: Test with crowned template centered and at right angle to crown. Maximum allowable variance from template is 1/4 inch (6 mm).

C. Asphalt Traffic-Calming Devices: Compact and form asphalt to produce the contour indicated and within a tolerance of plus or minus 1/8 inch (3 mm) of height indicated above pavement surface.

3.13 SURFACE TREATMENTS

A. Fog Seals: Apply fog seal at a rate of 0.10 to 0.15 gal./sq. yd. (0.45 to 0.7 L/sq. m) to existing asphalt pavement and allow to cure. With fine sand, lightly dust areas receiving excess fog seal.

B. Slurry Seals: Apply slurry coat in a uniform thickness according to ASTM D 3910 and allow to cure.

1. Roll slurry seal to remove ridges and provide a uniform, smooth surface.

3.14 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Thickness: In-place compacted thickness of hot-mix asphalt courses will be determined according to ASTM D 3549.

C. Surface Smoothness: Finished surface of each hot-mix asphalt course will be tested for compliance with smoothness tolerances.

D. Asphalt Traffic-Calming Devices: Finished height of traffic-calming devices above pavement will be measured for compliance with tolerances.

E. In-Place Density: Testing agency will take samples of uncompacted paving mixtures and compacted pavement according to ASTM D 979.

1. Reference maximum theoretical density will be determined by averaging results from four samples of hot-mix asphalt-paving mixture delivered daily to site, prepared according to ASTM D 2041, and compacted according to job-mix specifications.
2. In-place density of compacted pavement will be determined by testing core samples according to ASTM D 1188 or ASTM D 2726.

a. One core sample will be taken for every 1000 sq. yd. (836 sq. m) or less of installed pavement, with no fewer than three cores taken.
b. Field density of in-place compacted pavement may also be determined by nuclear method according to ASTM D 2950 and correlated with ASTM D 1188 or ASTM D 2726.

F. Replace and compact hot-mix asphalt where core tests were taken.

G. Remove and replace or install additional hot-mix asphalt where test results or measurements indicate that it does not comply with specified requirements.

3.15 WASTE HANDLING

A. General: Handle asphalt-paving waste according to approved waste management plan required in Section 017419 "Construction Waste Management and Disposal."

END OF SECTION 321216

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SECTION 321273 – ASPHALT PAVING JOINT SEALERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Expansion and contraction joints within cement concrete pavement.
2. Joints between cement concrete and asphalt pavement.

B. Related Sections include the following:

1. Division 32 Section "Asphalt Paving" for constructing joints between concrete and asphalt pavement.

1.3 SUBMITTALS

A. Product Data: For each joint-sealant product indicated.

B. Product Certificates: For each type of joint sealant and accessory, signed by product manufacturer.

C. Qualification Data: For Installer.

D. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for sealants.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: An employer of workers trained and approved by manufacturer.

B. Source Limitations: Obtain each type of joint sealant through one source from a single manufacturer.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to Project site in original unopened containers or bundles with labels indicating manufacturer, product name and designation, color, expiration date, pot life, curing time, and mixing instructions for multicomponent materials.

B. Store and handle materials to comply with manufacturer's written instructions to prevent their deterioration or damage due to moisture, high or low temperatures, contaminants, or other causes.

1.6 PROJECT CONDITIONS

A. Do not proceed with installation of joint sealants under the following conditions:

1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer.
2. When joint substrates are wet or covered with frost.
3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products listed in other Part 2 articles.

2.2 MATERIALS, GENERAL

A. Compatibility: Provide joint sealants, backing materials, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer based on testing and field experience.

2.3 COLD-APPLIED JOINT SEALANTS

A. Multicomponent Jet-Fuel-Resistant Sealant for Concrete: Pourable, chemically curing elastomeric formulation complying with the following requirements for formulation and with ASTM C 920 for type, grade, class, and uses indicated:

1. Urethane Formulation: Type M; Grade P; Class 12-1/2; Uses T, M, and, as applicable to joint substrates indicated, O.

2. Coal-Tar-Modified Polymer Formulation: Type M; Grade P; Class 25; Uses T and, as applicable to joint substrates indicated, O.

3. Bitumen-Modified Urethane Formulation: Type M; Grade P; Class 25; Uses T, M, and, as applicable to joint substrates indicated, O.

B. Single-Component Jet-Fuel-Resistant Urethane Sealant for Concrete: Single-component, pourable, coal-tar-modified, urethane formulation complying with ASTM C 920 for Type S; Grade P; Class 25; Uses T, M, and, as applicable to joint substrates indicated, O.

C. Type NS Silicone Sealant for Concrete: Single-component, low-modulus, neutral-curing, nonsag silicone sealant complying with ASTM D 5893 for Type NS.

1. Available Products:

a. Crafco Inc.; RoadSaver Silicone.
b. Dow Corning Corporation; 888.
c. Or Approved Equal.

D. Type SL Silicone Sealant for Concrete and Asphalt: Single-component, low-modulus, neutral-curing, self-leveling silicone sealant complying with ASTM D 5893 for Type SL.

1. Available Products:

a. Crafco Inc.; RoadSaver Silicone SL.
b. Dow Corning Corporation; 890-SL.
c. Or Approved Equal.

E. Multicomponent Low-Modulus Sealant for Concrete and Asphalt: Proprietary formulation consisting of reactive petropolymer and activator components producing a pourable, self-leveling sealant.

2.4 HOT-APPLIED JOINT SEALANTS

A. Jet-Fuel-Resistant Elastomeric Sealant for Concrete: Single-component formulation complying with ASTM D 3569.

1. Available Products:

a. Crafco Inc.; Superseal 444/777.
b. Meadows, W. R., Inc.; Poly-Jet 3569.
c. Or Approved Equal.

B. Jet-Fuel-Resistant Sealant for Concrete and Tar Concrete: Single-component formulation complying with ASTM D 3581.

1. Available Products:

a. Crafco Inc.; Superseal 1614A.

b. Meadows, W. R., Inc.; Poly-Jet 1614.
c. Meadows, W. R., Inc.; Poly-Jet 3406.
d. Meadows, W. R., Inc.; Poly-Jet 3569.
e. Or Approved Equal.

C. Elastomeric Sealant for Concrete: Single-component formulation complying with ASTM D 3406.

1. Available Products:

a. Crafco Inc.; Superseal 444/777.
b. Meadows, W. R., Inc.; Poly-Jet 3406.
c. Or Approved Equal.

D. Sealant for Concrete and Asphalt: Single-component formulation complying with ASTM D 3405.

1. Available Products:

a. Koch Materials Company; Product No. 9005.
b. Koch Materials Company; Product No. 9030.
c. Meadows, W. R., Inc.; Sealtight Hi-Spec.
d. Or Approved Equal.

2.5 JOINT-SEALANT BACKER MATERIALS

A. General: Provide joint-sealant backer materials that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by joint-sealant manufacturer based on field experience and laboratory testing.

B. Round Backer Rods for Cold- and Hot-Applied Sealants: ASTM D 5249, Type 1, of diameter and density required to control sealant depth and prevent bottom-side adhesion of sealant.

C. Backer Strips for Cold- and Hot-Applied Sealants: ASTM D 5249; Type 2; of thickness and width required to control sealant depth, prevent bottom-side adhesion of sealant, and fill remainder of joint opening under sealant.

D. Round Backer Rods for Cold-Applied Sealants: ASTM D 5249, Type 3, of diameter and density required to control sealant depth and prevent bottom-side adhesion of sealant.

2.6 PRIMERS

A. Primers: Product recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions.

B. Joint Priming: Prime joint substrates where indicated or where recommended in writing by joint-sealant manufacturer, based on preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

3.3 INSTALLATION OF JOINT SEALANTS

A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.

B. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

C. Install backer materials of type indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.

1. Do not leave gaps between ends of backer materials.
2. Do not stretch, twist, puncture, or tear backer materials.
3. Remove absorbent backer materials that have become wet before sealant application and replace them with dry materials.

D. Install sealants using proven techniques that comply with the following and at the same time backings are installed:

1. Place sealants so they directly contact and fully wet joint substrates.
2. Completely fill recesses provided for each joint configuration.
3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

E. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.

1. Remove excess sealants from surfaces adjacent to joint.
2. Use tooling agents that are approved in writing by joint-sealant manufacturer and that do not discolor sealants or adjacent surfaces.

F. Provide joint configuration to comply with joint-sealant manufacturer's written instructions, unless otherwise indicated.

G. Provide recessed joint configuration for silicone sealants of recess depth and at locations indicated.

3.4 CLEANING

A. Clean off excess sealants or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved by manufacturers of joint sealants and of products in which joints occur.

3.5 PROTECTION

A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately and replace with joint sealant so installations with repaired areas are indistinguishable from the original work.

END OF SECTION 321273

SECTION 321723 - PAVEMENT MARKINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes painted markings applied to asphalt and concrete pavement.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review methods and procedures related to marking pavement including, but not limited to, the following:

a. Pavement aging period before application of pavement markings.
b. Review requirements for protecting pavement markings, including restriction of traffic during installation period.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include technical data and tested physical and performance properties.

B. Shop Drawings: For pavement markings.

1. Indicate pavement markings, colors, lane separations, defined parking spaces, and dimensions to adjacent work.
2. Indicate, with international symbol of accessibility, spaces allocated for people with disabilities.

C. Samples: For each exposed product and for each color and texture specified; on rigid backing, 8 inches (200 mm) square.

1.5 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with materials, workmanship, and other applicable requirements of Virginia DOT for pavement-marking work.

1. Measurement and payment provisions and safety program submittals included in standard specifications do not apply to this Section.

1.6 FIELD CONDITIONS

A. Environmental Limitations: Proceed with pavement marking only on clean, dry surfaces and at a minimum ambient or surface temperature of 40 deg F (4.4 deg C) for alkyd materials, 55 deg F (12.8 deg C) for water-based materials, and not exceeding 95 deg F (35 deg C).

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Aexcel Inc.
2. Benjamin Moore & Co.
3. Color Wheel Paints & Coatings.
4. Columbia Paint & Coatings.
5. Conco Paints.
6. Coronado Paint; Division of INSL-X Products Corporation.
7. Diamond Vogel Paints.
8. Dunn-Edwards Corporation.
9. Ennis Traffic Safety Solutions, Inc.
10. Frazee Paint.
11. General Paint.
12. Kwal Paint.
13. M.A.B. Paints.
14. McCormick Paints.
15. Miller Paint.
16. Parker Paint Mfg. Co. Inc.
17. PPG Industries.
18. Pratt & Lambert.
19. Rodda Paint Co.
20. Rohm and Haas Company; a subsidiary of The Dow Chemical Company.
21. Scott Paint Company.
22. Sherwin-Williams Company (The).
23. Approved equivalent.

2.2 PAVEMENT-MARKING PAINT

A. Pavement-Marking Paint: Alkyd-resin type, lead and chromate free, ready mixed, complying with AASHTO M 248, Type N; colors complying with FS TT-P-1952.

1. Color: As required by Virginia DOT.

B. Pavement-Marking Paint: MPI #32, alkyd traffic-marking paint.

1. Color: As required by Virginia DOT.

C. Pavement-Marking Paint: Latex, waterborne emulsion, lead and chromate free, ready mixed, complying with FS TT-P-1952, Type II, with drying time of less than three minutes.

1. Color: As required by Virginia DOT.

D. Pavement-Marking Paint: MPI #97, latex traffic-marking paint.

1. Color: As required by Virginia DOT.

E. Glass Beads: AASHTO M 247, Type 1.

1. Roundness: Minimum 75 percent true spheres by weight.

F. VOC Content: Pavement markings used on building interior shall have a VOC content of 150 g/L or less.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that pavement is dry and in suitable condition to begin pavement marking according to manufacturer's written instructions.

B. Proceed with pavement marking only after unsatisfactory conditions have been corrected.

3.2 PAVEMENT MARKING

A. Do not apply pavement-marking paint until layout, colors, and placement have been verified with Architect.

B. Allow paving to age for a minimum of 30 days before starting pavement marking.

C. Sweep and clean surface to eliminate loose material and dust.

D. Apply paint with mechanical equipment to produce pavement markings, of dimensions indicated, with uniform, straight edges. Apply at manufacturer's recommended rates to provide a minimum wet film thickness of 15 mils (0.4 mm).

1. Apply graphic symbols and lettering with paint-resistant, die-cut stencils, firmly secured to pavement. Mask an extended area beyond edges of each stencil to

prevent paint application beyond the stencil. Apply paint so that it cannot run beneath the stencil.

2. Broadcast glass beads uniformly into wet markings at a rate of 6 lb/gal. (0.72 kg/L).

3.3 PROTECTING AND CLEANING

A. Protect pavement markings from damage and wear during remainder of construction period.

B. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

PART 4 - METHOD OF MEASUREMENT

4.1 The quantity of pavement markings and associated surface preparation to be paid for shall be the number of square feet or linear feet, as specified in Part 5, of painting performed in accordance with the specifications and accepted by the Engineer.

4.2 Existing pavement markings requiring removal shall not be measured for payment.

4.3 The quantity of roadway delineators and parking signage to be paid for shall be the number of each units placed in accordance with the specifications and accepted by the Engineer.

PART 5 - BASIS OF PAYMENT (Payment will be made under the following:)

5.1 SIGNAGE AND DELINEATORS

A. Payment shall be made at the contract unit price per each, which price and payment shall be full compensation for all labor, equipment, tools, and incidentals necessary to complete the work prescribed in this item.

Item 321723-1: Handicap Parking Sign – per each

Item 321723-3: Roadway Delineator – per each

5.2 PAVEMENT MARKING

Payment shall be made at the contract unit price per square foot or linear foot as specified below, which price and payment shall be full compensation for all labor, equipment, tools, and incidentals necessary to complete the work prescribed in this item.

Item 321723-2: Painted Pavement Marking (White or Blue) – per square foot

Item 321723-4: 24” Solid White Thermoplastic– per linear foot

END OF SECTION 321723

SECTION 329300 - LANDSCAPE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Trees
2. Shrubs
3. Ground cover, grasses, and perennials
4. Mulch

1.2 DEFINITIONS

A. Backfill: The earth used to replace or the act of replacing earth in an excavation.

B. Finish Grade: Elevation of finished surface of planting soil.

C. Manufactured Topsoil: Soil produced off-site by homogeneously blending mineral soils or sand with stabilized organic soil amendments to produce topsoil or planting soil.

D. Planting Soil: Native or imported topsoil, manufactured topsoil, or surface soil modified to become topsoil; mixed with soil amendments.

E. Subgrade: Surface or elevation of subsoil remaining after completing excavation, or top surface of a fill or backfill, before placing planting soil.

F. Subsoil: All soil beneath the topsoil layer of the soil profile, and typified by the lack of organic matter and soil organisms.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Samples of hardwood mulch.

C. Product certificates.

D. Planting Schedule: Indicating anticipated planting dates for exterior plants.

E. Maintenance Instructions: Recommended procedures to be established by Owner for maintenance of exterior plants during a calendar year including watering plan.

1.4 QUALITY ASSURANCE

A. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when planting is in progress.

B. Topsoil Analysis: Furnish soil analysis by a qualified soil-testing laboratory.

1. Report suitability of topsoil for plant growth. State-recommended quantities of nitrogen, phosphorus, and potash nutrients and soil amendments to be added to produce satisfactory topsoil.

2. Provide analysis both before and after amendments.

C. Provide quality, size, genus, species, and variety of exterior plants indicated, complying with applicable requirements in ANSI Z60.1, "American Standard for Nursery Stock."

D. Preinstallation Conference: Conduct conference at Project site.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Do not prune trees and shrubs before delivery. Protect bark, branches, and root systems from sun scald, drying, sweating, whipping, and other handling and tying damage. Do not bend or bind-tie trees or shrubs in such a manner as to destroy their natural shape. Provide protective covering of exterior plants during delivery. Do not drop exterior plants during delivery and handling.

B. Handle planting stock by root ball.

C. Deliver exterior plants after preparations for planting have been completed and install immediately. If planting is delayed more than six hours after delivery, set exterior plants and trees in shade, protect from weather and mechanical damage, and keep roots moist.

1.6 PERCOLATION TEST

A. Immediately following rough grading operation, identify a typical location for one of the largest trees and or shrubs and excavate a pit per the project details. The contractor shall fill the pit with water to a depth of 12 inches. The owner’s representative shall measure the length of time required for the water to percolate into the soil leaving the pit empty. Within six hours of the time the water has drained from the pit, the contractor, with the owner’s representative, shall again fill the pit with water to a depth of 12 inches. If the water does not completely percolate into the soil within 9 hours, a drainage system or a soil modification will be required for shrub beds and tree pits will re-excavated and soil and drain pipe reinstalled.

1.7 TIME RESTRICTIONS AND PLANTING CONDITIONS

A. Planting Dates

1. Deciduous Material: Deciduous material from March 15 to May 15 for spring/summer planting and from September 15 to December 15 for fall/winter planting.
2. Evergreen Material: Evergreen material from March 15 to May 15 for spring/summer planting and from September 15 to December 15 for fall/winter planting.

B. Restrictions: Do not plant when ground is frozen, snow covered, muddy, or when air temperature exceeds 32 degrees Celsius, 90 degrees Fahrenheit.

1.8 WARRANTY

A. Special Warranty: Installer's standard form in which Installer agrees to repair or replace plantings that fail in materials, workmanship, or growth within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Death and unsatisfactory growth, except for defects resulting from lack of adequate maintenance, neglect, abuse by Owner, or incidents that are beyond Contractor's control.
b. Structural failures including plantings falling or blowing over.

2. Warranty Periods from Date of Substantial Completion:

a. Trees and Shrubs: <u>One year.</u>
b. Ground Cover and Perennials: <u>One year.</u>

1.9 MAINTENANCE SERVICE

A. Initial Maintenance Service: Provide full maintenance by skilled employees of landscape Installer. Maintain as required in Part 3. Begin maintenance immediately after each area is planted and continue until plantings are acceptably healthy and well established, but for not less than maintenance period below. Maintenance to include <u>consistent and regular watering during</u> <u>the growing season (see below).</u>

1. Maintenance Period for Trees and Shrubs:12 months from date of Substantial Completion.
2. Maintenance Period for Ground Covers and Perennials: 12 months from date of Substantial Completion.

B. During the Initial Maintenance Service period the contractor shall water each plant with the following minimum quantities of water for each watering, unless otherwise directed by the Engineer.

1. Deciduous Trees over 10' Ht. 12 gallons per pit
2. Deciduous Trees 10' Ht. or less 6 gallons per pit
3. Evergreen Trees 8 gallons per pit
4. Shrubs over 18" Ht. 2 gallons per pit
5. Shrubs under 18" 1 gallons per pit
6. Ground Covers and Vines .25 gallons per pit

C. The Contractor shall water all living plants every 4 weeks during the period between April 1 and May 31; every 2 weeks during the period between June 1 and September 30; and every 4 weeks during the period between October 1
and November 30. For Contractor's bidding purposes, this assumes a total of 14 times per year.

PART 2 - PRODUCTS

2.1 TREE AND SHRUB MATERIAL

A. General: Furnish nursery-grown trees and shrubs complying with ANSI Z60.1, with healthy root systems developed by transplanting or root pruning. Provide well-shaped, fully branched, healthy, vigorous stock free of disease, insects, eggs, larvae, and defects such as knots, sun scald, injuries, abrasions, and disfigurement.

B. Root-Ball Depth: Furnish trees and shrubs with root balls measured from top of root ball, which shall begin at root flare according to ANSI Z60.1. Root flare shall be visible before and after planting.

C. Provide balled and burlapped, balled and potted, or container-grown trees.

D. Shrub sizes indicated on Drawings are sizes after pruning.

2.2 GROUND COVER PLANTS

A. Ground Cover: Provide ground cover of species indicated, established and well rooted in pots or similar containers, and complying with ANSI Z60.1.

2.3 PLANTS

A. Perennials: Provide healthy, field-grown plants from a commercial nursery, of species and variety shown or listed, complying with requirements in ANSI Z60.1.

2.4 TOPSOIL

A. Topsoil: ASTM D 5268, pH range of 5.5 to 7, a minimum of 4 percent organic material content; free of stones 1 inch or larger in any dimension and other extraneous materials harmful to plant growth.

1. Topsoil Source: Reuse surface soil stockpiled on-site. Verify suitability of stockpiled surface soil to produce topsoil. Clean surface soil of roots, plants, sod, stones, clay lumps, and other extraneous materials harmful to plant growth.

   a. Supplement with imported or manufactured topsoil from off-site sources when quantities are insufficient.

2. Topsoil Source: Import topsoil or manufactured topsoil from off-site sources. Obtain topsoil displaced from naturally well-drained construction or mining sites where topsoil occurs at least 4 inches deep; do not obtain from agricultural land, bogs or marshes.
3. Topsoil Source: Amend existing in-place surface soil to produce topsoil. Verify suitability of surface soil to produce topsoil. Clean surface soil of roots, plants, sod, stones, clay lumps, and other extraneous materials harmful to plant growth.

   a. Surface soil may be supplemented with imported or manufactured topsoil from off- site sources.

   b. Provide soil analysis for a minimum of 6-8 soil cores from various locations in the stockpile both before and after amendments.

   c. Amend all topsoil with organic amendments and fertilizers at rates as determined by the soil analysis of the stockpiled soils

2.5 INORGANIC SOIL AMENDMENTS

A. Lime: ASTM C 602, agricultural limestone containing a minimum of 80 percent calcium carbonate equivalent and as follows:

1. Class: T, with a minimum of 99 percent passing through No. 8 sieve and a minimum of 75 percent passing through No. 60 sieve.
2. Class: O, with a minimum of 95 percent passing through No. 8 sieve and a minimum of 55 percent passing through No. 60 sieve.

B. Sulfur: Granular, biodegradable, containing a minimum of 90 percent sulfur, with a minimum of 99 percent passing through No. 6 sieve and a maximum of 10 percent passing through No. 40 sieve.

C. Iron Sulfate: Granulated ferrous sulfate containing a minimum of 20 percent iron and 10 percent sulfur.

D. Aluminum Sulfate: Commercial grade, unadulterated.

E. Perlite: Horticultural perlite, soil amendment grade.

F. Agricultural Gypsum: Finely ground, containing a minimum of 90 percent calcium sulfate.

G. Sand: Clean, washed, natural or manufactured, free of toxic materials.

2.6 ORGANIC SOIL AMENDMENTS

A. Compost: Well-composted, stable, and weed-free organic matter, pH range of 5.5 to 8; moisture content 35 to 55 percent by weight; 100 percent passing through 3/4-inch sieve; soluble salt content of 5 to 10 decisiemens/m.

1. Organic Matter Content: 50 to 60 percent of dry weight.
2. Feedstock; Agricultural, food or industrial residuals; biosolids; yard trimmings; or source separated or compostable mixed solid waste.

B. Wood Derivatives: Decomposed, nitrogen-treated sawdust, ground bark, or wood waste; of uniform texture, free of chips, stones, sticks, soil, or toxic materials.

1. In lieu of decomposed wood derivatives mix partially decomposed wood derivaties with at least 0.15 lb of ammonium nitrate or 0.25 lb of ammonium sulfate per cubic foot of loose sawdust or ground bark.

C. Manure: Well-rotted, unleached, stable or cattle manure containing not more than 25 percent by volume of straw, sawdust, or other bedding materials; free of toxic substances, stones, sticks, soil, weed seed, and material harmful to plant growth.

2.7 FERTILIZER

A. Bonemeal: Commercial, raw or steamed, finely ground; a minimum of 4 percent nitrogen and 20 percent phosphoric acid.

B. Superphosphate: Commercial, phosphate mixture, soluble; a minimum of 20 percent available phosphoric acid.

C. Commercial Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of fast- and slow-release nitrogen, 50 percent derived from natural organic sources of urea formaldehyde, phosphorous, and potassium in the following composition:

1. Composition: 1 lb/1000 sq. ft. of actual nitrogen, 4 percent phosphorous, and 2 percent potassium, by weight.

D. Slow-Release Fertilizer: Granular or pelleted fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium in the following composition:

1. Composition: 20 percent nitrogen, 10 percent phosphorous, and 10 percent potassium, by weight.

2.8 PLANTING SOIL MIX

A. Planting Soil Mix: Mix topsoil to create a planting mix with the following soil amendments and fertilizers in the following quantities:
   1. 60 percent topsoil (as specified)
   2. 40 percent prepared additives (by volume as follows)
      a. 2 parts humus, peat, and or compost
      b. 1 part shredded pine bark (bark pieces between ½ inch and 2 inches long).
      c. 1 part sterilized, composted cow manure
   3. Commercial fertilizer as recommended
   4. Line as recommended.

2.9 MULCHES

A. Organic Mulch: Shredded hardwood.

B. Compost Mulch: Well-composted, stable, and weed-free organic matter, pH range of 5.5 to 8; moisture content 35 to 55 percent by weight; 100 percent passing through 1-inch sieve; soluble salt content of 2 to 5 decisiemens/m.

2.10 WEED-CONTROL BARRIERS

A. Not used

2.11 DRAINAGE PIPE FOR TREE PITS.

A. Corrugated plastic drainage tubing, 2 inches in diameter, perforated, conforming to ASTM F 405.

2.12 STAKING AND GUYING MATERIAL

A. Tree Support Stakes - Rough sawn hard wood free of knots, rot, cross grain, bark, long slivers, or other defects that impair strength. Stakes shall be minimum 2 inches square or 6 2 1/2 inch diameter by 8 feet long, pointed at one end.

B. Guying Material
   1. Guying Wire: 12 gauge annealed galvanized steel, ASTM A 580/A 580M.
   2. Guying Straps: Nylon

C. Hose Chafing Guards: New or used 2 ply 3/4 inch diameter reinforced rubber or plastic hose, black or dark green, all of same color.

D. Flags: White surveyor's plastic tape, 12 inches, fastened to guying wires or cables.

2.13 EROSION CONTROL MATERIALS

A. Erosion Control Blanket: 70 percent agricultural staw/30 percent coconut fiber matrix stitched with a degradable nettings, designed to degrade within 18 months.

B. Erosion Control Fabric: Fabric shall be knitted construction of polypropylene yarn with uniform mesh openings 3/4 to 1 inch square with strips of biodegradable paper. Filler paper strips shall have a minimum life of 6 months.

C. Erosion Control Net: Net shall be heavy, twisted jute mesh, weighing approximately 605 grams per meter 1.22 pounds per linear yard and 4 feet wide with mesh openings of approximately 1 inch square.

D. Erosion Control Material Anchors: Erosion control anchors shall be as recommended by the manufacturer.

2.14 ROOT CONTROL BARRIER

A. Pre-formed, linear barrier with integral vertical root deflecting ribs constructed of ultraviolet resistant polypropylene material. Color to be black.

2.15 WATER

A. Source of water to be approved by Contracting Officer and suitable quality for irrigation and shall not contain elements toxic to plant life.

PART 3 - EXECUTION

3.1 PLANTING BED PREPARATION

A. Verify location of underground utilities prior to excavation. Protect existing adjacent turf before excavations are made.

B. Layout: Stake out approved plant material locations and planter bed outlines on the project site before digging plant pits or beds. The Landscape Architect reserves the right to adjust plant material locations to meet field conditions. Do not plant closer than 24 inches to a building wall, fence or wall edge and other similar structures

C. Loosen subgrade of planting beds to a minimum depth of 12 inches. Remove stones larger than 1 inch in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Owner's property.

1. Apply superphosphate fertilizer directly to subgrade before loosening.
2. Thoroughly blend planting soil mix off-site before spreading; or spread topsoil, apply soil amendments and fertilizer on surface, and thoroughly blend planting soil mix.
3. Spread planting soil mix to a depth of **12 inches** but not less than required to

meet finish grades after natural settlement. Do not spread if planting soil or subgrade is frozen, muddy, or excessively wet.

D. Finish Grading: Grade planting beds to a smooth, uniform surface plane with loose, uniformly fine texture. Hand Rake, remove ridges, and fill depressions to meet finish grades.

3.2 TREES AND SHRUBS

A. Excavation of Pits and Trenches: Excavate circular pits with sides sloped inward. Trim base leaving center area raised slightly to support root ball and assist in drainage. Do not further disturb base. Scarify sides of plant pit smeared or smoothed during excavation.

1. Excavate approximately three times as wide as ball diameter.
2. Excavate at least 12 inches wider than root spread and deep enough to accommodate vertical roots for bare-root stock.

B. Locate the top of the root flare. Remove any excess soil around the top of the root ball to bring the top of the root ball even or slightly lower than the root collar.

C. Set trees and shrubs plumb and in center of pit or trench with top of root collar 1 inch above adjacent finish grades.

1. Balled and Burlapped: Remove burlap and wire baskets from tops of root balls and partially from sides, but do not remove from under root balls. Remove pallets, if any, before setting. Do not use planting stock if root ball is cracked or broken before or during planting operation.
2. Container Grown: Carefully remove root ball from container without damaging root ball or plant.
3. Fabric Bag Grown: Carefully remove root ball from fabric bag without damaging root ball or plant. Do not use planting stock if root ball is cracked or broken before or during planting operation.
4. Place planting soil mix around root ball in layers, tamping to settle mix and eliminate voids and air pockets. When pit is approximately one-half backfilled, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed. Water again after placing and tamping final layer of planting soil mix.

D. Organic Mulching: Apply 3-inch average thickness of organic mulch extending 12 inches beyond edge of planting pit or trench. Do not place mulch within 3 inches of trunks or stems.

3.3 TREE AND SHRUB PRUNING

A. Remove only dead, dying, or broken branches. Do not prune for shape.

B. Prune, thin, and shape trees and shrubs according to standard horticultural practice. Prune trees to retain required height and spread. Do not cut tree leaders; remove

only injured or dead branches from flowering trees. Prune shrubs to retain natural character.

3.4 STAKING AND GUYING

A. All trees shall be staked. Staking: Stake plants with the number of stakes indicated complete with double strand of 12 gage guy wire as detailed. Attach guy wire half the tree height but not more than 5 feet high. Drive stakes to a depth of 2 1/2 to 3 feet into the ground outside the plant pit. Do not injure the root ball. Use hose chafer guards where guy wire comes in contact with tree trunk.

B. Guying: Guy plants as indicated. Attach three strands of guying wire around the tree trunk at an angle of 45 degrees at approximately 1/2 of the trunk height Protect tree trunks with chafing guards where guying wire contacts the tree trunk. Anchor guys to wood ground stakes. Fasten flags to each guying wire approximately 2/3 of the distance up from ground level. Provide turnbuckles as indicated.

C. Flags: Securely fasten flags on each guy wire and cable approximately two-thirds of the distance up from ground level.

D. Staking and guying to be removed within 6 months of placement.

3.5 GROUND COVER AND PLANT PLANTING

A. Set out and space ground cover and plants as indicated.

B. Dig holes large enough to allow spreading of roots and backfill with planting soil.

C. Work soil around roots to eliminate air pockets and leave a slight saucer indentation around plants to hold water.

D. Water thoroughly after planting, taking care not to cover plant crowns with wet soil.

E. Protect plants from hot sun and wind; remove protection if plants show evidence of recovery from transplanting shock.

3.6 PLANTING BED MULCHING

A. Mulch backfilled surfaces of planting beds and other areas indicated. Provide mulch ring around trees in lawn areas.

1. Organic Mulch: Apply 3-inch average thickness of mulch, and finish level with adjacent finish grades. Do not place mulch against plant stems.

3.7 PLANT MAINTENANCE

A. Tree and Shrub Maintenance: Maintain plantings by pruning, cultivating, watering, weeding, fertilizing, restoring planting saucers, and resetting to proper grades or

vertical position, as required to establish healthy, viable plantings. Spray or treat as required to keep trees and shrubs free of insects and disease.

B. Ground Cover and Plant Maintenance: Maintain and establish plantings by watering, weeding, fertilizing, mulching, and other operations as required to establish healthy, viable plantings.

C. Protect exterior plants from damage due to landscape operations, operations by other contractors and trades, and others. Maintain protection during installation and maintenance periods. Treat, repair, or replace damaged plantings.

3.8 RESTORATION AND CLEAN UP

A. Restoration: Turf areas, pavements and facilities that have been damaged from the planting operation shall be restored to original condition at the Contractor's expense.

B. Clean Up: Excess and waste material shall be removed from the installed area and shall be disposed offsite. Adjacent paved areas shall be clean.

PART 4 – METHOD OF MEASUREMENT

4.1 LANDSCAPING

A. Landscaping as described above will be measured by lump sum.

PART 5 – BASIS OF PAYMENT

5.1 LANDSCAPING

A. Payment shall be made at the contract unit price per lump sum or fraction thereof, which price and payment shall be full compensation for all labor, equipment, materials, tools, and incidentals necessary to complete the work prescribed in this item.

Item 329300: Landscape – per lump sum

END OF SECTION 329300

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ITEM F-162 CHAIN-LINK FENCE

DESCRIPTION

162-1.1 This item shall consist of furnishing and erecting a chain-link fence in accordance with these specifications, the details shown on the plans, and in conformity with the lines and grades shown on the plans or established by the Engineer.

MATERIALS

162-2.1 Fabric. The fabric shall be woven with a 9-gauge galvanized steel wire in a 2-inch (50 mm) mesh and shall meet the requirements of ASTM A392, Class 2.

162-2.2 Barbed wire. Barbed wire shall be 2-strand 12-1/2 gauge zinc-coated wire with 4-point barbs and shall conform to the requirements of ASTM A121, Class 3, Chain Link Fence Grade.

162-2.3 Posts, rails, and braces. Line posts, rails, and braces shall conform to the requirements of ASTM F1043 or ASTM F1083 as follows:

Galvanized tubular steel pipe shall conform to the requirements of Group IA, (Schedule 40) coatings conforming to Type A, or Group IC (High Strength Pipe), External coating Type B, and internal coating Type B or D.

Roll Formed Steel Shapes (C-Sections) shall conform to the requirements of Group IIA, and be galvanized in accordance with the requirements of ASTM F1043, Type A.

~~Hot-Rolled Shapes (H Beams) shall meet the requirements of Group III, and be galvanized in accordance with the requirements of ASTM F1043, Type A.~~

~~Aluminum Pipe shall conform to the requirements of Group IB.~~

~~Aluminum Shapes shall conform to the requirements of Group IIB.~~

~~Vinyl or polyester coated steel shall conform to the requirements of ASTM F1043, Paragraph 7.3, Optional Supplemental Color Coating.~~

~~Composite posts shall conform to the strength requirements of ASTM F1043 or ASTM F1083. The strength loss of composite posts shall not exceed 10% when subjected to 3,600 hours of exposure to light and water in accordance with ASTM G152, ASTM G153, ASTM G154, and ASTM G155.~~

~~Posts, rails, and braces furnished for use in conjunction with aluminum alloy fabric shall be aluminum alloy or composite.~~

~~Posts, rails, and braces, with the exception of galvanized steel conforming to ASTM F1043 or ASTM F1083, Group 1A, Type A, or aluminum alloy, shall demonstrate the ability to withstand testing in salt spray in accordance with ASTM B117 as follows:~~

- ~~External: 1,000 hours with a maximum of 5% red rust.~~
- ~~Internal: 650 hours with a maximum of 5% red rust.~~

The dimensions of the posts, rails, and braces shall be in accordance with Tables I through VI of Federal Specification RR-F-191/3.

162-2.4 Gates. Gate frames shall consist of galvanized steel pipe and shall conform to the specifications for the same material under paragraph 162-2.3. The fabric shall be of the same type material as used in the fence.

162-2.5 Wire ties and tension wires. Wire ties for use in conjunction with a given type of fabric shall be of the same material and coating weight identified with the fabric type. Tension wire shall be 7-gauge marcelled steel wire with the same coating as the fabric type and shall conform to ASTM A824.

All material shall conform to Federal Specification RR-F-191/4.

162-2.6 Miscellaneous fittings and hardware. Miscellaneous steel fittings and hardware for use with zinc-coated steel fabric shall be of commercial grade steel or better quality, wrought or cast as appropriate to the article, and sufficient in strength to provide a balanced design when used in conjunction with fabric posts, and wires of the quality specified herein. All steel fittings and hardware shall be protected with a zinc coating applied in conformance with ASTM A153. Barbed wire support arms shall withstand a load of 250 pounds (113 kg) applied vertically to the outermost end of the arm.

162-2.7 Concrete. Concrete shall be of a commercial grade with a minimum 28-day compressive strength of 2500 psi (17 240 kPa).

162-2.8 Marking. Each roll of fabric shall carry a tag showing the kind of base metal (steel, aluminum, or aluminum alloy number), kind of coating, the gauge of the wire, the length of fencing in the roll, and the name of the manufacturer. Posts, wire, and other fittings shall be identified as to manufacturer, kind of base metal (steel, aluminum, or aluminum alloy number), and kind of coating.

162-2.9 POST CAPS. All posts shall have post caps installed on top to prevent moisture from entering through the top of the post. The post caps shall meet the requirements of paragraph 162-2.6 and shall be of the size such that when the post cap is installed over the top of the fence top, it will fit securely and not be loose.

CONSTRUCTION METHODS

162-3.1 Clearing fence line. All trees, brush, stumps, logs, and other debris which would interfere with the proper construction of the fence in the required location shall be removed a minimum width of 5 feet (1.5 m) on each side of the fence centerline before starting fencing operations. The cost of removing and disposing of the material shall not constitute a pay item and shall be considered incidental to fence construction.

162-3.2 Installing posts. All posts shall be set in concrete at the required dimension and depth and at the spacing shown on the plans.

The concrete shall be thoroughly compacted around the posts by tamping or vibrating and shall have a smooth finish slightly higher than the ground and sloped to drain away from the posts. All posts shall be set plumb and to the required grade and alignment. No materials shall be installed on the posts, nor shall the posts be disturbed in any manner within seven (7) days after the individual post footing is completed.

Should rock be encountered at a depth less than the planned footing depth, a hole 2 inches (50 mm) larger than the greatest dimension of the posts shall be drilled to a depth of 12 inches (300 mm). After the posts are set, the remainder of the drilled hole shall be filled with grout, composed of one part Portland cement and two parts mortar sand. Any remaining space above the rock shall be filled with concrete in the manner described above.

In lieu of drilling, the rock may be excavated to the required footing depth. No extra compensation shall be made for rock excavation.

162-3.3 Installing ~~top rails~~ tension wire. The bottom tension wire shall be installed within 6 inches of the bottom of the fabric and shall be at a consistent height throughout the length of fence. The top tension wire shall be installed at 6 inches off the top of the fabric and shall be at a consistent height through the length of the fence.~~The top rail shall be continuous and shall pass through the post tops. The coupling used to join the top rail lengths shall allow for expansion.~~

162-3.4 Installing braces. Horizontal brace rails, with diagonal truss rods and turnbuckles, shall be installed at all terminal posts.

162-3.5 Installing fabric. The wire fabric shall be firmly attached to the posts and braced as shown on the plans. All wire shall be stretched taut and shall be installed to the required elevations. The fence shall generally follow the contour of the ground, with the bottom of the fence fabric no less than one inch (25 mm) or more than 4 inches (100 mm) from the ground surface. Grading shall be performed where necessary to provide a neat appearance.

At locations of small natural swales or drainage ditches and where it is not practical to have the fence conform to the general contour of the ground surface, longer posts may be used and multiple strands of barbed wire stretched to span the opening below the fence. The vertical clearance between strands of barbed wire shall be 6 inches (150 mm) or less.

162-3.6 Electrical grounds. Electrical grounds shall be constructed where a power line passes over the fence at 500 feet (150 m) intervals. The ground shall be installed directly below the point of crossing. The ground shall be accomplished with a copper clad rod 8 feet (2.4 m) long and a minimum of 5/8 inches (16 mm) in diameter driven vertically until the top is 6 inches (150 mm) below the ground surface. A No. 6 solid copper conductor shall be clamped to the rod and to the fence in such a manner that each element of the fence is grounded. Installation of ground rods shall not constitute a pay item and shall be considered incidental to fence construction. The Contractor shall comply with FAA-STD-019, Lightning and Surge Protection, Grounding, Bonding and Shielding Requirements for Facilities and Electronic Equipment, Paragraph 4.2.3.8, Lightning Protection for Fences and Gates, when fencing is adjacent to FAA facilities.

162-3.7 Cleaning up. The Contractor shall remove from the vicinity of the completed work all tools, buildings, equipment, etc., used during construction. All disturbed areas shall be seeded per T-901.

METHOD OF MEASUREMENT

162-4.1 Chain-link fence will be measured for payment by the linear foot (meter). Measurement will be along the top of the fence from center to center of end posts, excluding the length occupied by gate openings.

162-4.2 Gates will be measured as complete units.

162-4.3 Removal of Chain-link fence will be measured for payment by the linear foot. Measurement will be along the top of the fence from center to center of end posts.

BASIS OF PAYMENT

162-5.1 Payment for chain-link fence will be made at the contract unit price per linear foot (meter).

162-5.2 Payment for vehicle or pedestrian gates will be made at the contract unit price for each gate.

The price shall be full compensation for furnishing all materials, and for all preparation, erection, and installation of these materials, and for all labor equipment, tools, and incidentals necessary to complete the item.

Payment will be made under:

Item F-162-5.1	Chain-Link Fence - per linear foot (meter)
Item F-162-5.2a	Vehicle Gates - per each
Item F-162-5.2b	Pedestrian Gates - per each
Item F-162-5.3	Removal of Chain-Link Fence with barbed wire - per linear foot (meter)

MATERIAL REQUIREMENTS

ASTM A121	Standard Specification for Metallic-Coated Carbon Steel Barbed Wire

ASTM A123	Standard Specification for Zinc (Hot Dip Galvanized) Coatings on Iron and Steel Products
ASTM A153	Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A392	Standard Specification for Zinc-Coated Steel Chain-Link Fence Fabric
ASTM A491	Standard Specification for Aluminum-Coated Steel Chain-Link Fence Fabric
ASTM A572	Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel
ASTM A653	Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A824	Standard Specification for Metallic-Coated Steel Marcelled Tension Wire for Use With Chain Link Fence
ASTM A1011	Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High Strength Low Alloy with Improved Formability, and Ultra High Strength
ASTM B117	Standard Practice for Operating Salt Spray (Fog) Apparatus
ASTM B221	Standard Specification for Aluminum and Aluminum Alloy Extruded Bars, Rods, Wire, Profiles and Tubes
ASTM B429	Standard Specification for Aluminum-Alloy Extruded Structural Pipe and Tube
ASTM F668	Standard Specification for Polyvinyl Chloride(PVC), Polyolefin and other Organic Polymer Coated Steel Chain-Link Fence Fabric
ASTM F1043	Standard Specification for Strength and Protective Coatings on Steel Industrial Fence Framework
ASTM F1083	Standard Specification for Pipe, Steel, Hot-Dipped Zinc-Coated (Galvanized) Welded, for Fence Structures
ASTM F1183	Standard Specification for Aluminum Alloy Chain Link Fence Fabric
ASTM F1345	Standard Specification for Zinc 5% Aluminum-Mischmetal Alloy Coated Steel Chain-Link Fence Fabric
ASTM G152	Standard Practice for Operating Open Flame Carbon Arc Light Apparatus for Exposure of Nonmetallic Materials
ASTM G153	Standard Practice for Operating Enclosed Carbon Arc Light Apparatus for Exposure of Nonmetallic Materials
ASTM G154	Standard Practice for Operating Fluorescent Ultraviolet (UV) Lamp Apparatus for Exposure of Nonmetallic Materials
ASTM G155	Standard Practice for Operating Xenon Arc Light Apparatus for Exposure of Nonmetallic Materials
FED SPEC RR-F-191/3	Fencing, Wire and Post, Metal (Chain-Link Fence Posts, Top Rails and Braces)
FED SPEC RR-F-191/4	Fencing, Wire and Post, Metal (Chain-Link Fence Accessories)
FAA-STD-019	Lightning and Surge Protection, Grounding, Bonding and Shielding Requirements for Facilities and Electronic Equipment

END OF ITEM F-162

SECTION P-110 TRENCHING AND BACKFILLING FOR PROTECTION OF NEW AND EXISTING UNDERGROUND UTILITIES

DESCRIPTION

110-1.1 This item consists of trenching, bedding and backfilling for underground utility systems.

MATERIALS

110-2.1 All materials shall be classified as defined below:

a. Unsuitable Material. Natural soils having physical properties, because of organic content, plasticity, excessive moisture content, or other characteristics which cannot be readily upgraded by draining, manipulating, blending with select earth materials, or densification to provide the required structural support values, or cannot be compacted to the required density, are designated as unsuitable materials.

b. Select Backfill. Satisfactory soil material shall be free of rock or gravel larger than 2-inches in any dimension, debris, waste, frozen materials, vegetation or other deleterious matter. Use excavated or borrowed material that has been sampled and tested by the Owner authorized testing laboratory and accepted by the Engineer as satisfactory soil material.

c. Sand Bedding. Fine aggregate natural sand shall be free of organics and excessive clay, have a plasticity index not greater than 6 and not more than 40 percent of the material passing a No. 200 sieve.

d. Crushed Aggregate Bedding. The gradation (job mix) of the final mixture shall fall within the design range indicated in Table 1, when tested in accordance with ASTM C 117 and C136.

TABLE 1. REQUIREMENTS FOR GRADATION OF CRUSHED AGGREGATE

Sieve Size	Design Range Percentage by Weight Passing Sieves	Job Mix Tolerances, Percent
1-1/2 in.	100	+/- 5
1 in.	95	+/- 8
1/2 in.	43	+/- 8
No. 4	0-7	+/- 8
No. 30	0-3	+/- 8

No. 57 Aggregate is acceptable.

e. Flowable Backfill. Material consisting of portland cement, fine aggregate and water shall be used as follows.

Ingredients	Lbs./C.Y.
Cement (0.53 sack)	50
Water (50 gallons)	417 (or as needed)
Coarse Aggregate (Size no. 8,max.3/8")	1700
Sand (ASTM C 33)	2000

The minimum desired 28-day strength is 2,500 psi (compressive strength).
The above combination of material or an equivalent may be used to obtain the desired flowable backfill.

f. Detection Tape. Provide detectable magnetic plastic tape manufactured specifically for warning and identification of buried piping. Tape shall be detectable by electronic detection instrumentation. Provide tape in rolls, 3 inches minimum width, color coded for the utility involved, with warning and identification imprinted in bold black letters continuously over entire tape length. Warning and identification shall be CAUTION - BURIED GAS LINE BELOW or similar. Use permanent code and letter coloring unaffected by moisture and other substances contained in trench backfill material. Bury tape with the printed side up at a depth of 12 inches below the top surface of earth or the top surface of the subgrade under pavements.

CONSTRUCTION METHODS

110-3.1 UNDERGROUND UTILITIES. Underground utilities have been located on the plans based on the best available data. The Contractor is ultimately responsible for locating all existing underground utilities whether shown on the plans or not shown.

The Contractor shall confirm the location, clearance and depths of utilities and shall notify the Engineer of any discrepancies or additional utilities and obtain direction before proceeding with trenching operations.

Where any information is shown or stated pertaining to the character of the materials expected to be encountered in the excavation work (whether from borings, observations, records or otherwise) it is expressly understood that the Engineer does not guarantee such information in any way except that, in the judgment of the Engineer, the information appeared to be valid and reasonably accurate at the place and time that the information was originally developed or observed.

110-3.2 ENVIRONMENTAL CONTROL. The Contractor shall plan and execute his operations in compliance with applicable Federal, State and local laws and regulations concerning the control and abatement of water pollution, the prevention and control of air pollution and preservation of the site.

110-3.3 QUALITY CONTROL. The Contractor shall employ and pay for the services of an Independent Testing Laboratory to perform the required tests.

The Contractor shall be responsible for the following, but not limited to, items:

a. To control the quality of all materials used on the project. The Contractor shall ensure that all materials are in compliance with the designated material specifications and ensures the fabrication and installation of the materials comply with the plans and specifications.

b. Rework any areas not meeting the specified compaction requirements.

c. Provide qualified personnel and supervision to carry out compaction operations.

110-3.4 Inspections and Tests. An independent testing laboratory shall be obtained by the Owner for any acceptance testing of any materials used on the project. All materials are subject to review and approval at the source of supply, fabrication as well as at the job site.

If the independent testing laboratory's tests reveal inferior materials, poor workmanship or improper placement of the material(s), then the Contractor shall also pay for the repair or replacement of all defective materials or conditions resulting from poor workmanship with no additional compensation from the Owner.

110-3.5 PREPARATION. The location of the lines and grades shown in the plans or called for in these

specifications may be changed only by direction of the Engineer.

The Contractor shall furnish at his own expense and place in position as directed by the Engineer, all necessary batter boards for controlling the work. The boards and all location stakes must be protected from possible injury or change of location. Also, the Contractor shall be required to furnish, at his own expense, good, sound tilled grade lines and graduated poles made of a form approved by the Engineer or laser equipment for grade control of utilities required to be installed on a grade.

110-3.6 TRENCH EXCAVATION. Unless otherwise specified in the plans or permitted by the Engineer, all pipe shall be installed in open cut trenches with vertical sides.

Sheeting, Shoring and Bracings shall conform to the following:

a. Trenches shall be sheathed and braced to the extent necessary to maintain the sides of the trench in vertical position throughout the construction period and to comply with all OSHA requirements. Adequacy of the sheathing and bracing shall be the responsibility of the Contractor.

b. Care shall be taken to prevent voids outside the sheeting. If voids are formed, they shall immediately be filled and compacted.

c. After completion of the structure, all sheeting, shoring and bracing shall be removed unless approval has been granted by the Engineer, in writing, to leave any or all of it in place. The sheeting, shoring and bracing shall be removed as excavations are backfilled in a manner that will prevent injurious caving of the excavation or damage to the structure.

d. Voids left or caused by removal of sheeting shall immediately be filled with select fill and compacted.

e. The Engineer shall have the right to limit the amount of trench which shall be opened or partially opened at any time in advance of the completed line and also the amount of trench left unfilled.

Strip topsoil and stockpile as directed by the Engineer.

The cut edges of excavations shall be sloped away from excavations or embankments created to prevent surface water from entering the excavation.

Excavation in existing roads, together with the maintenance of traffic where specified, and the restoration of the pavement surface shall be in accordance with details in the plans or as required by other specifications included in the Contract.

All materials from excavation operations not required for backfilling the trench shall be placed in embankments if considered suitable by the Engineer. All material not suitable for use in embankments will be declared surplus by the Engineer and shall become the property of the Contractor to dispose of as he wishes. Such surplus material shall be removed from the work promptly following the completion of the portion of the trench involved.

Dewatering shall conform to the following:

a. Prevent surface water and subsurface or groundwater from flowing into trench excavations.

(1) Do not allow water to accumulate in excavations. Remove water to prevent softening of trench bottoms, and soil changes detrimental to stability of subgrade.

(2) Provide dewatering system components necessary to convey water away from

excavations. Do not use trench excavations as temporary drainage ditches.

Trench Width. The trench width at the pipe zone (six inches below and twelve inches above the outer projections of the pipe or accessories) should be kept to a minimum. The minimum permissible clearance between the outside body of the pipe and the trench wall at the pipe zone will be such that the bedding material can be placed on all sides of the pipe. The maximum clearance will be 12 inches on each side of the piping.

Trench Depth. Trenches shall be excavated to a depth that provides proper clearance beneath all parts of the pipe and fittings for placement of the bedding, cradle, jacket, etc. Unless otherwise specified, this depth shall be six inches below the outer parts of the pipe, fittings, and accessories. Before placing any bedding, etc., any part of the trench that may have been excavated too deep shall be filled to the proper subgrade with selected fine material graded and thoroughly tamped over the full width of the excavation between undisturbed trench walls, to the satisfaction of the Engineer.

Trench Conditions. No pipe or bedding shall be placed where the trench bottom, in the opinion of the Engineer, is found to be a soft material, poor fill material or otherwise unstable material not suitable as a foundation. Instead, the Engineer may direct that the trench bottom be stabilized by installing a granular foundation mat of crushed stone, pea gravel or other granular material approved by the Engineer.

Undercutting. Rock, shale, hardpan, loose rock, boulders, or other material unsatisfactory for bedding shall be excavated to a minimum depth of 12 inches, or to the depth specified by the Engineer, below the utility invert and 12 inches adjacent to the pipe placement.

110-3.6 EXISTING STRUCTURES. When old structures or foundations are encountered in the excavation, such obstructions shall be removed for the full width of the trench and to a depth of one foot below the bottom of the trench. When old inlets or manholes are encountered and no plan provision is made for adjustment or connection to the new sewers, such manholes and inlets shall be removed completely to a depth one foot below the bottom of the trench. In each instance, the bottom of the trench shall be restored to grade by backfilling and compacting by the methods provided hereinafter for backfill. Where the trench cuts through storm or sanitary sewers which are known to be abandoned, these sewers shall be cut flush with the sides of the trench and blocked with a concrete plug in a manner satisfactory to the Engineer.

110-3.7 BEDDING PIPE. All piping shall be installed in a continuous envelope of sand or crushed aggregate. The bedding material shall extend from six inches below to twelve inches above the outer parts of the pipe, fittings and accessories over the full width of the excavation between the undisturbed trench walls, unless otherwise shown in the plans.

Place bedding material so that at least the lower quarter of pipe circumference is in continuous contact with backfill. Place the material carefully and uniformly up each side of the pipe in a manner that assures compaction along the sides and haunches.

110-3.8 BACKFILLING TRENCH. Pipes and trenches shall be inspected before any backfill is placed; any pipes found to be out of alignment, unduly settled, or damaged shall be removed and relaid or replaced at the Contractor's expense.

Material for backfill shall be fine, readily compactable soil, or granular material selected from the excavation or a source of the Contractor's choosing. It shall not contain frozen lumps, stones that would be retained on a 2-inch sieve, chunks of highly plastic clay, or other objectionable material. No less than 95 percent of a granular backfill material shall pass through a 1/2-inch sieve, and no less than 95 percent of it shall be retained on a No. 4 sieve.

When the top of the pipe is even with or below the top of the trench, the backfill shall be compacted in

layers not exceeding 8 inches on both sides of the pipe and shall be brought up one foot above the top of the pipe or to natural ground level, whichever is greater. Care shall be exercised to thoroughly compact the backfill material under the haunches of the pipe. Material shall be brought up evenly on both sides of the pipe.
When the top of the pipe is above the top of the trench, the backfill shall be compacted in layers not exceeding 8 inches and shall be brought up evenly on both sides of the pipe to 1 foot above the top of the pipe. The width of backfill on each side of the pipe for the portion above the top of the trench shall be equal to twice the pipe's diameter or 12 feet, whichever is less.

All backfill shall be compacted to the density required under Item P-152, Excavation and Embankment.

Place backfill materials in layers not more than 8 inches in loose depth for material compacted by heavy compaction equipment and not more than 8 inches in loose depth for material compacted by hand-operated equipment.

a. Before compaction, moisten or aerate each layer as necessary to provide the optimum moisture content of the soil material. Compact each layer to the required density for each area classification. Do not place backfill material on surfaces that are muddy, frozen, or contain frost or ice.

b. Place backfill materials evenly adjacent to piping, tanks or structures to the required elevations. Take care to prevent wedging action of the backfill by carrying the material uniformly around the piping, tanks or structure to approximately the same elevation in each lift.

c. Do not place layer of loose material over a previously compacted layer until after compacted layer is tested and evaluated by the independent testing laboratory and acceptable to the Engineer.

d. Moisten as necessary to obtain optimum moisture content prior to compaction. Do not use water to compact backfill materials.

110-3.9 COMPACTION. Compact soil materials that exhibit a well defined moisture density relationship to not less than the specified density determined by ASTM D 1557 or D 4253.

Compact soil materials for following area classifications to not less than the specified in-place density applicable for type soil material:

a. Pipe Bedding: Compact bedding material to minimum of 85 percent relative density, as determined by ASTM D 2049.

b. Balance of Pipe Trench Excavations:

(1) Within Structure Lines and Under Pavements: Compact each layer of backfill material to the minimum percent maximum dry density at optimum moisture as specified in P-152 Excavation and Embankment.

(2) Other Areas: Compact each layer of backfill material to minimum of 95 percent maximum dry density at optimum moisture.

Moisture shall be controlled as follows:

a. Where the bottom grade or layer of soil material must be moisture conditioned before compaction, uniformly apply water to the surface of bottom grade, or layer of soil material. Prevent free water from appearing on the surface during or subsequent to compaction operations.

b. Remove and replace, or scarify and air dry, soil material that is too wet to permit compaction

to specified density.

110-3.10 FIELD QUALITY CONTROL. Allow the independent testing laboratory to test all subgrades and fill layers before further construction work is performed.

a. General: Field density tests shall be performed in accordance with ASTM D 2922 (nuclear method).

b. Trench Subgrade: At least one field density test of trench subgrade for every 100 linear feet.

c. Backfill Under and around Structures: At least one field density test will be taken under each structure. At least one field density test will be taken per lift or any portion there of around the structure. Test locations around the structure shall be determined on a random basis.

d. Backfill Under Pavement: At least one field density test of trench backfill will be taken for each lift at a frequency of 50 linear feet.

e. All Other Areas: At least one field density test of trench backfill will be taken for every other lift at a frequency of 100 linear feet.

f. Evaluation:

(1) The independent testing laboratory shall determine whether the Contractor's methods of excavating, segregation of backfill and fill materials, preparation of subgrade, dewatering and placement of backfill is as specified and, if necessary, shall recommend corrective measures.

(2) The independent testing laboratory will observe excavated soils or sources of fill and backfill materials to determine their suitability and the compaction criteria required to produce specified results.

g. Additional Work: If, in the opinion of the Engineer, based on the independent testing laboratory reports, subgrade or fills which have been placed are below specified density, provide additional earthwork and compaction until satisfactory results are obtained at no additional cost to the Owner.

METHOD OF MEASUREMENT

110-4.1 No separate measurement shall be made for work under this Item.

BASIS OF PAYMENT

110-5.1 No separate payment will be made for work under this Item. The cost of the work described in this Item shall be considered incidental to installation of the various utility systems included in the project.

TESTING REQUIREMENTS

ASTM C 33	Specification for Concrete Aggregate
ASTM D 1557	Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures using 10 lb. Rammer and 18 inch Drop
ASTM D 4253	Maximum Index Density and Unit Weight of Soils using a Vibratory Table

ASTM D 2922	Density of Soil and Soil Aggregate in-place by Nuclear Method

END OF SECTION P-110

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ITEM P-156 TEMPORARY AIR AND WATER POLLUTION, SOIL EROSION, AND SILTATION CONTROL

DESCRIPTION

156-1.1 This item shall consist of temporary control measures as shown on the plans or as ordered by the Engineer during the life of a contract to control water pollution, soil erosion, and siltation through the use of silt fences, berms, dikes, dams, sediment basins, fiber mats, gravel, mulches, grasses, slope drains, and other erosion control devices or methods.

The temporary erosion control measures contained herein shall be coordinated with the permanent erosion control measures specified as part of this contract to the extent practical to assure economical, effective, and continuous erosion control throughout the construction period.

Temporary control may include work outside the construction limits such as borrow pit operations, equipment and material storage sites, waste areas, and temporary plant sites.

Temporary control measures shall be design, installed and maintained to minimize the creation of wildlife attractants that have the potential to attract hazardous wildlife on or near public-use airports.

156-1.2 Any permits which the Owner has obtained for any purpose such as NPDES, SPCC, etc., does not include nor cover the Contractor's haul routes, equipment access points, staging areas, office compounds, materials stockpiles, blending and batch plant areas and operations or other project related activity areas outside the project limits or off site.

156-1.3 The Contractor shall prepare all required documentation, pay all fees and perform all services and work necessary to obtain all permits and approvals from any and all local, state and federal regulatory agencies for the Contractor's staging, stockpile, blending and batch plant areas and operations. The cost of all permitting shall be subsidiary to other items of work.

156-1.4 The Contractor shall develop a Pollution Prevention Plan to supplement the Owner's Stormwater Pollution Prevention Plan (SWPPP) as contained in the drawings. The plan shall be in strict compliance with the National Pollutant Discharge Elimination System (NPDES) permit issued or approved by the U.S. Environmental Protection Agency (EPA) pursuant to 40 CFR Part 122.6. The Plan shall address all measures to dispose of, control, or prevent the discharge of solid, hazardous and sanitary wastes to the waters of the U.S. The plan shall include procedures to control offsite tracking of soil by vehicles and construction equipment and procedures for cleanup and reporting of non-storm water discharges such as contaminated groundwater or accidental spills.

The Contractor shall also be required to submit a written documentation that all required permits have been obtained to the Engineer prior to start up of construction activities.

MATERIALS

156-2.1 Grass. Grass that will not compete with the grasses sown later for permanent cover per Item T-901shall be a quick-growing species (such as ryegrass, Italian ryegrass, or cereal grasses) suitable to the area providing a temporary cover. Selected grass species shall not create a wildlife attractant.

156-2.2 Mulches. Mulches may be hay, straw, fiber mats, netting, bark, wood chips, or other suitable material reasonably clean and free of noxious weeds and deleterious materials per ItemT-908. Mulches shall not create a wildlife attractant.

156-2.3 Fertilizer. Fertilizer shall be a standard commercial grade and shall conform to all Federal and state regulations and to the standards of the Association of Official Agricultural Chemists.

156-2.4 Slope drains. Slope drains may be constructed of pipe, fiber mats, rubble, Portland cement concrete, bituminous concrete, or other materials that will adequately control erosion.

156-2.5 Silt fence. The silt fence shall consist of polymeric filaments which are formed into a stable network such that filaments retain their relative positions. Synthetic filter fabric shall contain ultraviolet ray inhibitors and stabilizers to provide a minimum of six months of expected usable construction life. Silt fence shall meet the requirements of ASTM D6461.

156-2.6 Other. All other materials shall meet commercial grade standards and shall be approved by the Engineer before being incorporated into the project.

CONSTRUCTION REQUIREMENTS

156-3.1 General. In the event of conflict between these requirements and pollution control laws, rules, or regulations of other Federal, state, or local agencies, the more restrictive laws, rules, or regulations shall apply.

The Engineer shall be responsible for assuring compliance to the extent that construction practices, construction operations, and construction work are involved.

156-3.2 Schedule. Prior to the start of construction, the Contractor shall submit schedules for accomplishment of temporary and permanent erosion control work for clearing and grubbing; grading; construction; paving; and structures at watercourses. The Contractor shall also submit a proposed method of erosion and dust control on haul roads and borrow pits and a plan for disposal of waste materials. Work shall not be started until the erosion control schedules and methods of operation for the applicable construction have been accepted by the Engineer.

156-3.3 Construction details. The Contractor will be required to incorporate all permanent erosion control features into the project at the earliest practicable time as outlined in the accepted schedule. Except where future construction operations will damage slopes, the Contractor shall perform the permanent seeding and mulching and other specified slope protection work in stages, as soon as substantial areas of exposed slopes can be made available. Temporary erosion and pollution control measures will be used to correct conditions that develop during construction that were not foreseen during the design stage; that are needed prior to installation of permanent control features; or that are needed temporarily to control erosion that develops during normal construction practices, but are not associated with permanent control features on the project.

Where erosion may be a problem, clearing and grubbing operations should be scheduled and performed so that grading operations and permanent erosion control features can follow immediately if project conditions permit; otherwise, temporary erosion control measures may be required.

The Engineer shall limit the area of clearing and grubbing, excavation, borrow, and embankment operations in progress, commensurate with the Contractor's capability and progress in keeping the finish grading, mulching, seeding, and other such permanent control measures current with the accepted schedule. If seasonal limitations make such coordination unrealistic, temporary erosion control measures shall be taken immediately to the extent feasible and justified as directed by the Engineer.

The Contractor shall provide immediate permanent or temporary pollution control measures to minimize contamination of adjacent streams or other watercourses, lakes, ponds, or other areas of water impoundment as directed by the Engineer. If temporary erosion and pollution control measures are required due to the Contractor's negligence, carelessness, or failure to install permanent controls as a part of the work as scheduled or directed by the Engineer, the work shall be performed by the Contractor and the cost shall be incidental to this item.

The Engineer may increase or decrease the area of erodible earth material that can be exposed at any time based on an analysis of project conditions.

The erosion control features installed by the Contractor shall be acceptably maintained by the Contractor during the construction period.

Whenever construction equipment must cross watercourses at frequent intervals, temporary structures should be provided.

Pollutants such as fuels, lubricants, bitumen, raw sewage, wash water from concrete mixing operations, and other harmful materials shall not be discharged into any waterways, impoundments or into natural or manmade channels.

The Contractor shall provide equipment wash out areas, constructed and protected to not allow any discharge of silt, fuels, lubricants and other harmful materials into nearby impoundments, ponds or surface water drainage systems.

The Contractor shall periodically inspect the pollution control features at the intervals stated in the approved Pollution Control Plan, and immediately after each rainfall and at least daily during prolonged rainfall and immediately correct any deficiencies. The Contractor shall review the location of pollution control features for effectiveness. If deficiencies exist, the Contractor shall correct as directed by the Engineer.

Remove sediment deposits when the deposit reaches approximately 1/3 of the volume capacity of the sediment control feature, or as otherwise required. Remove all sediment deposits when the sediment control feature is removed. Grade and dress area to restore to preconstruction condition or finish grade as called for on the plans.

If construction is suspended, the Contractor shall inspect, maintain and operate temporary pollution control features during such suspension. If suspension is part of the project phasing and sequencing plan, or if the suspension is requested by the Contractor, the Contractor shall not be paid additional or separate compensation to maintain and operate the erosion/pollution control facilities.

The Contractor is responsible for the removal of all temporary erosion/pollution control facilities and the restoration of those sites. This work will include the repair of any trenching for silt fence, removal of all silt build-up, the removal of fencing, barriers and silt bales and the associated stakes and appurtenances, and the placing of seeding or sodding to restore those sites. All inlets, catch basins and manholes constructed for this project shall be cleaned and the new drainage pipes flushed. All materials taken from the facilities or flushed from the new piping system shall be collected by the Contractor and disposed of off site.

156-3.4 Installation, maintenance and removal of silt fences. Silt fences shall extend a minimum of 16 inches (41 cm) and a maximum of 34 inches (86 cm) above the ground surface. Posts shall be set no more than 10 feet (3 m) on center. Filter fabric shall be cut from a continuous roll to the length required minimizing joints where possible. When joints are necessary, the fabric shall be spliced at a support post with a minimum 12-inch (300-mm) overlap and securely sealed. A trench shall be excavated approximately 4 inches (100 mm) deep by 4 inches (100 mm) wide on the upslope side of the silt fence. The trench shall be backfilled and the soil compacted over the silt fence fabric. The Contractor shall remove and dispose of silt that accumulates during construction and prior to establishment of permanent erosion control. The fence shall be maintained in good working condition until permanent erosion control is established. Silt fence shall be removed upon approval of the Engineer.

METHOD OF MEASUREMENT

156-4.1 Temporary erosion and pollution control work required will be performed as scheduled or directed by the Engineer. Completed and accepted work will be measured as follows:

a. Temporary seeding and mulching will be measured by the square yard (square meter).

b. Temporary slope drains will be measured by the linear foot (meter).

c. Temporary benches, dikes, dams, and sediment basins will be measured by the cubic yard (cubic meter) of excavation performed, including necessary cleaning of sediment basins, and the cubic yard (cubic meter) of embankment placed as directed by the Engineer.

d. All fertilizing will be measured by the ton (kg).

e. Installation and removal of silt fence will be measured by the linear foot.

f. Temporary inlet and outlet protection will be measured per each.

156-4.2 Control work performed for protection of construction areas outside the construction limits, such as borrow and waste areas, haul roads, equipment and material storage sites, and temporary plant sites, will not be measured and paid for directly but shall be considered as a subsidiary obligation of the Contractor.

BASIS OF PAYMENT

156-5.1 Accepted quantities of temporary water pollution, soil erosion, and siltation control work ordered by the Engineer and measured as provided in paragraph 156-4.1 will be paid for under:

~~Item P-156-5.1a Temporary Seeding and Mulching - per square yard (square meter)~~

~~Item P-156-5.1b Temporary Slope Drains - per linear foot (meter)~~

Item P-156-5.1a Temporary ~~Benches,~~ Dikes, ~~Dams and Sediment Basins~~ - per cubic yard (cubic meter)

~~Item P-156-5.1d Fertilizing - per ton (kg)~~

Item P-156-5.1b Installation and Removal of Silt Fence – per linear feet

Item P-156-5.1c Temporary Inlet and Outlet Protection - per each

Where other directed work falls within the specifications for a work item that has a contract price, the units of work shall be measured and paid for at the contract unit price bid for the various items.

Temporary control features not covered by contract items that are ordered by the Engineer will be paid for in accordance with Section 90-05 Payment for Extra work.

MATERIAL REQUIREMENTS

ASTM D6461 Standard Specification for Silt Fence Materials

AC 150/5200-33 Hazardous Wildlife Attractants

END OF ITEM P-156

ITEM P-610 STRUCTURAL PORTLAND CEMENT CONCRETE

DESCRIPTION

610-1.1 This item shall consist of plain ***and/or*** reinforced structural portland cement concrete (PCC), prepared and constructed in accordance with these specifications, at the locations and of the form and dimensions shown on the plans. This specification shall be used for all structural and miscellaneous concrete including signage bases.

MATERIALS

610-2.1 General. Only approved materials, conforming to the requirements of these specifications, shall be used in the work. Materials may be subject to inspection and tests at any time during their preparation or use. The source of all materials shall be approved by the Engineer before delivery or use in the work. Representative preliminary samples of the materials shall be submitted by the Contractor, when required, for examination and test. Materials shall be stored and handled to ensure preservation of their quality and fitness for use and shall be located to facilitate prompt inspection. All equipment for handling and transporting materials and concrete must be clean before any material or concrete is placed in them.

The use of pit-run aggregates shall not be permitted unless the pit-run aggregate has been screened and washed, and all fine and coarse aggregates stored separately and kept clean. The mixing of different aggregates from different sources in one storage stockpile or alternating batches of different aggregates shall not be permitted.

a. Reactivity. Fine and Coarse aggregates to be used in all concrete shall be evaluated and tested by the Contractor for alkali-aggregate reactivity in accordance with both ASTM C1260 and C1567. Aggregate and mix proportion reactivity tests shall be performed for each project.

(1) Coarse and fine aggregate shall be tested separately in accordance with ASTM C1260. The aggregate shall be considered innocuous if the expansion of test specimens, tested in accordance with ASTM C1260, does not exceed 0.10% at 28 days (30 days from casting).

(2) Combined coarse and fine aggregate shall be tested in accordance with ASTM C1567, modified for combined aggregates, using the proposed mixture design proportions of aggregates, cementitious materials, and/or specific reactivity reducing chemicals. If lithium nitrate is proposed for use with or without supplementary cementitious materials, the aggregates shall be tested in accordance with Corps of Engineers (COE) CRD C662. If lithium nitrate admixture is used, it shall be nominal 30% ±0.5% weight lithium nitrate in water.

(3) If the expansion of the proposed combined materials test specimens, tested in accordance with ASTM C1567, modified for combined aggregates, or COE CRD C662, does not exceed 0.10% at 28 days, the proposed combined materials will be accepted. If the expansion of the proposed combined materials test specimens is greater than 0.10% at 28 days, the aggregates will not be accepted unless adjustments to the combined materials mixture can reduce the expansion to less than 0.10% at 28 days, or new aggregates shall be evaluated and tested.

610-2.2 Coarse aggregate. The coarse aggregate for concrete shall meet the requirements of ASTM C33. Crushed stone aggregate shall have a durability factor, as determined by ASTM C666, greater than or equal to 95. The Engineer may consider and reserve final approval of other State classification procedures addressing aggregate durability.

Coarse aggregate shall be well graded from coarse to fine and shall meet the following gradation shown in the table below when tested per ASTM C136.

Gradation For Coarse Aggregate

Sieve Designation (square openings)	Percentage by Weight Passing Sieves
	1" (25 mm)
No. 4 to 3/4 in. (4.75-19 mm)	100
No. 4 to 1 in. (4.75-25 mm)	90-100
No. 4 to 1-1/2 in. (4.75-38 mm)	

610-2.2.1 Aggregate susceptibility to durability (D) cracking. Coarse aggregate may be accepted from sources that have a 20 year service history for the same gradation to be supplied with no durability issues.

a. Material currently being produced shall have a durability factor ≥ 95 using ASTM C666. Coarse aggregates that are crushed granite, calcite cemented sandstone, quartzite, basalt, diabase, rhyolite or trap rock are considered to meet the D-cracking test but must meet all other quality tests. Aggregates meeting State Highway Department material specifications may be acceptable with concurrence of the FAA.

b. The Contractor shall submit a current certification that the aggregate does not have a history of D-cracking and that the aggregate meets the state specifications for use in PCC pavement for use on interstate highways. Certifications, tests and any history reports must be for the same gradation as being proposed for use on the project. Certifications which are not dated or which are over one (1) year old or which are for different gradations will not be accepted. Test results will only be accepted when tests were performed by a State Department of Transportation (DOT) materials laboratory or an accredited laboratory.

610-2.3 Fine aggregate. The fine aggregate for concrete shall meet the requirements of ASTM C33.

The fine aggregate shall be well graded from fine to coarse and shall meet the requirements of the table below when tested in accordance with ASTM C136:

Gradation For Fine Aggregate

Sieve Designation (square openings)	Percentage by Weight Passing Sieves
3/8 inch (9 mm)	100
No. 4 (4.75 mm)	95-100
No. 16 (1.18 mm)	45-80
No. 30 (0.60 mm)	25-55
No. 50 (0.30 mm)	10-30
No. 100 (0.15 mm)	2-10

Blending will be permitted, if necessary, to meet the gradation requirements for fine aggregate. Fine aggregate deficient in the percentage of material passing the No. 50 mesh sieve may be accepted, if the deficiency does not exceed 5% and is remedied by the addition of pozzolanic or cementitious materials other than Portland cement, as specified in paragraph 610-2.6, Admixtures, in sufficient quantity to produce the required workability as approved by the Engineer.

610-2.4 Cement. Cement shall conform to the requirements of ***ASTM C150*** Type ***I or II***.

If aggregates are deemed innocuous when tested in accordance with paragraph 610-2.1.a.1 and accepted in accordance with paragraph 610-2.1.a.3, higher equivalent alkali content in the cement may be allowed if approved by the Engineer and FAA. If cement becomes partially set or contains lumps of caked cement, it shall be rejected. Cement salvaged from discarded or used bags shall not be used.

The Contractor shall furnish vendors' certified test reports for each carload, or equivalent, of cement shipped to the project. The report shall be delivered to the Engineer before use of the cement is granted. All test reports shall be subject to verification by testing sample materials received for use on the project.

610-2.5 Water. The water used in concrete shall be fresh, clean and potable; free from injurious amounts of oils, acids, alkalies, salts, organic materials or other substances deleterious to concrete.

610-2.6 Admixtures. The Contractor shall submit certificates indicating that the material to be furnished meets all of the requirements indicated below. In addition, the Engineer may require the Contractor to submit complete test data from an approved laboratory showing that the material to be furnished meets all of the requirements of the cited specifications. Subsequent tests may be made of samples taken by the Engineer from the supply of the material being furnished or proposed for use on the work to determine whether the admixture is uniform in quality with that approved.

a. Air-entraining admixtures. Air-entraining admixtures shall meet the requirements of ASTM C260 and shall consistently entrain the air content in the specified ranges under field conditions. The air-entrainment agent and any water reducer admixture shall be compatible.

b. Water-reducing admixtures. Water-reducing admixture shall meet the requirements of ASTM C494, Type A, B, or D. ASTM C494, Type F and G high range water reducing admixtures and ASTM C1017 flowable admixtures shall not be used.

c. Other chemical admixtures. The use of set retarding, and set-accelerating admixtures shall be approved by the Engineer. Retarding shall meet the requirements of ASTM C494, Type A, B, or D and set-accelerating shall meet the requirements of ASTM C494, Type C. Calcium chloride and admixtures containing calcium chloride shall not be used.

d. Lithium nitrate. The lithium admixture shall be a nominal 30% aqueous solution of Lithium Nitrate, with a density of 10 pounds/gallon (1.2 kg/L), and shall have the approximate chemical form as shown below:

Constituent	Limit (Percent by Mass)
LiNO3 (Lithium Nitrate)	30 ±0.5
SO4 (Sulfate Ion)	0.1 (max)
Cl (Chloride Ion)	0.2 (max)
Na (Sodium Ion)	0.1 (max)
K (Potassium Ion)	0.1 (max)

Provide a trained representative to supervise the lithium nitrate admixture dispensing and mixing operations.

610-2.7 Premolded joint material. Premolded joint material for expansion joints shall meet the requirements of ASTM ***D1751*.**

610-2.8 Joint filler. The filler for joints shall meet the requirements of Item P-605, unless otherwise specified.

610-2.9 Steel reinforcement. Reinforcing shall consist of ***welded wire fabric*** conforming to the requirements of ***ASTM A1064 or reinforcing steel conforming to the requirements of ASTM A615.***

610-2.10 Materials for curing concrete. Curing materials shall conform to one of the following.

The Engineer shall select one or more of the following:

Waterproof paper	ASTM C171
Clear or white Polyethylene Sheeting	ASTM C171
White-pigmented Liquid Membrane-Forming Compound, Type 2, Class B	ASTM C309

CONSTRUCTION METHODS

610-3.1 General. The Contractor shall furnish all labor, materials, and services necessary for, and incidental to, the completion of all work as shown on the drawings and specified here. All machinery and equipment used by the Contractor on the work, shall be of sufficient size to meet the requirements of the work. All work shall be subject to the inspection and approval of the Engineer.

610-3.2 Concrete composition. The concrete shall develop a compressive strength of ***4,000*** psi in 28 days as determined by test cylinders made in accordance with ASTM C31 and tested in accordance with ASTM C39. The concrete shall contain not less than 470 pounds of cement per cubic yard (280 kg per cubic meter). The concrete shall contain 5% of entrained air, ±1%, as determined by ASTM C231 and shall have a slump of not more than 4 inches (100 mm) as determined by ASTM C143.

610-3.3 Acceptance sampling and testing. Concrete for each structure will be accepted on the basis of the compressive strength specified in paragraph 610-3.2. The concrete shall be sampled in accordance with ASTM C172. Concrete cylindrical compressive strength specimens shall be made in accordance with ASTM C31 and tested in accordance with ASTM C39. The Contractor shall cure and store the test specimens under such conditions as directed by the Engineer. The Engineer will make the actual tests on the specimens at no expense to the Contractor.

610-3.4 Qualifications for concrete testing service. Perform concrete testing by an approved laboratory and inspection service experienced in sampling and testing concrete. Testing agency must meet the requirements of ASTM C1077 or ASTM E329.

610-3.5 Proportioning and measuring devices. When package cement is used, the quantity for each batch shall be equal to one or more whole sacks of cement. The aggregates shall be measured separately by weight. If aggregates are delivered to the mixer in batch trucks, the exact amount for each mixer charge shall be contained in each batch compartment. Weighing boxes or hoppers shall be approved by the Engineer and shall provide means of regulating the flow of aggregates into the batch box so the required, exact weight of aggregates is obtained.

610-3.6 Consistency. The consistency of the concrete shall be determined by the slump test specified in ASTM C143.

610-3.7 Mixing. Concrete may be mixed at the construction site, at a central point, or wholly or in part in truck mixers. The concrete shall be mixed and delivered in accordance with the requirements of ASTM C94.

610-3.8 Mixing conditions. The concrete shall be mixed only in quantities required for immediate use. Concrete shall not be mixed while the air temperature is below 40°F (4°C) without permission of the Engineer. If permission is granted for mixing under such conditions, aggregates or water, or both, shall be heated and the concrete shall be placed at a temperature not less than 50°F (10°C) nor more than 100°F (38°C). The Contractor shall be held responsible for any defective work, resulting from freezing or injury in any manner during placing and curing, and shall replace such work at his expense.

Retempering of concrete by adding water or any other material shall not be permitted.

The rate of delivery of concrete to the job shall be sufficient to allow uninterrupted placement of the concrete.

610-3.9 Forms. Concrete shall not be placed until all the forms and reinforcements have been inspected and approved by the Engineer. Forms shall be of suitable material and shall be of the type, size, shape, quality, and strength to build the structure as shown on the plans. The forms shall be true to line and grade and shall be mortar-tight and sufficiently rigid to prevent displacement and sagging between supports. The surfaces of forms shall be smooth and free from irregularities, dents, sags, and holes. The Contractor shall be responsible for their adequacy.

The internal form ties shall be arranged so no metal will show in the concrete surface or discolor the surface when exposed to weathering when the forms are removed. All forms shall be wetted with water or with a non-staining mineral oil, which shall be applied immediately before the concrete is placed. Forms shall be constructed so they can be removed without injuring the concrete or concrete surface. The forms shall not be removed until at least 30 hours after concrete placement for vertical faces, walls, slender columns, and similar structures. Forms supported by falsework under slabs, beams, girders, arches, and similar

construction shall not be removed until tests indicate the concrete has developed at least 60% of the design strength.

610-3.10 Placing reinforcement. All reinforcement shall be accurately placed, as shown on the plans, and shall be firmly held in position during concrete placement. Bars shall be fastened together at intersections. The reinforcement shall be supported by approved metal chairs. Shop drawings, lists, and bending details shall be supplied by the Contractor when required.

610-3.11 Embedded items. Before placing concrete, all embedded items shall be firmly and securely fastened in place as indicated. All embedded items shall be clean and free from coating, rust, scale, oil, or any foreign matter. The concrete shall be spaded and consolidated around and against embedded items. The embedding of wood shall not be allowed.

610-3.12 Placing concrete. All concrete shall be placed during daylight hours, unless otherwise approved. The concrete shall not be placed until the depth and condition of foundations, the adequacy of forms and falsework, and the placing of the steel reinforcing have been approved by the Engineer. Concrete shall be placed as soon as practical after mixing, but in no case later than one (1) hour after water has been added to the mix. The method and manner of placing shall avoid segregation and displacement of the reinforcement. Troughs, pipes, and chutes shall be used as an aid in placing concrete when necessary. The concrete shall not be dropped from a height of more than 5 feet (1.5 m). Concrete shall be deposited as nearly as practical in its final position to avoid segregation due to rehandling or flowing. Do not subject concrete to procedures which cause segregation. Concrete shall be placed on clean, damp surfaces, free from running water, or on a properly consolidated soil foundation.

610-3.13 Vibration. Vibration shall follow the guidelines in American Concrete Institute (ACI) Committee 309, Guide for Consolidation of Concrete. Where bars meeting ASTM A775 or A934 are used, the vibrators shall be equipped with rubber or non-metallic vibrator heads. Furnish a spare, working, vibrator on the job site whenever concrete is placed. Consolidate concrete slabs greater than 4 inches (100 mm) in depth with high frequency mechanical vibrating equipment supplemented by hand spading and tamping. Consolidate concrete slabs 4 inches (100 mm) or less in depth by wood tampers, spading, and settling with a heavy leveling straightedge. Operate internal vibrators with vibratory element submerged in the concrete, with a minimum frequency of not less than 6000 cycles per minute when submerged. Do not use vibrators to transport the concrete in the forms. Penetrate the previously placed lift with the vibrator when more than one lift is required. Use external vibrators on the exterior surface of the forms when internal vibrators do not provide adequate consolidation of the concrete. Vibrators shall be manipulated to work the concrete thoroughly around the reinforcement and embedded fixtures and into corners and angles of the forms. The vibration at any point shall be of sufficient duration to accomplish compaction but shall not be prolonged to where segregation occurs. Concrete deposited under water shall be carefully placed in a compact mass in its final position by means of a tremie or other approved method and shall not be disturbed after placement.

610-3.14 Construction joints. If the placement of concrete is suspended, necessary provisions shall be made for joining future work before the placed concrete takes its initial set. For the proper bonding of old and new concrete, provisions shall be made for grooves, steps, reinforcing bars or other devices as specified. The work shall be arranged so that a section begun on any day shall be finished during daylight of the same day. Before depositing new concrete on or against concrete that has hardened, the surface of the hardened concrete shall be cleaned by a heavy steel broom, roughened slightly, wetted, and covered with a neat coating of cement paste or grout.

610-3.15 Expansion joints. Expansion joints shall be constructed at such points and dimensions as indicated on the drawings. The premolded filler shall be cut to the same shape as the surfaces being joined. The filler shall be fixed firmly against the surface of the concrete already in place so that it will not be displaced when concrete is deposited against it.

610-3.16 Defective work. Any defective work discovered after the forms have been removed, which in the opinion of the Engineer cannot be repaired satisfactorily, shall be immediately removed and replaced at the expense of the Contractor. Defective work shall include deficient dimensions, or bulged, uneven, or honeycomb on the surface of the concrete.

610-3.17 Surface finish. All exposed concrete surfaces shall be true, smooth, and free from open or rough areas, depressions, or projections. All concrete horizontal plane surfaces shall be brought flush to the

proper elevation with the finished top surface struck-off with a straightedge and floated. Mortar finishing shall not be permitted, nor shall dry cement or sand-cement mortar be spread over the concrete during the finishing of horizontal plane surfaces.

The surface finish of exposed concrete shall be a rubbed finish. If forms can be removed while the concrete is still green, the surface shall be wetted and then rubbed with a wooden float until all irregularities are removed. If the concrete has hardened before being rubbed, a carborundum stone shall be used to finish the surface. When approved, the finishing can be done with a finishing machine.

610-3.18 Curing and protection. All concrete shall be properly cured and protected by the Contractor. The concrete shall be protected from the weather, flowing water, and from defacement of any nature during the project. The concrete shall be cured by covering with an approved material as soon as it has sufficiently hardened. Water-absorptive coverings shall be thoroughly saturated when placed and kept saturated for at least three (3) days following concrete placement. All curing mats or blankets shall be sufficiently weighted or tied down to keep the concrete surface covered and to prevent the surface from being exposed to air currents. Wooden forms shall be kept wet at all times until removed to prevent opening of joints and drying out of the concrete. Traffic shall not be allowed on concrete surfaces for seven (7) days after the concrete has been placed.

610-3.19 Drains or ducts. Drainage pipes, conduits, and ducts that are to be encased in concrete shall be installed by the Contractor before the concrete is placed. The pipe shall be held rigidly so that it will not be displaced or moved during the placing of the concrete.

610-3.20 Cold weather placing. When concrete is placed at temperatures below 40°F (4°C), the Contractor shall provide satisfactory methods and means to protect the mix from injury by freezing. The aggregates, or water, or both, shall be heated to place the concrete at temperatures between 50°F and 100°F (10°C and 38°C).

Calcium chloride may be incorporated in the mixing water when directed by the Engineer. Not more than pounds (908 grams) of Type 1 nor more than 1.6 pounds (726 grams) of Type 2 shall be added per bag of cement. After the concrete has been placed, the Contractor shall provide sufficient protection such as cover, canvas, framework, heating apparatus, etc., to enclose and protect the structure and maintain the temperature of the mix at not less than 50°F (10°C) until at least 60% of the designed strength has been attained.

610-3.21 Hot weather placing. Concrete shall be properly placed and finished with procedures previously submitted. The concrete-placing temperature shall not exceed ***90***°F (***32***°C) when measured in accordance with ASTM C1064. Cooling of the mixing water and aggregates, or both, may be required to obtain an adequate placing temperature. A retarder meeting the requirements of paragraph 610-2.6 may be used to facilitate placing and finishing. Steel forms and reinforcement shall be cooled prior to concrete placement when steel temperatures are greater than 120°F (50°C). Conveying and placing equipment shall be cooled if necessary to maintain proper concrete-placing temperature. Submit the proposed materials and methods for review and approval by the Engineer, if concrete is to be placed under hot weather conditions.

610-3.22 Filling joints. All joints that require filling shall be thoroughly cleaned, and any excess mortar or concrete shall be cut out with proper tools. Joint filling shall not start until after final curing and shall be done only when the concrete is completely dry. The cleaning and filling shall be done with proper equipment to obtain a neat looking joint free from excess filler.

METHOD OF MEASUREMENT

~~**610-4.1** Portland cement concrete shall be measured by the number of cubic yards (cubic meters) of concrete complete in place and accepted. In computing the yardage of concrete for payment, the dimensions used shall be those shown on the plans or ordered by the Engineer. No measurements or other allowances shall be made for forms, falsework, cofferdams, pumping, bracing, expansion joints, or finishing of the concrete. No deductions in yardage shall be made for the volumes of reinforcing steel or embedded items.~~

~~**610-4.2** Reinforcing steel shall be measured by the calculated theoretical number of pounds (kg) placed, as shown on the plans, complete in place and accepted. The unit weight used for deformed bars shall be the weight of plain square or round bars of equal nominal size. If so indicated on the plans, the poundage to be paid for shall include the weight of metal pipes and drains, metal conduits and ducts, or similar materials indicated and included.~~

610-4.1 Structural Portland cement concrete shall not be measured separately for payment.

BASIS OF PAYMENT

~~**610-5.1** Payment shall be made at the contract unit price per cubic yard (cubic meter) for structural Portland cement concrete and per pound (kg) for reinforcing steel. These prices shall be full compensation for furnishing all materials and for all preparation, delivery and installation of these materials, and for all labor, equipment, tools, and incidentals necessary to complete the item.~~

610-5.1 Structural Portland cement concrete shall not be paid for separately but its cost shall be included in the unit prices of the pay items which require structural Portland cement concrete.

TESTING REQUIREMENTS

ASTM C31	Standard Practice for Making and Curing Concrete Test Specimens in the Field
ASTM C39	Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
ASTM C136	Standard Test Method for Sieve or Screen Analysis of Fine and Coarse Aggregates
ASTM C138	Standard Test Method for Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete
ASTM C143	Standard Test Method for Slump of Hydraulic-Cement Concrete
ASTM C231	Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C666	Standard Test Method for Resistance of Concrete to Rapid Freezing and Thawing
ASTM C1017	Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete
ASTM C1064	Standard Test Method for Temperature of Freshly Mixed Hydraulic-Cement Concrete
ASTM C1077	Standard Practice for Agencies Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Testing Agency Evaluation
ASTM C1260	Standard Test Method for Potential Alkali Reactivity of Aggregates (Mortar-Bar Method)
ASTM C1567	Standard Test Method for Determining the Potential Alkali-Silica Reactivity of Combinations of Cementitious Materials and Aggregates (Accelerated Mortar-Bar Method)
ASTM E329	Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection
U.S. Army Corps of Engineers (USACE) Concrete Research Division (CRD) C662	Determining the Potential Alkali-Silica Reactivity of Combinations of Cementitious Materials, Lithium Nitrate Admixture and Aggregate (Accelerated Mortar-Bar Method)

MATERIAL REQUIREMENTS

ASTM A184	Standard Specification for Welded Deformed Steel Bar Mats for Concrete Reinforcement
ASTM A185	Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete
ASTM A615	Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
ASTM A704	Standard Specification for Welded Steel Plain Bar or Rod Mats for Concrete Reinforcement
ASTM A706	Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement
ASTM A775	Standard Specification for Epoxy-Coated Steel Reinforcing Bars
ASTM A934	Standard Specification for Epoxy-Coated Prefabricated Steel Reinforcing Bars
ASTM A1064	Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete
ASTM C33	Standard Specification for Concrete Aggregates
ASTM C94	Standard Specification for Ready-Mixed Concrete
ASTM C150	Standard Specification for Portland Cement
ASTM C171	Standard Specification for Sheet Materials for Curing Concrete
ASTM C172	Standard Practice for Sampling Freshly Mixed Concrete
ASTM C260	Standard Specification for Air-Entraining Admixtures for Concrete
ASTM C309	Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
ASTM C494	Standard Specification for Chemical Admixtures for Concrete
ASTM C595	Standard Specification for Blended Hydraulic Cements
ASTM C618	Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
ASTM D1751	Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Asphalt Types)
ASTM D1752	Standard Specification for Preformed Sponge Rubber Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction
ACI 305R	Hot Weather Concreting
ACI 306R	Cold Weather Concreting
ACI 309R	Guide for Consolidation of Concrete

END OF ITEM P-610

ITEM T-901 SEEDING

DESCRIPTION

901-1.1 This item shall consist of soil preparation, seeding ***and fertilizing*** the areas shown on the plans or as directed by the Engineer in accordance with these specifications.

MATERIALS

901-2.1 Seed. The species and application rates of grass, legume, and cover-crop seed furnished shall be those stipulated herein. Seed shall conform to the requirements of Federal Specification JJJ-S-181, Federal Specification, Seeds, Agricultural.

Seed shall be furnished separately or in mixtures in standard containers labeled in conformance with the Agricultural Marketing Service (AMS) Seed Act and applicable state seed laws with the seed name, lot number, net weight, percentages of purity and of germination and hard seed, and percentage of maximum weed seed content clearly marked for each kind of seed. The Contractor shall furnish the Engineer duplicate signed copies of a statement by the vendor certifying that each lot of seed has been tested by a recognized laboratory for seed testing within six (6) months of date of delivery. This statement shall include: name and address of laboratory, date of test, lot number for each kind of seed, and the results of tests as to name, percentages of purity and of germination, and percentage of weed content for each kind of seed furnished, and, in case of a mixture, the proportions of each kind of seed. Wet, moldy, or otherwise damaged seed will be rejected.

Seeds shall be applied as follows:

Seed	**Minimum Seed Purity (Percent)**	**Minimum Germination (Percent)**	**Rate of Application lb/acre (or lb/1,000 S.F.)**
Bermudagrass OR Kentucky Bluegrass	95%	85%	175
Turf-TypeTall Fescue Weeping Lovegrass Foxtail Millet Rye	95%	85%	25 20 (2/1 -4/30 only) 80 (5/1 -8/30 only) 20 (2/1 -4/30 only)
	240		240

Seeding shall be performed during the period between Feb 1 and August 30 inclusive, unless otherwise approved by the Engineer.

~~**901-2.2 Lime.** Lime shall be ground limestone containing not less than 85% of total carbonates, and shall be ground to such fineness that 90% will pass through a No. 20 mesh sieve and 50% will pass through a No. 100 mesh sieve. Coarser material will be acceptable, providing the rates of application are increased to provide not less than the minimum quantities and depth specified in the special provisions ***herein*** on the basis of the two sieve requirements above. Dolomitic lime or a high magnesium lime shall contain at least 10% of magnesium oxide. Lime shall be applied at the rate of **[____]**. All liming materials shall conform to the requirements of ASTM C602.~~

901-2.3 Fertilizer. Fertilizer shall be standard commercial fertilizers supplied separately or in mixtures containing the percentages of total nitrogen, available phosphoric acid, and water-soluble potash. They shall be applied at the rate and to the depth specified, and shall meet the requirements of applicable state

laws. They shall be furnished in standard containers with name, weight, and guaranteed analysis of contents clearly marked thereon. No cyanamide compounds or hydrated lime shall be permitted in mixed fertilizers.

The fertilizers may be supplied in one of the following forms:

a. A dry, free-flowing fertilizer suitable for application by a common fertilizer spreader;

b. A finely-ground fertilizer soluble in water, suitable for application by power sprayers; or

c. A granular or pellet form suitable for application by blower equipment.

Fertilizers shall be 12-12-12 (n-p-k) commercial fertilizer and shall be spread at the rate of **400 pounds per acre.**

901-2.4 Soil for repairs. The soil for fill and topsoiling of areas to be repaired shall be at least of equal quality to that which exists in areas adjacent to the area to be repaired. The soil shall be relatively free from large stones, roots, stumps, or other materials that will interfere with subsequent sowing of seed, compacting, and establishing turf, and shall be approved by the Engineer before being placed.

901-2.5 Submittals and certifications. Shop drawings for each seeding related component shall be submitted to the Engineer for review and approval and shall be approved prior to ordering any materials associated with this item. The submittals shall include the following:

a. Catalogue data and certification showing that the seed mixture percent by weight, percent purity, percent germination and date of manufacture meet the requirements specified.

b. Catalogue data and certification showing that the guaranteed analysis of the fertilizer meets the requirements specified.

CONSTRUCTION METHODS

901-3.1 Advance preparation and cleanup. After grading of areas has been completed and before applying fertilizer and ground limestone, areas to be seeded shall be raked or otherwise cleared of stones larger than 2 inches (50 mm) in any diameter, sticks, stumps, and other debris that might interfere with sowing of seed, growth of grasses, or subsequent maintenance of grass-covered areas. If any damage by erosion or other causes has occurred after the completion of grading and before beginning the application of fertilizer and ground limestone, the Contractor shall repair such damage include filling gullies, smoothing irregularities, and repairing other incidental damage.

An area to be seeded shall be considered a satisfactory seedbed without additional treatment if it has recently been thoroughly loosened and worked to a depth of not less than 5 inches (125 mm) as a result of grading operations and, if immediately prior to seeding, the top 3 inches (75 mm) of soil is loose, friable, reasonably free from large clods, rocks, large roots, or other undesirable matter, and if shaped to the required grade.

When the area to be seeded is sparsely sodded, weedy, barren and unworked, or packed and hard, any grass and weeds shall first be cut or otherwise satisfactorily disposed of, and the soil then scarified or otherwise loosened to a depth not less than 5 inches (125 mm). Clods shall be broken and the top 3 inches (75 mm) of soil shall be worked into a satisfactory seedbed by discing, or by use of cultipackers, rollers, drags, harrows, or other appropriate means.

Seeding, mulching and/or fertilizing operations will not be permitted when wind velocities are in excess of 15 miles per hour.

901-3.2 Dry application method.

~~**a. Liming.** Lime shall be applied separately and prior to the application of any fertilizer or seed and only on seedbeds that have previously been prepared as described above. The lime shall then be worked into the top 3 inches (75 mm) of soil after which the seedbed shall again be properly graded and dressed to a smooth finish.~~

b. Fertilizing. Following advance preparations and cleanup fertilizer shall be uniformly spread at the rate that will provide not less than the minimum quantity stated in paragraph 901-2.3.

c. Seeding. Grass seed shall be sown at the rate specified in paragraph 901-2.1 immediately after fertilizing. The fertilizer and seed shall be raked within the depth range stated ~~in the special provisions~~ ***herein***. Seeds of legumes, either alone or in mixtures, shall be inoculated before mixing or sowing, in accordance with the instructions of the manufacturer of the inoculant. When seeding is required at other than the seasons shown on the plans or ~~in the special provisions~~ ***herein***, a cover crop shall be sown by the same methods required for grass and legume seeding.

d. Rolling. After the seed has been properly covered, the seedbed shall be immediately compacted by means of an approved lawn roller, weighing 40 to 65 pounds per foot (60 to 97 kg per meter) of width for clay soil (or any soil having a tendency to pack), and weighing 150 to 200 pounds per foot (223 to 298 kg per meter) of width for sandy or light soils.

901-3.3 Wet application method.

a. General. The Contractor may elect to apply seed and fertilizer (and lime, if required) by spraying them on the previously prepared seedbed in the form of an aqueous mixture and by using the methods and equipment described herein. The rates of application shall be as specified ~~in the special provisions~~ ***herein***.

b. Spraying equipment. The spraying equipment shall have a container or water tank equipped with a liquid level gauge calibrated to read in increments not larger than 50 gallons (190 liters) over the entire range of the tank capacity, mounted so as to be visible to the nozzle operator. The container or tank shall also be equipped with a mechanical power-driven agitator capable of keeping all the solids in the mixture in complete suspension at all times until used.

The unit shall also be equipped with a pressure pump capable of delivering 100 gallons (380 liters) per minute at a pressure of 100 lb / sq inches (690 kPa). The pump shall be mounted in a line that will recirculate the mixture through the tank whenever it is not being sprayed from the nozzle. All pump passages and pipe lines shall be capable of providing clearance for 5/8 inch (16 mm) solids. The power unit for the pump and agitator shall have controls mounted so as to be accessible to the nozzle operator. There shall be an indicating pressure gauge connected and mounted immediately at the back of the nozzle.

The nozzle pipe shall be mounted on an elevated supporting stand in such a manner that it can be rotated through 360 degrees horizontally and inclined vertically from at least 20 degrees below to at least 60 degrees above the horizontal. There shall be a quick-acting, three-way control valve connecting the recirculating line to the nozzle pipe and mounted so that the nozzle operator can control and regulate the amount of flow of mixture delivered to the nozzle. At least three different types of nozzles shall be supplied so that mixtures may be properly sprayed over distance varying from 20 to 100 feet (6 to 30 m). One shall be a close-range ribbon nozzle, one a medium-range ribbon nozzle, and one a long-range jet nozzle. For case of removal and cleaning, all nozzles shall be connected to the nozzle pipe by means of quick-release couplings.

In order to reach areas inaccessible to the regular equipment, an extension hose at least 50 feet (15 m) in length shall be provided to which the nozzles may be connected.

c. Mixtures. Lime, if required, shall be applied separately, in the quantity specified, prior to the fertilizing and seeding operations. Not more than 220 pounds (100 kg) of lime shall be added to and mixed with each 100 gallons (380 liters) of water. Seed and fertilizer shall be mixed together in the relative proportions specified, but not more than a total of 220 pounds (100 kg) of these combined solids shall be added to and mixed with each 100 gallons (380 liters) of water.

All water used shall be obtained from fresh water sources and shall be free from injurious chemicals and other toxic substances harmful to plant life. Brackish water shall not be used at any time. The Contractor shall identify to the Engineer all sources of water at least two (2) weeks prior to use. The Engineer may take samples of the water at the source or from the tank at any time and have a laboratory test the samples for chemical and saline content. The Contractor shall not use any water from any source that is disapproved by the Engineer following such tests.

All mixtures shall be constantly agitated from the time they are mixed until they are finally applied to the seedbed. All such mixtures shall be used within two (2) hours from the time they were mixed or they shall be wasted and disposed of at approved locations.

d. Spraying. Lime, if required, shall be sprayed only upon previously prepared seedbeds. After the applied lime mixture has dried, the lime shall be worked into the top 3 inches (75 mm), after which the seedbed shall again be properly graded and dressed to a smooth finish.

Mixtures of seed and fertilizer shall only be sprayed upon previously prepared seedbeds on which the lime, if required, shall already have been worked in. The mixtures shall be applied by means of a high-pressure spray that shall always be directed upward into the air so that the mixtures will fall to the ground like rain in a uniform spray. Nozzles or sprays shall never be directed toward the ground in such a manner as might produce erosion or runoff.

Particular care shall be exercised to ensure that the application is made uniformly and at the prescribed rate and to guard against misses and overlapped areas. Proper predetermined quantities of the mixture in accordance with specifications shall be used to cover specified sections of known area.

Checks on the rate and uniformity of application may be made by observing the degree of wetting of the ground or by distributing test sheets of paper or pans over the area at intervals and observing the quantity of material deposited thereon.

On surfaces that are to be mulched as indicated by the plans or designated by the Engineer, seed and fertilizer applied by the spray method need not be raked into the soil or rolled. However, on surfaces on which mulch is not to be used, the raking and rolling operations will be required after the soil has dried.

901-3.4 Maintenance of seeded areas. The Contractor shall protect seeded areas against traffic or other use by warning signs or barricades, as approved by the Engineer. Surfaces gullied or otherwise damaged following seeding shall be repaired by regrading and reseeding as directed. The Contractor shall mow, water as directed, and otherwise maintain seeded areas in a satisfactory condition until final inspection and acceptance of the work.

The Contractor will be required to water seeded areas three days per week until the proper stand of grass is well established and approved by the Engineer. The Contractor shall water every other day such that the seeded areas are watered at least three times per week. It is imperative that the Contractor water consistently to ensure proper seed growth.

When either the dry or wet application method outlined above is used for work done out of season, it will be required that the Contractor establish a good stand of grass of uniform color and density to the satisfaction of the Engineer. A grass stand shall be considered adequate when bare spots are one square foot (0.01 sq m) or less, randomly dispersed, and do not exceed 3% of the area seeded.

901-3.5 Acceptable stand of grass. At the time of final inspection, a healthy, uniform, close stand of grass shall be established, free of weeds and surface irregularities, with coverage exceeding 90% over any 10 square feet and bare spots not exceeding 4-inches x 4-inches.

METHOD OF MEASUREMENT

901-4.1 The quantity of seeding to be paid for shall be the number of units acre (sq m) measured on the ground surface, completed and accepted.

BASIS OF PAYMENT

901-5.1 Payment shall be made at the contract unit price per acre (sq m) or fraction thereof, which price and payment shall be full compensation for furnishing and placing all material and for all labor, equipment, tools, and incidentals necessary to complete the work prescribed in this item.

Payment will be made under:

Item 901-5.1 Seeding - per acre (sq m)

MATERIAL REQUIREMENTS

ASTM C602	Standard Specification for Agricultural Liming Materials
ASTM D977	Standard Specification for Emulsified Asphalt
FED SPEC	JJJ-S-181, Federal Specification, Seeds, Agricultural

END OF ITEM T-901

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ITEM T-905 TOPSOILING

DESCRIPTION

905-1.1 This item shall consist of preparing the ground surface for topsoil application, removing topsoil from designated stockpiles or areas to be stripped on the site or from approved sources off the site, and placing and spreading the topsoil on prepared areas in accordance with this specification at the locations shown on the plans or as directed by the Engineer.

MATERIALS

905-2.1 Topsoil. Topsoil shall be the surface layer of soil with no admixture of refuse or any material toxic to plant growth, and it shall be reasonably free from subsoil and stumps, roots, brush, stones (2 inches (50 mm) or more in diameter), and clay lumps or similar objects. Brush and other vegetation that will not be incorporated with the soil during handling operations shall be cut and removed. Ordinary sod and herbaceous growth such as grass and weeds are not to be removed, but shall be thoroughly broken up and intermixed with the soil during handling operations. Heavy sod or other cover, which cannot be incorporated into the topsoil by discing or other means, shall be removed. The topsoil or soil mixture, unless otherwise specified or approved, shall have a pH range of approximately 5.5 pH to 7.6 pH, when tested in accordance with the methods of testing of the Association of Official Agricultural Chemists in effect on the date of invitation of bids. The organic content shall be not less than 3% nor more than 20% as determined by the wet-combustion method (chromic acid reduction). There shall be not less than 20% nor more than 80% of the material passing the 200 mesh (0.075 mm) sieve as determined by the wash test in accordance with ASTM C117.

Natural topsoil may be amended by the Contractor with approved materials and methods to meet the above specifications.

905-2.2 Inspection and tests. Within 10 days following acceptance of the bid, the Engineer shall be notified of the source of topsoil to be furnished by the Contractor. The topsoil shall be inspected to determine if the selected soil meets the requirements specified and to determine the depth to which stripping will be permitted. At this time, the Contractor may be required to take representative soil samples from several locations within the area under consideration and to the proposed stripping depths, for testing purposes as specified in paragraph 905-2.1.

CONSTRUCTION METHODS

905-3.1 General. Areas to be topsoiled shall be shown on the plans. If topsoil is available on the site, the location of the stockpiles or areas to be stripped of topsoil and the stripping depths shall be shown on the plans.

Suitable equipment necessary for proper preparation and treatment of the ground surface, stripping of topsoil, and for the handling and placing of all required materials shall be on hand, in good condition, and approved by the Engineer before the various operations are started.

905-3.2 Preparing the ground surface. Immediately prior to dumping and spreading the topsoil on any area, the surface shall be loosened by discs or spike-tooth harrows, or by other means approved by the Engineer, to a minimum depth of 2 inches (50 mm) to facilitate bonding of the topsoil to the covered subgrade soil. The surface of the area to be topsoiled shall be cleared of all stones larger than 2 inches (50 mm) in any diameter and all litter or other material which may be detrimental to proper bonding, the rise of capillary moisture, or the proper growth of the desired planting. Limited areas, as shown on the plans, which are too compact to respond to these operations shall receive special scarification.

Grades on the area to be topsoiled, which have been established by others as shown on the plans, shall be maintained in a true and even condition. Where grades have not been established, the areas shall be smooth-graded and the surface left at the prescribed grades in an even and compacted condition to prevent the formation of low places or pockets where water will stand.

905-3.3 Obtaining topsoil. Prior to the stripping of topsoil from designated areas, any vegetation, briars, stumps and large roots, rubbish or stones found on such areas, which may interfere with subsequent operations, shall be removed using methods approved by the Engineer. Heavy sod or other cover, which cannot be incorporated into the topsoil by discing or other means shall be removed.

When suitable topsoil is available on the site, the Contractor shall remove this material from the designated areas and to the depth as directed by the Engineer. The topsoil shall be spread on areas already tilled and smooth-graded, or stockpiled in areas approved by the Engineer. Any topsoil stockpiled by the Contractor shall be rehandled and placed without additional compensation. Any topsoil that has been stockpiled on the site by others, and is required for topsoiling purposes, shall be removed and placed by the Contractor. The sites of all stockpiles and areas adjacent thereto which have been disturbed by the Contractor shall be graded if required and put into a condition acceptable for seeding.

When suitable topsoil is secured off the airport site, the Contractor shall locate and obtain the supply, subject to the approval of the Engineer. The Contractor shall notify the Engineer sufficiently in advance of operations in order that necessary measurements and tests can be made. The Contractor shall remove the topsoil from approved areas and to the depth as directed. The topsoil shall be hauled to the site of the work and placed for spreading, or spread as required. Any topsoil hauled to the site of the work and stockpiled shall be rehandled and placed without additional compensation.

905-3.4 Placing topsoil. The topsoil shall be evenly spread on the prepared areas to a uniform depth of inches (50 mm) after compaction, unless otherwise shown on the plans or stated in the special provisions. Spreading shall not be done when the ground or topsoil is frozen, excessively wet, or otherwise in a condition detrimental to the work. Spreading shall be carried on so that turfing operations can proceed with a minimum of soil preparation or tilling.

After spreading, any large, stiff clods and hard lumps shall be broken with a pulverizer or by other effective means, and all stones or rocks (2 inches (50 mm) or more in diameter), roots, litter, or any foreign matter shall be raked up and disposed of by the Contractor. after spreading is completed, the topsoil shall be satisfactorily compacted by rolling with a cultipacker or by other means approved by the Engineer. The compacted topsoil surface shall conform to the required lines, grades, and cross-sections. Any topsoil or other dirt falling upon pavements as a result of hauling or handling of topsoil shall be promptly removed.

METHOD OF MEASUREMENT

905-4.1 ***Topsoil shall be measured by the number of cubic yards (cubic meters) of topsoil measured in its final position, complete in place.***

~~**905-4.2** Topsoil obtained off the site shall be measured by the number of cubic yards (cubic meters) of topsoil measured in its original position and stripped or excavated. Topsoil shall be measured by volume in cubic yards (meters) computed by the method of end areas.~~

BASIS OF PAYMENT

905-5.1 ***Payment shall be made at the contract unit price per cubic yard (cubic meter) for topsoiling. This price shall be full compensation for furnishing all materials and for all preparation, placing, and spreading of the materials, and for all labor, equipment, tools, and incidentals necessary to complete the item.***

~~**905-5.2** Payment will be made at the contract unit price per cubic yard (cubic meter) for topsoiling (obtained off the site). This price shall be full compensation for furnishing all materials and for all preparation, placing, and spreading of the materials, and for all labor, equipment, tools, and incidentals necessary to complete the item.~~

Payment will be made under:

Item T-905-5.1	Topsoiling - per cubic yard (cubic meter)

TESTING MATERIALS

ASTM C117	Materials Finer than 75 μm (No. 200) Sieve in Mineral Aggregates by Washing

END OF ITEM T-905

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ITEM T-908 MULCHING

DESCRIPTION

908-1.1 This item shall consist of furnishing, hauling, placing, and securing mulch on surfaces indicated on the plans or designated by the Engineer.

MATERIALS

908-2.1 Mulch material. Acceptable mulch shall be the materials listed below or any approved locally available material that is similar to those specified. Mulch shall be free from noxious weeds, mold, and other deleterious materials. Mulch materials, which contain matured seed of species that would volunteer and be detrimental to the proposed overseeding, or to surrounding farm land, will not be acceptable. Straw or other mulch material which is fresh and/or excessively brittle, or which is in such an advanced stage of decomposition as to smother or retard the planted grass, will not be acceptable.

~~**[a. Hay**. Hay shall be native hay in an air-dry condition and of proper consistency for placing with commercial mulch blowing equipment. Hay shall be sterile, containing no fertile seed.~~

~~**b. Straw.** Straw shall be the stalks from threshed plant residue of oats, wheat, barley, rye, or rice from which grain has been removed. Furnish in air-dry condition and of proper consistency for placing with commercial mulch blowing equipment. Straw shall contain no fertile seed.~~

~~**c. Hay mulch containing seed**. Hay mulch shall be mature hay containing viable seed of native grasses or other desirable species stated in the special provisions or as approved by the Engineer. The hay shall be cut and handled so as to preserve the maximum quantity of viable seed. Hay mulch that cannot be hauled and spread immediately after cutting shall be placed in weather-resistant stacks or baled and stored in a dry location until used.~~

d. Manufactured mulch. Cellulose-fiber or wood-pulp mulch shall be products commercially available for use in spray applications. **]**

e. Asphalt binder. Asphalt binder material shall conform to the requirements of ASTM D977, Type SS-1 or RS-1.

908-2.2 Inspection. The Engineer shall be notified of sources and quantities of mulch materials available and the Contractor shall furnish him with representative samples of the materials to be used 30 days before delivery to the project. These samples may be used as standards with the approval of the Engineer and any materials brought on the site that do not meet these standards shall be rejected.

CONSTRUCTION METHODS

908-3.1 Mulching. Before spreading mulch, all large clods, stumps, stones, brush, roots, and other foreign material shall be removed from the area to be mulched. Mulch shall be applied immediately after seeding. The spreading of the mulch may be by ~~hand methods,~~ blower, or other mechanical methods, provided a uniform covering is obtained.

Mulch material shall be furnished, hauled, and evenly applied on the area shown on the plans or designated by the Engineer~~. Straw or hay shall be spread over the surface to a uniform thickness at the rate of 2 to 3 tons per acre (1800 - 2700 kg per acre) to provide a loose depth of not less than 1-1/2 inches (38 cm) nor more than 3 inches (75 mm).~~ Other organic material shall be spread at the rate directed by the Engineer. Mulch may be blown on the slopes and the use of cutters in the equipment for this purpose will be permitted to the extent that at least 95% of the mulch in place on the slope shall be 6 inches (150 mm) or more in

length. When mulches applied by the blowing method are cut, the loose depth in place shall be not less than one inch (25 mm) nor more than 2 inches (50 mm).

908-3.2 Securing mulch. The mulch shall be held in place by ~~light discing, a very thin covering of topsoil, pins, stakes, wire mesh~~, asphalt binder, or other adhesive material approved by the Engineer. Where mulches have been secured by either of the asphalt binder methods, it will not be permissible to walk on the slopes after the binder has been applied. When an application of asphalt binder material is used to secure the mulch, the Contractor must take every precaution to guard against damaging or disfiguring structures or property on or adjacent to the areas worked and will be held responsible for any such damage resulting from the operation.

~~If the "peg and string" method is used, the mulch shall be secured by the use of stakes or wire pins driven into the ground on 5-foot (1.5-m) centers or less. Binder twine shall be strung between adjacent stakes in straight lines and crisscrossed diagonally over the mulch, after which the stakes shall be firmly driven nearly flush to the ground to draw the twine down tight onto the mulch.~~

908-3.3 Care and repair.

a. The Contractor shall care for the mulched areas until final acceptance of the project. Care shall consist of providing protection against traffic or other use by placing warning signs, as approved by the Engineer, and erecting any barricades that may be shown on the plans before or immediately after mulching has been completed on the designated areas.

b. The Contractor shall be required to repair or replace any mulch that is defective or becomes damaged until the project is finally accepted. When, in the judgment of the Engineer, such defects or damages are the result of poor workmanship or failure to meet the requirements of the specifications, the cost of the necessary repairs or replacement shall be borne by the Contractor.

c. If the "asphalt spray" method is used, all mulched surfaces shall be sprayed with asphalt binder material so that the surface has a uniform appearance. The binder shall be uniformly applied to the mulch at the rate of approximately 8 gallons (32 liters) per 1,000 square feet (100 sq m), or as directed by the Engineer, with a minimum of 6 gallons (24 liters) and a maximum of 10 gallons (40 liters) per 1,000 square feet (100 sq m) depending on the type of mulch and the effectiveness of the binder securing it. Bituminous binder material may be sprayed on the mulched slope areas from either the top or the bottom of the slope. An approved spray nozzle shall be used. The nozzle shall be operated at a distance of not less than 4 feet (1.2 m) from the surface of the mulch and uniform distribution of the bituminous material shall be required. A pump or an air compressor of adequate capacity shall be used to ensure uniform distribution of the bituminous material.

d. If the "asphalt mix" method is used, the mulch shall be applied by blowing, and the asphalt binder material shall be sprayed into the mulch as it leaves the blower. The binder shall be uniformly applied to the mulch at the rate of approximately 8 gallons (32 liters) per 1,000 square feet (100 sq m) or as directed by the Engineer, with a minimum of 6 gallons (24 liters) and a maximum of 10 gallons (40 liters) per 1,000 square feet (100 sq m) depending on the type of mulch and the effectiveness of the binder securing it.

METHOD OF MEASUREMENT

908-4.1 Mulching shall be measured in ***acres*** ~~square yards (square meters)~~ on the basis of the actual surface area acceptably mulched.

BASIS OF PAYMENT

908-5.1 Payment will be made at the contract unit price per square yard (square meter) for mulching. The price shall be full compensation for furnishing all materials and for placing and anchoring the materials, and for all labor, equipment, tools, and incidentals necessary to complete the item.

Payment will be made under:

Item T-908-5.1 Mulching – per ***acres*** ~~square yard (square meter)~~

MATERIAL REQUIREMENTS

ASTM D977	Standard Specification for Emulsified Asphalt

END OF ITEM T-908

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SECTION 330500 - COMMON WORK RESULTS FOR UTILITIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Piping joining materials.
2. Transition fittings.
3. Dielectric fittings.
4. Sleeves.
5. Identification devices.
6. Grout.
7. Flowable fill.
8. Piped utility demolition.
9. Piping system common requirements.
10. Equipment installation common requirements.
11. Painting.
12. Concrete bases.
13. Metal supports and anchorages.

1.3 DEFINITIONS

A. Exposed Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions.

B. Concealed Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

C. ABS: Acrylonitrile-butadiene-styrene plastic.

D. CPVC: Chlorinated polyvinyl chloride plastic.

E. PE: Polyethylene plastic.

F. PVC: Polyvinyl chloride plastic.

1.4 ACTION SUBMITTALS

A. Product Data: For the following:

1. Dielectric fittings.
2. Identification devices.

1.5 INFORMATIONAL SUBMITTALS

A. Welding certificates.

1.6 QUALITY ASSURANCE

A. Steel Support Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Steel Piping Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

C. Comply with ASME A13.1 for lettering size, length of color field, colors, and viewing angles of identification devices.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.8 COORDINATION

A. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

B. Coordinate installation of identifying devices after completing covering and painting if devices are applied to surfaces.

C. Coordinate size and location of concrete bases. Formwork, reinforcement, and concrete requirements are specified in Section 033000 "Cast-in-Place Concrete."

PART 2 - PRODUCTS

2.1 PIPING JOINING MATERIALS

A. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.

1. ASME B16.21, nonmetallic, flat, asbestos free, 1/8-inch (3.2-mm) maximum thickness, unless otherwise indicated.

a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.

2. AWWA C110, rubber, flat face, 1/8 inch (3.2 mm) thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.

B. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

C. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.

D. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

E. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.

F. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

G. Solvent Cements for Joining Plastic Piping:

1. ABS Piping: ASTM D 2235.
2. CPVC Piping: ASTM F 493.
3. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
4. PVC to ABS Piping Transition: ASTM D 3138.

H. Fiberglass Pipe Adhesive: As furnished or recommended by pipe manufacturer.

2.2 TRANSITION FITTINGS

A. Transition Fittings, General: Same size as, and with pressure rating at least equal to and with ends compatible with, piping to be joined.

B. Transition Couplings NPS 1-1/2 (DN 40) and Smaller:

1. Underground Piping: Manufactured piping coupling or specified piping system fitting.

2. Aboveground Piping: Specified piping system fitting.

C. AWWA Transition Couplings NPS 2 (DN 50) and Larger:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Cascade Waterworks Mfg. Co.
   b. Dresser, Inc.; DMD Div.
   c. Ford Meter Box Company, Inc. (The); Pipe Products Div.
   d. JCM Industries.
   e. Smith-Blair, Inc.
   f. Viking Johnson.
   g. Approved Equal.

3. Description: AWWA C219, metal sleeve-type coupling for underground pressure piping.

D. Plastic-to-Metal Transition Fittings:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Manufacturers: Subject to compliance with requirements.

2. Description: CPVC and PVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint or threaded end.

E. Plastic-to-Metal Transition Unions:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Colonial Engineering, Inc.
   b. NIBCO INC.
   c. Spears Manufacturing Co.
   d. Approved Equal.

3. Description: MSS SP-107, CPVC and PVC four-part union. Include brass or stainless-steel threaded end, solvent-cement-joint or threaded plastic end, rubber O-ring, and union nut.

F. Flexible Transition Couplings for Underground Nonpressure Drainage Piping:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Cascade Waterworks Mfg. Co.
    b. Fernco, Inc.
    c. Mission Rubber Company.
    d. Plastic Oddities.
    e. Approved Equal.

3. Description: ASTM C 1173 with elastomeric sleeve, ends same size as piping to be joined, and corrosion-resistant metal band on each end.

2.3 DIELECTRIC FITTINGS

A. Dielectric Fittings, General: Assembly of copper alloy and ferrous materials or ferrous material body with separating nonconductive insulating material suitable for system fluid, pressure, and temperature.

B. Dielectric Unions:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Capitol Manufacturing Co.
    b. Central Plastics Company.
    c. Epco Sales, Inc.
    d. Hart Industries, International, Inc.
    e. Watts Water Technologies, Inc.
    f. Zurn Plumbing Products Group; Wilkins Div.
    g. Approved Equal.

3. Description: Factory fabricated, union, NPS 2 (DN 50) and smaller.

    a. Pressure Rating: 250 psig (1725 kPa) at 180 deg F (82 deg C).
    b. End Connections: Solder-joint copper alloy and threaded ferrous; threaded ferrous.

C. Dielectric Flanges:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Capitol Manufacturing Co.
b. Central Plastics Company.
c. Epco Sales, Inc.
d. Watts Water Technologies, Inc.
e. Approved Equal.

3. Description: Factory-fabricated, bolted, companion-flange assembly, NPS 2-1/2 to NPS 4 (DN 65 to DN 100) and larger.

a. Pressure Rating: 300 psig (2070 kPa).
b. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

D. Dielectric-Flange Kits:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Advance Products & Systems, Inc.
b. Calpico, Inc.
c. Central Plastics Company.
d. Pipeline Seal and Insulator, Inc.
e. Approved Equal.

3. Description: Nonconducting materials for field assembly of companion flanges, NPS 2-1/2 (DN 65) and larger.

a. Pressure Rating: 150 psig (1035 kPa) minimum.
b. Gasket: Neoprene or phenolic.
c. Bolt Sleeves: Phenolic or polyethylene.
d. Washers: Phenolic with steel backing washers.

E. Dielectric Couplings:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Calpico, Inc.
b. Lochinvar Corporation.
c. Approved Equal.

3. Description: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining, NPS 3 (DN 80) and smaller.

a. Pressure Rating: 300 psig (2070 kPa) at 225 deg F (107 deg C).

b. End Connections: Threaded.

F. Dielectric Nipples:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Perfection Corporation.
   b. Precision Plumbing Products, Inc.
   c. Victaulic Company.
   d. Approved Equal.

3. Description: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining.

   a. Pressure Rating: 300 psig (2070 kPa) at 225 deg F (107 deg C).
   b. End Connections: Threaded or grooved.

2.4 SLEEVES

A. Mechanical sleeve seals for pipe penetrations are specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

B. Galvanized-Steel Sheet Sleeves: 0.0239-inch (0.6-mm) minimum thickness; round tube closed with welded longitudinal joint.

C. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized, plain ends.

D. Cast-Iron Sleeves: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

E. Molded PVC Sleeves: Permanent, with nailing flange for attaching to wooden forms.

F. PVC Pipe Sleeves: ASTM D 1785, Schedule 40.

G. Molded PE Sleeves: Reusable, PE, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.

2.5 IDENTIFICATION DEVICES

A. General: Products specified are for applications referenced in other utilities Sections. If more than single type is specified for listed applications, selection is Installer's option.

B. Equipment Nameplates: Metal permanently fastened to equipment with data engraved or stamped.

1. Data: Manufacturer, product name, model number, serial number, capacity, operating and power characteristics, labels of tested compliances, and essential data.
2. Location: Accessible and visible.

C. Stencils: Standard stencils prepared with letter sizes complying with recommendations in ASME A13.1. Minimum letter height is 1-1/4 inches (30 mm) for ducts, and 3/4 inch (20 mm) for access door signs and similar operational instructions.

1. Material: Fiberboard.
2. Stencil Paint: Exterior, oil-based, alkyd-gloss black enamel, unless otherwise indicated. Paint may be in pressurized spray-can form.
3. Identification Paint: Exterior, oil-based, alkyd enamel in colors according to ASME A13.1, unless otherwise indicated.

D. Snap-on Plastic Pipe Markers: Manufacturer's standard preprinted, semirigid, snap-on type. Include color-coding according to ASME A13.1, unless otherwise indicated.

E. Pressure-Sensitive Pipe Markers: Manufacturer's standard preprinted, color-coded, pressure-sensitive-vinyl type with permanent adhesive.

F. Pipes with OD, Including Insulation, Less Than 6 Inches (150 mm): Full-band pipe markers, extending 360 degrees around pipe at each location.

G. Pipes with OD, Including Insulation, 6 Inches (150 mm) and Larger: Either full-band or strip-type pipe markers, at least three times letter height and of length required for label.

H. Lettering: Manufacturer's standard preprinted captions as selected by Architect.

I. Lettering: Use piping system terms indicated and abbreviate only as necessary for each application length.

1. Arrows: Either integrally with piping system service lettering to accommodate both directions of flow, or as separate unit on each pipe marker to indicate direction of flow.

J. Plastic Tape: Manufacturer's standard color-coded, pressure-sensitive, self-adhesive vinyl tape, at least 3 mils (0.08 mm) thick.

1. Width: 1-1/2 inches (40 mm) on pipes with OD, including insulation, less than 6 inches (150 mm); 2-1/2 inches (65 mm) for larger pipes.
2. Color: Comply with ASME A13.1, unless otherwise indicated.

K. Valve Tags: Stamped or engraved with 1/4-inch (6.4-mm) letters for piping system abbreviation and 1/2-inch (13-mm) sequenced numbers. Include 5/32-inch (4-mm) hole for fastener.

1. Material: 0.032-inch- (0.8-mm-) thick, polished brass or aluminum.
2. Material: 0.0375-inch- (1-mm-) thick stainless steel.

3. Material: 3/32-inch- (2.4-mm-) thick plastic laminate with 2 black surfaces and a white inner layer.
4. Material: Valve manufacturer's standard solid plastic.
5. Size: 1-1/2 inches (40 mm) in diameter, unless otherwise indicated.
6. Shape: As indicated for each piping system.

L. Valve Tag Fasteners: Brass, wire-link or beaded chain; or brass S-hooks.

M. Engraved Plastic-Laminate Signs: ASTM D 709, Type I, cellulose, paper-base, phenolic-resin-laminate engraving stock; Grade ES-2, black surface, black phenolic core, with white melamine subcore, unless otherwise indicated. Fabricate in sizes required for message. Provide holes for mechanical fastening.

1. Engraving: Engraver's standard letter style, of sizes and with terms to match equipment identification.
2. Thickness: 1/16 inch (1.6 mm), unless otherwise indicated.
3. Thickness: 1/16 inch (1.6 mm), for units up to 20 sq. in. (130 sq. cm) or 8 inches (200 mm) in length, and 1/8 inch (3 mm) for larger units.
4. Fasteners: Self-tapping, stainless-steel screws or contact-type permanent adhesive.

N. Plastic Equipment Markers: Manufacturer's standard laminated plastic, in the following color codes:

1. Green: Cooling equipment and components.
2. Yellow: Heating equipment and components.
3. Brown: Energy reclamation equipment and components.
4. Blue: Equipment and components that do not meet criteria above.
5. Hazardous Equipment: Use colors and designs recommended by ASME A13.1.
6. Terminology: Match schedules as closely as possible. Include the following:

   a. Name and plan number.
   b. Equipment service.
   c. Design capacity.
   d. Other design parameters such as pressure drop, entering and leaving conditions, and speed.

7. Size: 2-1/2 by 4 inches (65 by 100 mm) for control devices, dampers, and valves; 4-1/2 by 6 inches (115 by 150 mm) for equipment.

O. Plasticized Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with mat finish suitable for writing.

1. Size: 3-1/4 by 5-5/8 inches (83 by 143 mm).
2. Fasteners: Brass grommets and wire.
3. Nomenclature: Large-size primary caption such as DANGER, CAUTION, or DO NOT OPERATE.

P. Lettering and Graphics: Coordinate names, abbreviations, and other designations used in piped utility identification with corresponding designations indicated. Use

numbers, letters, and terms indicated for proper identification, operation, and maintenance of piped utility systems and equipment.

1. Multiple Systems: Identify individual system number and service if multiple systems of same name are indicated.

2.6 GROUT

A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.

1. Characteristics: Post hardening, volume adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
2. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.
3. Packaging: Premixed and factory packaged.

2.7 FLOWABLE FILL

A. Description: Low-strength-concrete, flowable-slurry mix.

1. Cement: ASTM C 150, Type I, portland.
2. Density: 115- to 145-lb/cu. ft. (1840- to 2325-kg/cu. m).
3. Aggregates: ASTM C 33, natural sand, fine and crushed gravel or stone, coarse.
4. Aggregates: ASTM C 33, natural sand, fine.
5. Admixture: ASTM C 618, fly-ash mineral.
6. Water: Comply with ASTM C 94/C 94M.
7. Strength: 100 to 200 psig (690 to 1380 kPa) at 28 days.

PART 3 - EXECUTION

3.1 PIPED UTILITY DEMOLITION

A. Refer to Section 024119 "Selective Demolition" for general demolition requirements and procedures.

B. Disconnect, demolish, and remove piped utility systems, equipment, and components indicated to be removed.

1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
2. Piping to Be Abandoned in Place: Drain piping. Fill abandoned piping with flowable fill, and cap or plug piping with same or compatible piping material.
3. Equipment to Be Removed: Disconnect and cap services and remove equipment.
4. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make operational.

5. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.

C. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

3.2 DIELECTRIC FITTING APPLICATIONS

A. Dry Piping Systems: Connect piping of dissimilar metals with the following:

1. NPS 2 (DN 50) and Smaller: Dielectric unions.
2. NPS 2-1/2 to NPS 12 (DN 65 to DN 300): Dielectric flanges.

B. Wet Piping Systems: Connect piping of dissimilar metals with the following:

1. NPS 2 (DN 50) and Smaller: Dielectric couplings or dielectric nipples.
2. NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Dielectric nipples.
3. NPS 2-1/2 to NPS 8 (DN 65 to DN 200): Dielectric nipples or dielectric flange kits.
4. NPS 10 and NPS 12 (DN 250 and DN 300): Dielectric flange kits.

3.3 PIPING INSTALLATION

A. Install piping according to the following requirements and utilities Sections specifying piping systems.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on the Coordination Drawings.

C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

D. Install piping to permit valve servicing.

E. Install piping at indicated slopes.

F. Install piping free of sags and bends.

G. Install fittings for changes in direction and branch connections.

H. Select system components with pressure rating equal to or greater than system operating pressure.

I. Sleeves are not required for core-drilled holes.

J. Permanent sleeves are not required for holes formed by removable PE sleeves.

K. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs.

1. Cut sleeves to length for mounting flush with both surfaces.

a. Exception: Extend sleeves installed in floors of equipment areas or other wet areas 2 inches (50 mm) above finished floor level.

2. Install sleeves in new walls and slabs as new walls and slabs are constructed.

a. Steel Pipe Sleeves: For pipes smaller than NPS 6 (DN 150).
b. Steel Sheet Sleeves: For pipes NPS 6 (DN 150) and larger, penetrating gypsum-board partitions.

L. Verify final equipment locations for roughing-in.

M. Refer to equipment specifications in other Sections for roughing-in requirements.

3.4 PIPING JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and utilities Sections specifying piping systems.

B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

D. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

E. Welded Joints: Construct joints according to AWS D10.12/D10.12M, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.

F. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

G. Grooved Joints: Assemble joints with grooved-end pipe coupling with coupling housing, gasket, lubricant, and bolts according to coupling and fitting manufacturer's written instructions.

H. Soldered Joints: Apply ASTM B 813 water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy (0.20 percent maximum lead content) complying with ASTM B 32.

I. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.

J. Pressure-Sealed Joints: Assemble joints for plain-end copper tube and mechanical pressure seal fitting with proprietary crimping tool to according to fitting manufacturer's written instructions.

K. Plastic Piping Solvent-Cemented Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:

1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
2. ABS Piping: Join according to ASTM D 2235 and ASTM D 2661 appendixes.
3. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
4. PVC Pressure Piping: Join schedule number ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.
5. PVC Nonpressure Piping: Join according to ASTM D 2855.
6. PVC to ABS Nonpressure Transition Fittings: Join according to ASTM D 3138 Appendix.

L. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139.

M. Plastic Nonpressure Piping Gasketed Joints: Join according to ASTM D 3212.

N. Plastic Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.

1. Plain-End PE Pipe and Fittings: Use butt fusion.
2. Plain-End PE Pipe and Socket Fittings: Use socket fusion.

O. Bonded Joints: Prepare pipe ends and fittings, apply adhesive, and join according to pipe manufacturer's written instructions.

3.5 PIPING CONNECTIONS

A. Make connections according to the following, unless otherwise indicated:

1. Install unions, in piping NPS 2 (DN 50) and smaller, adjacent to each valve and at final connection to each piece of equipment.
2. Install flanges, in piping NPS 2-1/2 (DN 65) and larger, adjacent to flanged valves and at final connection to each piece of equipment.
3. Install dielectric fittings at connections of dissimilar metal pipes.

3.6 EQUIPMENT INSTALLATION

A. Install equipment level and plumb, unless otherwise indicated.

B. Install equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference with other installations. Extend grease fittings to an accessible location.

C. Install equipment to allow right of way to piping systems installed at required slope.

3.7 PAINTING

A. Painting of piped utility systems, equipment, and components is specified in Section 099600 "Painting."

B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish per Section 099600.

C. All pipes, valves, flow meters, and any other portions of water main or ferrous metals exposed inside of the pump station or water treatment plant shall be painted.

3.8 IDENTIFICATION

A. Piping Systems: Install pipe markers on each system. Include arrows showing normal direction of flow.

1. Stenciled Markers: According to ASME A13.1.
2. Plastic markers, with application systems. Install on insulation segment if required for hot noninsulated piping.
3. Locate pipe markers on exposed piping according to the following:

   a. Near each valve and control device.
   b. Near each branch, excluding short takeoffs for equipment and terminal units. Mark each pipe at branch if flow pattern is not obvious.
   c. Near locations where pipes pass through walls or floors or enter inaccessible enclosures.
   d. At manholes and similar access points that permit view of concealed piping.
   e. Near major equipment items and other points of origination and termination.

B. Equipment: Install engraved plastic-laminate sign or equipment marker on or near each major item of equipment.

1. Lettering Size: Minimum 1/4 inch (6.4 mm) high for name of unit if viewing distance is less than 24 inches (610 mm), 1/2 inch (13 mm) high for distances up to 72 inches (1800 mm), and proportionately larger lettering for greater distances. Provide secondary lettering two-thirds to three-fourths of size of principal lettering.

2. Text of Signs: Provide name of identified unit. Include text to distinguish among multiple units, inform user of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations.

C. Adjusting: Relocate identifying devices that become visually blocked by work of this or other Divisions.

3.9 CONCRETE BASES

A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.

1. Construct concrete bases of dimensions indicated, but not less than 4 inches (100 mm) larger in both directions than supported unit.
2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of base.
3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
5. Install anchor bolts to elevations required for proper attachment to supported equipment.
6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
7. Use 3000-psi (20.7-MPa), 28-day compressive-strength concrete and reinforcement as specified in Section 033000 "Cast-in-Place Concrete."

3.10 ERECTION OF METAL SUPPORTS AND ANCHORAGES

A. Refer to Section 055000 "Metal Fabrications" for structural steel.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor piped utility materials and equipment.

C. Field Welding: Comply with AWS D1.1/D1.1M.

3.11 GROUTING

A. Mix and install grout for equipment base bearing surfaces, pump and other equipment base plates, and anchors.

B. Clean surfaces that will come into contact with grout.

C. Provide forms as required for placement of grout.

D. Avoid air entrapment during placement of grout.

E. Place grout, completely filling equipment bases.

F. Place grout on concrete bases and provide smooth bearing surface for equipment.

G. Place grout around anchors.

H. Cure placed grout.

END OF SECTION 330500

SECTION 331113 - PUBLIC WATER UTILITY DISTRIBUTION PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Conditions and Division 1 Specification Sections, apply to this Section.

B. References to details pertain to standard details for water lines and appurtenance installation, as shown on the construction drawings.

1.2 SUMMARY

A. This Section includes water-distribution piping and specialties for the following:

1. Work to be done hereunder shall include furnishing of all labor, materials, tools, transportation, supplies, plant, equipment, and appurtenances necessary for complete and satisfactory construction of water mains, as shown on Drawings or Specifications, as approved by the Owner, complete and ready for service.

1.3 DEFINITIONS

A. Combined Water Service and Fire-Service Main: Exterior water piping for both domestic-water and fire-suppression piping.

B. The following are industry abbreviations for plastic materials:

1. PVC: Polyvinyl chloride plastic.

2. PE: Polyethylene plastic.

3. DIP: Ductile Iron Pipe

1.4. REFERENCES:

The work shall comply with most recent standards or tentative standards as published at the date of the contract and as listed in these specifications using the abbreviation shown:

American Society for Testing and Materials..... ASTM
American Water Works Association.....AWWA
American Association of State Highways and Transportation Officials. AASHTO
Virginia Department of Transportation ..... VDOT
National Sanitation Foundation ..... NSF
Chain Link Fence Manufacturers Institute..... CLFMI

Occupational Safety and Health Administration ..... OSHA

1.4 SUBMITTALS

A. Product Data: For the following:

1. Piping and specialties.
2. Valves and accessories.
3. Fire hydrants.
4. Flushing hydrants.
5. Casing pipe.
6. Air relief valves.

B. Coordination Drawings: For piping and specialties, including relation to other services in same area. Show piping and specialty sizes and valves, meter and specialty locations, and elevations.

C. As-Built Drawings: Marked-up drawings shall be given to Engineer upon project completion.

D. Operation and Maintenance Data: For specialties to include in emergency, operation, and maintenance manuals. Include the following:

1. Valves.
2. Fire hydrants.
3. Flushing hydrants.
4. Air relief valves.

1.5 QUALITY ASSURANCE

A. Product Options: Drawings indicate sizes, profiles, and dimensional requirements of piping and specialties and are based on the specific system indicated.

B. Regulatory Requirements:

1. Comply with Owner requirements, including tapping of water mains and backflow prevention.
2. Comply with standards of authorities having jurisdiction for potable-water-service piping, including materials, installation, testing, and disinfection.
3. Comply with standards of authorities having jurisdiction for fire-suppression water-service piping, including materials, hose threads, installation, and testing.

C. Piping materials shall bear label, stamp, or other markings of specified testing agency.

D. Comply with appended standard details of Owner.

E. Comply with FM's "Approval Guide" or UL's "Fire Protection Equipment Directory" for fire-service-main products.

F. NFPA Compliance: Comply with NFPA 24 for materials, installations, tests, flushing, and valve and hydrant supervision for fire-service-main piping for fire suppression.

G. NSF Compliance:

1. Comply with NSF 61 for materials for piping and specialties for domestic water.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Preparation for Transport: Prepare valves, including fire hydrants, according to the following:

1. Ensure that valves are dry and internally protected against rust and corrosion.
2. Protect valves against damage to threaded ends and flange faces.
3. Set valves in best position for handling. Set valves closed to prevent rattling.

B. During Storage: Use precautions for valves, including fire hydrants, according to the following:

1. Do not remove end protectors unless necessary for inspection; then reinstall for storage.
2. Protect from weather. Store indoors and maintain temperature higher than ambient dew-point temperature. Support off the ground or pavement in watertight enclosures when outdoor storage is necessary.

C. Handling: Use sling to handle valves and fire hydrants if size requires handling by crane or lift. Rig valves to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

D. Deliver piping with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe-end damage and to prevent entrance of dirt, debris, and moisture.

E. Protect stored piping from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor when storing inside.

F. Protect flanges, fittings, and specialties from moisture and dirt.

G. Store plastic piping protected from direct sunlight. Support to prevent sagging and bending.

1.7 PROJECT CONDITIONS

A. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:

1. Notify Engineer not less than two days in advance of proposed utility interruptions.

2. Do not proceed with utility interruptions without Engineer's written permission.

1.8 TRENCH PROTECTION

A. Contractor shall furnish and erect sheathing, bracing, and shoring, and shall furnish necessary signs, barricades, and temporary lighting, as may be pertinent for protection of work, employees, public, and adjacent structures, and to guard against contingencies which might give rise to delays in work. Sheathing left in place shall be at Contractor's expense. Responsibility for preservation of trench banks and other excavated spaces and the prevention of injury to any persons or property shall rest entirely with Contractor. Unless otherwise approved by Engineer, maximum of 200 feet of trench will be allowed open at any one time. No trench will remain open overnight unless authorized by Engineer.

1.9 UNDERGROUND UTILITIES

A. Contractor shall contact the appropriate utility companies and have utilities located prior to starting construction. Locations of existing facilities should be determined by Contractor far enough in advance of construction to provide for modification in design, if required. Contractor shall call “Miss Utility”, 811.

1.10 BLASTING

A. Blasting shall be done in strict accordance with Virginia Statewide Fire Prevention Code (VR 394-01-6), latest edition. Contractor shall adhere to requirements of local municipalities and shall notify Owner, County, and City prior to any blasting.

1.11 CLEARING AND EROSION CONTROL

A. Contractor shall be responsible for complying with all provisions of erosion and sediment control plans and notes, including construction, installation, and maintenance of all mechanical and vegetative erosion and sediment control measures for the duration of project. If unforeseen erosion and sediment problems arise during the construction, Contractor shall implement corrective measures acceptable to Engineer.

B. Siltation and pollution control requirements for installation, operation, maintenance, and removal shall be in accordance with Virginia Erosion and Sediment Control Manual, latest edition, and Virginia Department of Transportation Road and Bridge Specifications, latest edition.

C. Only that portion of right-of-way or easement actually needed for construction shall be cleared or used by heavy equipment, unless directed by Engineer. In no case shall clearing or debris from clearing operations be taken past right-of-way or permanent easement lines onto private property. Areas disturbed by construction operations shall be protected from erosion by suitable means outlined in the “Virginia Erosion and Sediment Control Handbook.” Equipment and materials shall be stored only in approved areas.

1.12 TRAFFIC

A. All traffic control and directional signs shall be supplied by the Contractor. Traffic control shall conform to the latest edition of Uniform Manual for Traffic Control Devices, the Owner, VDOT, and local regulations. Placement of excavated material on existing pavement shall be permitted upon approval of a written request to VDOT and provided a stone dust or sand layer is first placed on the pavement. No cleated equipment shall be used on pavements. Road drainage shall not be clogged, and shoulders, ditches, roadside drainage facilities, and pavement affected by the grading operations shall be maintained in a condition satisfactory to VDOT. Traffic shall not be blocked or rerouted without permission of VDOT. Where one way traffic is permitted to be maintained, it shall be flagged 24 hours per day. Traffic shall at all times be properly protected by adequate lights, barricades, and signs, and also flagging personnel when needed.

1.13 INSTALLATION WITHIN VDOT RIGHT-OF-WAY

A. Contractor shall install water main within Virginia Department of Transportation right-of-way as required by Owner and approved by VDOT.

1.14 SEPARATION OF WATER AND SEWER LINES

A. Parallel Installation: Water lines shall normally be separated from sanitary sewers horizontally by a distance of 10 feet. This distance shall be measured from outside of pipe to outside of pipe. When local conditions prevent a horizontal separation of 10 feet, bottom of water line shall be a minimum of 18" above top of sewer. Where this vertical separation cannot be achieved, sanitary sewer shall be constructed of AWWA-approved water pipe, pressure tested in place to 150 psi without leakage prior to backfilling. The Contractor is required to receive prior Engineer approval of the construction methods whenever normal separation installation conditions can not be achieved.

B. Crossings: Water lines crossing house, storm, or sanitary sewers shall provide separation of at least 18 inches between bottom of the water line and top of sewer. If this vertical separation is not possible, sanitary sewers shall be constructed and tested per Section 1.14.A.

C. When local conditions require water lines to pass under such sewers, adequate structural support shall be provided for sewer to prevent excessive deflection. Also, length of water pipe shall be centered at point of crossing, and a vertical separation of at least 18 inches shall be provided between bottom of the sewer and top of water line. In this case, sanitary sewers passing over shall be constructed and tested as noted in Section 1.14.A.

D. No water pipe shall pass through or come in contact with any part of a sewer or sewer manhole.

1.15 SAFETY

A. All pertinent safety regulations, including federal and state OSHA standards, shall be followed. In addition, all safety precautions noted on manufacturer's product data sheets and labels shall be observed for both material and equipment. Contractor shall be responsible for initiating, maintaining, and supervising all safety precautions and programs in connection with work.

1.16 OSHA REQUIREMENTS

A. Contractor shall be responsible for performing all excavation, pipe installation, and backfilling, in accordance with 1990 OSHA Excavation Standards 29 CFR Part 1926, Subpart P – Excavations. Contractor's responsibility also extends to providing a "Competent Person", as defined by OSHA regulation referenced above, on job site.

1.17 WASTE AREAS

A. Disposal of unsuitable and surplus material will be carried out in accordance with Virginia Department of Transportation Road and Bridge Specifications, Section 106.04, except that Contractor shall be responsible for obtaining rights to any waste area for disposal of unsuitable or surplus material either shown or not shown on plans. All work in disposing of such material shall be considered incidental to work

1.18 CLEANUP

A. Before final acceptance, all borrow pits, waste areas, storage areas, and all grounds occupied by the Contractor in connection with the work, shall be cleaned of all rubbish, excess materials, and temporary structures, and all parts of the work shall be left in a neat and presentable condition.

1.19 COORDINATION

A. Coordinate connection to water mains with Owner.

B. Contractor shall notify owner of property upon which work is to be performed in advance of commencing. In event of necessity of disrupting utility or other services to such property, Contractor shall notify owner of such utility or other services and arrange for disruption and restoration of such service in a manner which will result in a minimum of inconvenience to parties concerned. Contractor shall cooperate fully with Owner to effect proper coordination and progress to complete Project on schedule and in proper sequence. Insofar as possible, decisions of all kinds required by Owner shall be anticipated by Contractor to provide ample time for inspection, investigation, or preparation of instructions.

C. No valve, hydrant, or other appurtenance on existing water lines shall be opened or closed for

any purpose by Contractor. Any opening or closing of valves, hydrants, or other appurtenance shall be by Owner. Contractor shall notify the Owner at least 48 hours prior to need to open or close any appurtenance, except in emergencies, at which time the Owner shall be notified immediately.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the products specified.
2. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the manufacturers specified.
3. All materials and equipment provided shall be compatible with materials and equipment already in Owner system, and shall be new and in first class condition.

2.2 PIPING MATERIALS

A. As indicated on the design plans, pipe material is to be installed as called out. Water main pipe installed through casing pipe shall have locked gaskets or restrained joints such as “Mega-Lug”, “AquaGrip”, “Lock Tyton”, or Approved Equal.

2.3 DUCTILE-IRON PIPE AND FITTINGS

A. Push-on-Joint, Ductile-Iron Pipe: AWWA C151, Pressure Class 350, with push-on-joint, bell- and plain-spigot end unless grooved or flanged ends are indicated. Nominal 18-feet or 20-feet lengths.

1. Push-on-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.

   a. Gaskets: AWWA C111, rubber.

   b. Cement Lining: AWWA C 104

2.4 PVC PIPE

A. PVC (SDR 14) C900 pipe shall be Pressure Class 305 polyvinyl chloride plastic furnished in 20-foot nominal lengths. Pipe shall have a 4 to 1 sustained pressure safety factor at recommended maximum working pressure. Pipe shall conform to AWWA Specification C.900 for PVC pressure pipe, 4-inch through 12-inch. Joints shall be push-on type with rubber rings conforming to ASTM D3139 and ASTM F477. PVC pipe will only be allowed on line sizes 8” and smaller.

B. Small Diameter Pressure Pipe: PVC pipe 4-inches in diameter and smaller shall be Class 250 polyvinyl chloride plastic. Pipe shall be manufactured in accordance with ASTM D 2241 for PVC pressure rated pipe. Joints shall be manufactured in accordance with ASTM D 3139. Rubber rings shall be manufactured in accordance with ASTM F 477. Pipe shall be certified by the National Sanitation Foundation for Potable Water Service (NSF No. 14) and the same shall be so indicated on the pipe. Pipe shall be equal to Yelowmine as manufactured by Certain Teed or Aquamine as manufactured by Victaulic, or approved equal.

C. Schedule 40 PVC: Drain, waste, and vent piping shall be Schedule 40, Type 1, Grade 1, plain end conforming to ASTM D1784 and ASTM D1785 with solvent weld joints and fittings, as called for on the plans.

D. Schedule 80 PVC: Drain, waste, and vent piping shall be Schedule 80, conforming to ASTM D1785 with solvent weld joints and fittings, as called for on the plans.

2.5 POLYETHYLENE (PE) PIPE

A. High Density PE (HDPE): HDPE shall be used in accordance with specifications and installation shall follow the manufacturer’s and Plastic Pipe Institutes’ recommendations. Pipe and heat-fusion fittings shall be PE 3408 high density polyethylene and conform to latest revision of AWWA C 901 and AWWA C 906. Pipe shall have a minimum standard dimension ratio (SDR) of 11. HDPE pipe installed by horizontal directional drilling (HDD) shall be provided with a 12 gauge solid copper wire for pipe location purposes.
   1. Drilling Fluid: Contractor shall utilize a bentonite drilling mud, which is compatible with the environment. Waste oil or environmentally non-compatible polymers cannot be part of composition.
   2. HDPE Joints
      a. Use Butt fusion joining techniques for joining pipe segments installed by HDD.
      b. When joining HDPE pipe at ends of directional drilling runs, fusion bond to the adjacent pipe section. Use Butt fusion, Socket fusion, or Electrofusion Coupling joining technique.
      c. Mechanical couplings are not permitted for joining of directionally drilled pipe sections.
      d. Connect to other pipe materials as indicated by manufacturer.
      e. Contractor shall certify that all joining operations are conducted by personnel trained by the joining equipment manufacturer. Certification shall be provided to the Engineer prior to construction.

B. Polyethylene (PE) Pressure Tubing: PE tubing shall be pressure class 200, copper tubing size, meeting the requirements of AWWA C 901. In water applications, PE tubing shall only be used for service lines and shall be 1-inch in diameter.

2.6 FITTINGS

A. All fittings for pipe shall be mechanical joint, ductile iron or cast iron, in compliance with AWWA C 104, C 110, or C 153. When connecting any PVC pipe to a cast iron bell fitting, pipe end shall be prepared for installation in accordance with manufacturer's directions.

2.7 PROTECTIVE COATING

A. Ductile iron pipe and fittings shall be cement lined and sealed in accordance with AWWA C.104. Underground metal pipe, fittings, and accessories, and metal piping in casings shall also have an exterior coat of a bituminous material.

2.8 JOINING MATERIALS

A. All joint assembly shall be in accordance with manufacturer's directions. Restrained joints, such as "Mega-Lug", "AquaGrip", "Lock Tyton," or approved equal, may be used for ductile iron pipe upon approval by Engineer. Where such joints are used, concrete anchorage shown on the Drawings will not be required.

2.9 LUBRICANT

A. Lubricant for joints shall be that supplied by the manufacturer of the pipe being used. If PVC pipe is used, the lubricant for PVC pipe shall be used at joints with valves, fittings, hydrants, or other pipe materials. With PVC pipe, no lubricant harmful to polyvinyl chloride plastic shall be used.

2.10 PIPE ENCASEMENT FOR CROSSINGS

Steel casing pipe shall conform to the Materials Standards of ASTM Designation A-139, Grade B, or approved equal. Only new prime pipe will be permitted. Wall thickness will be as shown on the plans. The pipe shall have an exterior coat of bituminous material. Casing pipe and joints shall be of leak proof construction so as to prevent leakage of any substance from the casing throughout its length.

2.11 GATE VALVES

A. Refer to Section 331250 – Valves.

2.12 AIR RELIEF VALVES

A. Refer to Section 331250 - Valves.

2.13 BLOW-OFF ASSEMBLY

A. Blow-off valves shall be installed at low points in the water line or as selected by the Owner. Blow-offs shall be field assembled in accordance with the details on the design plans, or shall be provided in the form of a box hydrant. Two-inch blow-off valves shall be installed at the end of water lines. Concrete bulkhead anchors shall be provided at all blow-off assemblies as shown in the Standard Details.

2.14 HYDRANTS

A. General: Fire hydrants shall be traffic type with safety flange protection conforming to AWWA C.502 and shall have not less than 6-inch diameter barrel, 5 ¼-inch minimum hydrant valve and a measured loss of not more than 2.5 psi through the hydrant at 600 gpm. Hydrants shall have 6 inch mechanical joint connection to the water main, two 2 ½-inch hose outlets, and one 4 ½-inch pumper outlet and nozzle threading shall be National Standard. Hydrants shall be so designed that if broken off, hydrant valve will remain closed. Direction of opening shall be left (counterclockwise) with 1 ½-inch pentagon-shaped operating nut. Such hydrants shall have a working pressure of not less than 250 psi. Hydrants shall be Mueller A-423, American Darling B 84B, Kennedy K81D, or approved equal.

2.15 CONCRETE

A. Miscellaneous concrete shall be Type A-3 conforming to VDOT Specifications and Section 033000.

2.16 METER/VALVE VAULTS

A. General: All meters enclosed in a meter vault shall be equipped with approved touch read or radio read apparatus as indicated on the plans. Meter vaults constructed of masonry brick or block will not be acceptable.

B. Large Vault: Chamber for meter or control valve shall be equal to VDOT JB-1 or precast utility vaults approved by Engineer. Minimum dimensions and section details shall be as given in the plans for the size meter/valve assembly required. Joints on precast unit shall be sealed with an asphaltic butyl compound to make them watertight. Access hatch shall be Bilco J-4 series doorway, Halliday, or approved equal or Bilco JH-20, Halliday, or approved equal in traffic areas.

2.17 TAPPING DEVICES

A. General: All wet taps on water lines shall only be made with approved tapping sleeve or tapping saddle.

B. Tapping Sleeves: Tapping sleeves are required for connecting to 2-inch and larger water mains and shall be full circle stainless steel sleeves with approved tapping valve included as part of the tapping sleeve installation. All tapping sleeves are to rated for a working pressure of 250 psi.

2.22 TIE RODS

A. Shall be ¾-inch thread steel rods for hydrant clamping, galvanized or otherwise rustproof-
treated. Compatible washers and nuts shall be similarly rustproof-treated. Tie bolts shall be A36 steel.

2.23 STONE

A. Stone for repair of gravel road shoulder shall be VDOT #25 or #26.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Refer to Division 31 Section "Earthwork" for excavating, trenching, and backfilling.

3.2 EXCAVATION AND TRENCH PREPARATION PIPING

A. Width: Width shall be sufficient to allow laying without walking or standing on pipe and shall not be less than six inches on each side of pipe's largest diameter. The maximum clear width at
top of pipe shall not be more than outside diameter of the pipe plus two feet.

B. Bell holes shall be excavated to accommodate each bell.

C. Rock Excavation: Ledge rock, boulders, and large stones shall be removed to provide a clearance of at least six inches below and on each side of all pipe, valves, and fittings. Before pipe is laid, subgrade shall be made by backfilling with approved material and shall be tamped and graded. Commercial stone shall be as shown on the plans and standard details. or shall be VDOT #26 for ductile iron pipe and #10 for PVC pipe when not specified.

D. Excavation to Grade: Trench shall be excavated so as to provide a uniform and continuous bearing and support for pipe on solid and undisturbed ground between bell

holes. Any part of bottom of trench excavated below specified grade shall be brought back to grade with approved material, thoroughly compacted. Finished subgrade shall be prepared accurately by means of hand tools.

E. Unsuitable Material: Wet or otherwise unsuitable soil at subgrade shall be removed and replaced with approved sound materials as part of original contract cost and at no additional cost to the Owner. Excess or unsuitable material shall be legally disposed of by Contractor.

F. Topsoil Storage: Topsoil to be used in landscaping shall be stockpiled separately from other backfill material.

G. Trench Protection: Contractor shall furnish and erect such sheathing, bracing, and shoring, and shall furnish necessary signs, barricades, and temporary lighting as may be pertinent, for protection of the work, employees, public, and adjacent structures. Sheathing left in place shall be at Contractor's expense. Maximum of 200 feet of trench will be allowed open at any one time. No excavation within VDOT right-of-way or elsewhere will be allowed to remain open overnight unless special permission is obtained.

H. Pumping, Bailing, and Ditching: Contractor shall remove by appropriate means any water which may accumulate in trenches or other excavations and shall keep excavations clear of water while work is being installed.

I. Road or Driveway Crossings:

1. All VDOT road crossings must be bored unless otherwise shown on plans. Driveways may be open cut unless otherwise shown on plans. All driveways must be restored to conditions equivalent to existing conditions.

2. Wherever road pavement is to be cut, not over one-half width shall be disturbed at one time. On crossings, first opening shall be completely restored to satisfactory travelable condition before second half can be opened. Where this is not possible, steel crossing plates must be used to maintain access at all times. Where pavement is disturbed, or deemed weakened, it, in its entirety, or such portions of it as deemed desirable by VDOT shall be restored or replaced in a manner directed by and to the satisfaction of VDOT.

3. When pavement must be cut, cut shall be made in a straight line, parallel to pipe and six inches wider than trench, on each side, so that an undisturbed shoulder will be provided under new work. Sidewalks or curb and gutter disturbed by construction shall be removed and replaced at existing joints. Cutting shall be done neatly so that a uniform, straight joint will result to provide a bond with original concrete or pavement.

J. Erosion and Siltation Control: Within all easements and rights-of-way, straw barriers, silt fencing, settlement basins, brush barriers, and all other means necessary for adequate erosion and siltation control are to be utilized. All work shall be done according to the latest edition of the Virginia Erosion and Sediment Control Handbook.

3.3 HORIZONTAL DIRECTIONAL DRILLING (HDD)

A. Background: Directional drilling is a two-stage process consisting of drilling a pilot hole through the ground, and pulling back a pipe while the drilling pipe is removed. A lubrication system mixes and pumps bentonite through a hollow stem drill rod to lubricate the hole, assists in the cutting of the earth and rock, and stabilizes the bore hole. When the drill rod exits at the correct location, a back reamer is installed to the drill rod to enlarge the hole. The pipe is attached to the reamer with a swivel installed between the two to ensure that the rotating action of the reamer is not transmitted to the pipe or cable being pulled back. During the pull back, drilling fluid is pumped through the hollow stem drill rod and is injected at the reamer to assist in the cutting and lubrication of the hole, the reduction of friction of the outside of the pipe, and the stabilization of the bore hole.

B. Contractor Qualifications: Contractor shall be actively engaged in horizontal direction drilling for a minimum of three years, and must have completed at least five projects in the last two years of similar size and type as required for the installation. Field supervisory personnel shall have at least three years of experience in the performance of the type installation to be done. Experience information shall be submitted to the Engineer. Information including the following shall also be submitted to the Engineer: size & capacity of equipment; Bentonite drilling mud: product information, material specifications, handling procedures, MSDS (material safety data sheet), special precautions required, and method of mixing and application; Pipe and Fittings: material specifications, pipe fusion equipment, specifications, operation procedures, and testing requirements.

C. Site Conditions: The operations must be conducted in a manner to eliminate discharge of water, drilling mud, and cuttings to streams and other water bodies.

D. General: The directional boring scope shall include, but not be limited to, steerable directional boring equipment, boring pits and equipment, sheeting, location signs as required, miscellaneous appurtenances to complete the entire work as shown on the plan and drawings, and restoration. Directional boring operations shall be performed within the right of way and/or easements shown on the drawings.

Determine the drilling length and equipment pull strength for the type of soil encountered. Provide method to control line and grade.

1. Provide and maintain instrumentation that will accurately locate the pilot hole.
2. Drill pilot hole along the path shown on drawings to the following tolerances:
   a. Vertical alignment plus or minus one (1) foot. Vertical path of the pilot hole must not establish new high points not shown on the profile drawings.
   b. Horizontal alignment plus or minus one (1) foot along pipe corridor.
3. Record position readings at a maximum of ten-foot intervals.
4. At completion of pilot hole drilling, provide Engineer with tabulations of horizontal and vertical alignment. Serious deviations between the design position which may affect the installation of the pipeline which are beyond the control of the Contractor to correct shall be documented and immediately brought to the attention of the Owner for discussion and/or approval. The profile and alignment designed on the construction drawings for the bores define the minimum depth.

E. Drilling Fluids: Maintain drilling fluid in bore hole to increase stability of the surrounding soil and reduce drag on pulled pipe. Dispose of drilling fluid and other spoils at location chosen by Contractor and approved by Engineer and Owner. Transport excess fluids and other spoils to a disposal site. Disposal shall be performed at no cost to the Owner. Minimize drilling fluid at locations other than entry and exit points. Immediately clean up any drilling fluids that inadvertently surface. During the drilling, reaming, or pullback operations, the Contractor shall make adequate provisions for handling the drilling fluids, or cuttings at the entry and exit pits. These fluids must not be discharged into the waterways. When the Contractor's provisions for storage of the fluids or cuttings on site are exceeded, these materials should be hauled away to a suitable, legal disposal site. After completion of the directional drilling work, the entry and exit pit locations shall be restored to original conditions. The Contractor shall comply with all permit provisions.

F. Pilot Hole Drilling: Establish entry angle hole so that the curvature of the pilot hole does not exceed the allowable bending radius of the HDPE pipe. Maintain a curvature so that it does not exceed the allowable bending radius of HDPE pipe.

Follow the pipeline alignment, as shown on the drawings, within the tolerances specified herein. Prior to adjustments, notify Engineer for approval. Notify Engineer when forward motion of operation is stopped by an obstruction. When it is determined impossible to advance the HDD, abandon in place filled with drilling fluid, unless otherwise directed by the Engineer. Attemp a second installation at a location approved by the Engineer. Withdrawls, abandonments, and restarts are at no additional expense to the Owner. If pilot hole, or exit point fails to conform to drawing or is outside of easement limits, too deep, or too shallow, the Owner may require a new pilot hole.

Exercise caution including, but not limited to, the following steps: locate all utilities. Provide down holes (test pits) to observe drill stems or reamer assembly clearing any utility or structure as necessary. Test pits shall be performed at no additional cost to the Owner.

G. Installing HDPE Pipe: Provide a swivel to reaming assembly and pull section of pipe to minimize torsional stress on the pull section after drilling pilot hole. Hold reaming diameter to 1.5 times the outside diameter of HDPE pipe being installed. Protect pull section as it proceeds during pull back so that it moves freely and is not damaged by stones or debris on the ground. When connecting to the adjacent pipe section or struction, allow the pulled section of pipe to extend past the termination point. Make tie-ins in a minimum of 24 hours after the pullback of HDPE pipe. The necessary amount of extra pulled HDPE pipe will be at the Contractor's discretion. Contractor to provide restrained joint on the backside of the transition coupling from HDPE to the adjacent pipe section.

H. Testing: Pipe installed is required to be an integral part of the overall system. The pipe shall be tested in accordance with the Plastic Pipe Institute document entitled "Inspections, Test and Safety Considerations." Hydrostatic pressure testing will be done utilizing water as the test medium and following the document sections on "Hydrostatic Pressure Testing of Water Mains." Contractor shall provide one copy of Record Drawings with x-y-z coordinates prior to final acceptance of installation. The pipe shall be sterilized in accordance with these specifications.

3.4 INSTALLATION OF PIPE, FITTINGS, AND ACCESSORIES

A. Handling: Pipe shall be placed in trench in such a manner as to prevent damage to pipe and protective coatings and linings. Under no circumstances shall pipe be dropped or dumped into trench.

B. Cleaning: Every precaution shall be taken to prevent foreign material from entering pipe while it is being installed. Spigot and bell ends of pipe and gaskets shall be cleaned and lubricated according to the manufacturer's instructions. When pipe laying is not in progress, open ends of pipe shall be closed by a watertight plug.

C. Direction of Laying: Pipe shall be laid with bell ends facing in direction of laying, unless otherwise directed by Engineer. Laying shall start at bottom and shall proceed upward with bell ends of pipe upgrade, where feasible.

D. Roadway Crossings Through Casings: When special conditions require use of casings, spiders shall be bolted to pipe before it is pushed into casing, to keep it centered and avoid damage during installation. Care shall be taken to insure that installed pipeline is well secured to prevent movement, as shown in Details.

E. Stream Crossings: When water mains cross under streams, ductile iron pipe and concrete encasement shall be used. Concrete encasement shall extend a minimum of five (5) feet to each side of the stream crossing or until the pipe construction is out of the water table, whichever is further. Minimum cover along the stream crossing shall be 24-inches measured from the top of encasement and as shown in the standard details.

F. Deflection at Joints: Maximum deflection for joints will be as follows:

Maximum Allowable Deflection in Inches

Pipe Size	Ductile Iron (Mechanical) Lengths				Ductile Iron (Push On) Lengths				PVC SDR 14
	12'	16'	18'	20'	12'	16'	18'	20'	20'
4"	21	28	31	34	12	17	19	21	12
6"	18	24	27	30	12	17	19	21	4
8"	13	18	20	22	12	17	19	21	3
10"	13	18	20	22	12	17	19	21	2.5
12"	13	18	20	22	12	17	19	21	2
16"	9	12	13.5	15	7.5	10	11	12	--

G. Setting of Valves, Hydrants, and Fittings: Provide a valve box for every valve. Valve box shall not transmit shock or stress to valve and shall be centered and plumb over wrench nut of valve, with box cover flush with surface of finished pavement or as directed by Engineer. Valve boxes shall be installed in accordance with plan details. Hydrants shall be set so that center of outlet is 16 to 18 inches above finished grade when connected to main and shall be tied to main or anchored to control thrust. At least 0.5 cubic yards of crushed stone or gravel shall be provided under base to allow

drainage from hydrant drain valve. Hydrants shall not be subject to surface flooding and shall be installed per plan details. Extra supports are required for fittings, valves, and hydrants when PVC pipe is used. Only valves, valve boxes, and hydrants approved by the Engineer may be used during system construction.

H. Anchorage: Pipe lines shall be protected against joint pulling or thrust damage by suitable anchors, braces, or tie rods installed at direction changes as a result of fittings and all other critical points. Rods and clamps shall be galvanized or otherwise rustproof treated. Reaction backing shall be of size indicated on plans and in the plan details and shall bear on solid undisturbed earth. Where Mega Lug, AquaGrip, Lok-Tyton, Super-Lock or a similar joint or mega lug restraining gland is used, bracing and anchorage will not be required.

H. Hydrostatic Pressure Testing of Water Mains:

1. Hydrostatic testing shall be performed in accordance with this specification and in presence of Owner representative. Where this specification cites that work shall be "approved" or "acceptable", it shall be understood that such approval or acceptance shall be by Owner.
2. All construction, including piping, valves, equipment, thrust restraints, and sufficient backfill to prevent pipe movement, shall be complete, inspected, and approved before testing is performed. Testing shall be performed within 30 days after completion of pipe installation, but at least 7 days after final concrete thrust anchor has been poured.
3. Hydrostatic pressure testing shall be performed against closed fire hydrants, if present; after installation of service taps, if applicable; and with closed air release valves.
4. Flushing of water lines shall be performed in such a manner as to prevent erosion control nuisance, interruption of traffic, or damage to downstream properties.
5. Section of pipe to be tested shall be isolated from connecting sections in an acceptable manner and slowly filled with potable water. When existing water mains are used as water source, acceptable backflow prevention measures shall be utilized, which measures shall be removed before testing begins. All air shall be expelled from pipe before testing is performed. Prevent entrapment of air at high points.
6. Test equipment shall be supplied by the Contractor, properly calibrated and approved before use, and shall maintain a stable test pressure, ± 5 psi, for duration of test. Test pressure shall be 1.5 times anticipated working pressure of water main, based on highest static pressure within project limits, as determined by Engineer, but not less than 150 psi, nor higher than 250 psi, or as shown on the plans.

7. Duration of test shall be a minimum of two hours. During this time, all pipe, joints, fittings, and equipment shall be observed for apparent leakage.

8. Leakage shall be defined as observed water loss at any point within section of pipe being tested, or as quantity of water that must be supplied to maintain test pressure, ± 5 psi. Leakage shall not be measured by a drop in pressure over time.

9. Allowable leakage, in gallons per hour, per 1,000 feet of ductile iron pipe.

Avg. Test Pressure (psi)	Nominal Pipe Diameter, in. 4	6	8	10	12	14	16	18	20
250	0.47	0.71	0.95	1.19	1.42	1.66	1.90	2.14	2.37
225	0.45	0.68	0.90	1.13	1.35	1.58	1.80	2.03	2.25
200	0.43	0.64	0.85	1.06	1.28	1.48	1.70	1.91	2.12
175	0.40	0.59	0.80	0.99	1.19	1.39	1.59	1.79	1.98
150	0.37	0.55	0.74	0.92	1.10	1.29	1.47	1.66	1.84

10. Allowable leakage, in gallons per hour, per 50 joints of polyvinyl chloride (PVC) pipe.

Avg. Test Pressure (psi)	Nominal Pipe Diameter, in. 2	4	6	8	10	12	14	16	18
250	0.23	0.43	0.64	0.85	1.07	1.28	1.50	1.71	1.92
225	0.22	0.41	0.61	0.81	1.01	1.22	1.42	1.62	1.82
200	0.20	0.38	0.57	0.76	0.96	1.15	1.34	1.53	1.72
175	0.19	0.36	0.54	0.72	0.89	1.07	1.25	1.43	1.61
150	0.17	0.33	0.50	0.66	0.83	0.99	1.16	1.32	1.49

11. All defective materials and workmanship shall be repaired. Also, measured leakage

that exceeds limits specified in the tables in Section 33 shall be cause for Contractor to investigate and correct leaks, in accordance with Contract Documents.

12. Upon completion of corrective measures, the pressure test shall be repeated.

13. This procedure shall be repeated until leakage is within limits cited above. Acceptance shall be based on allowable leakage.

14. Cost of all testing and repairs shall be responsibility of the Contractor, as part of Project.

Additional cost to Owner for engineering and/or inspection services for re-testing shall be responsibility of the Contractor and shall be deducted from contract proceeds.

15. Volume of water required to initially fill new lines for pressure testing will be provided by Owner. If pressure testing fails and leaks are found, any additional water required to refill lines after initial test will need to be purchased by Contractor from Owner.

3.5 DISINFECTION OF WATER MAINS

A. Water mains and accessories shall be disinfected in accordance with AWWA C651. Care shall be taken to minimize entrance of foreign material into pipe, fittings, and valves. The water main shall be flushed prior to disinfection, with sufficient flow to produce a velocity of 2.5 fps. Flushing shall take place in areas with adequate drainage.

Diameter (in.)	**GPM @ 2.5 ft/sec**
6	220
8	392
10	612
12	881
16	1565

B. Chlorine application by approved method shall be made using water from existing distribution system or water supply. Initial chlorine concentration in water to be used shall be a minimum of 50 mg/L free available chlorine. Chlorinated water shall be retained in water main for at least 24 hours, but not more than 72 hours, during which time all valves and hydrants in section treated shall be operated. At end of this period, treated water shall contain no less than 25 mg/L free available chlorine throughout, and final flushing shall follow to insure that chlorine concentration is not higher than that generally prevailing in system, before being used by any customer. Chlorinated water shall not be discharged to any water course or drainageway until it is diluted or reduced to a level which will result in no damage to aquatic life. A dechlorination device detail shall be submitted to the Engineer for approval prior to use.

C. After final flushing and before water main is placed in service, two consecutive samples shall be collected at 24 hours intervals for each 2,000 feet of line. These samples shall be tested for bacteriologic quality by a laboratory approved by Virginia Division of Consolidated Laboratories and shall show absence of coliform organisms. Samples will be collected by Contractor. At its discretion, the Owner may require that it collect

all samples. If initial disinfection fails to produce satisfactory results, water line shall be flushed and disinfection shall be repeated until satisfactory samples have been obtained. Costs associated with flushing, disinfection, and laboratory testing, including repeat applications of the procedures after failure of testing, will be at Contractor's expense. Initial water required for flushing will be provided by Owner at no cost to Contractor.

D. Methods of Application:

1. Continuous feed method - Potable water shall be introduced into the pipe main at a constant flow rate. Chlorine shall be added at a constant rate to this flow so that the chlorine concentration in the water in the pipe is at least 50 mg/L. The chlorinated water shall remain in the main at least 24 hours, after which, the chlorine concentration in the water shall be at least 25 mg/L. All valves and appurtenances shall be operated while the chlorinated water remains in the main.

2. Slug method - Potable water shall be introduced into the main at a constant flow rate. This water shall receive a chlorine dosage which will result in a chlorine concentration of 100 mg/L in a "slug" of the water. The chlorine shall be added long enough to insure that all portions of the main are exposed to the 100 mg/L chlorine solution for at least three hours. The chlorine residual shall be checked at regular intervals not to exceed 2,000 feet to insure that adequate residual is maintained. As the chlorinated water passes valves and appurtenances, they shall be operated to insure disinfection of these appurtenances.

3.6 BACTERIOLOGIC TESTS

A. After final flushing, and before water main is placed in service, a sample or samples shall be collected from end of water line and tested for bacteriologic quality and shall show absence of coliform organisms. At least one set of samples shall be collected at least 24 hours apart, in every 1,200’ section of new water main, plus one set from the end of the line and at least one set from each branch, and tested by a Virginia Division of Consolidated Laboratories. The approved laboratory and results shall be submitted to the Engineer. Test failure shall be followed by repeating disinfection procedure in Section 3.4 of this specification and repeat sampling and testing, until test success. Contractor shall be responsible for collecting all bacteriological samples and having laboratory tests made to determine presence of total coliform bacteria. All costs associated with bacteriologic testing, including re-testing due to test failure, shall be the responsibility of the Contractor.

B. Samples for bacteriological analysis shall be collected in sterile bottles treated with sodium thiosulphate. If laboratory results indicate presence of total coliform bacteria, samples are unsatisfactory and disinfection shall be repeated until samples are satisfactory. The tablet method shall not be used in repeated disinfections. Cleaning and disinfection will be responsibility of Contractor. Water for these operations will be furnished by Owner, but Contractor shall be responsible for loading, hauling and discharging of water.

C. If a corporation stop or other sampling means is not available at required minimum intervals along water line, Contractor shall install, at his own expense, a sampling tap consisting of a corporation cock installed in pipe with a copper goose neck assembly.

D. Testing and disinfection of completed sections shall not relieve Contractor of his responsibility to repair or replace any cracked or defective pipe. All work necessary to secure a tight line shall be done at Contractor's expense.

3.7 BACKFILLING

Refer to Division 31 Section – Earth Moving.

3.8 CLEANUP

A. Contractor shall at all times keep job site clean to satisfaction of Engineer. Surfaces of paved streets shall be "broomed" immediately after backfilling. Surplus materials shall be removed and disposed of from site of work, unless directed otherwise by Engineer. Where material is placed on pavement, a layer of stone dust or sand shall be applied first to facilitate cleanup.

3.9 SEEDING

A. Refer to Division 32 Section – Lawns & Grasses

PART 4 - METHOD OF MEASUREMENT

4.1 The quantity of water piping to be paid for shall be the number of linear feet, placed in accordance with the specifications and accepted by the Engineer. All fittings and connections associated with water piping shall not be measured for payment.

4.2 The quantity of backflow preventers to be paid for shall be the number of each units placed in accordance with the specifications and accepted by the Engineer.

PART 5 - BASIS OF PAYMENT (Payment will be made under the following:)

5.1 WATER PIPING

A. Payment shall be made at the contract unit price per linear foot, which price and payment shall be full compensation for all labor, equipment, tools, and incidentals necessary to complete the work prescribed in this item.

Item 331113-1: 6-inch PE Water Line – per linear foot

5.2 BACKFLOW PREVENTER

A. Payment shall be made at the contract unit price per each as specified below, which price and payment shall be full compensation for all labor, equipment, tools, and incidentals necessary to complete the work prescribed in this item.

Item 331113-2: 3-inch RPZ Backflow Preventer – per each

END OF SECTION 331113

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SECTION 331250 - VALVES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Work Included: Provide complete, in place, and free from leakage, all valves as shown on the plans and in accordance with this Specification. Valves shall be furnished complete with valve operators and accessories for a complete assembly adequate for the specified or indicated purpose. Valve assemblies shall be installed, painted, tested, and adjusted.

B. Related Sections:
1. Section 013300 – Submittals
2. Section 016600 – Delivery, Storage, and Handling
3. Section 330500 – Common Work Results for Utilities
4. Section 331113 – Public Water Utility Distribution Piping

1.3 REFERENCES

A. General: The work shall comply with the most recent standards or tentative standards as published at the date of the contract and as listed in this specification using the abbreviation shown.
1. <u>American National Standard Institute (ANSI):</u>
   a. Z21.22 – Relief Valves and Automatic Gas Shutoff Devices for Hot Water Supply Systems
2. <u>American National Standard Institute (ANSI)/American Society of Sanitary Engineers (ASSE):</u>
   a. 1011 – Hose Connection Vacuum Breakers
   b. 1013 – Reduced Pressure Principle Backflow Preventers
3. <u>American National Standard Institute (ANSI)/American Water Works Association (AWWA):</u>
   a. C500 – Standard for Metal Seated Gate Valves for Water Supply Service
   b. C508 – Standard for Swing-Check Valves for Waterworks Service
   c. C509 – Standard for Resilient-Seated Gate Valves for Water Supply Service
   d. C800 – Standard for Underground Service Line Valves and Fittings
4. <u>American Society for Testing and Material (ASTM):</u>
   a. A126 – Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings

5. National Sanitation Foundation (NSF):
   a. 61 – Standard which states certified NSF products are limited 11 parts per billion (PPB) of lead in water from endpoint devices.

1.4 SUBMITTALS

A. General: Submittals shall be in accordance with Section 013300 – Submittals. Each submittal shall be identified with precise use, line, and location.

B. Shop Drawings: As a minimum, shop plans shall include manufacturer's name, class of materials, catalog, and engineering data showing compliance with the specified requirements.

C. Maintenance Instructions: Submit corrective and preventive maintenance instructions, including recommended spare parts.

1.5 QUALITY ASSURANCE

A. Product Options: Drawings indicate sizes, profiles, and dimensional requirements of valve and specialties and are based on the specific system indicated.

B. Valves shall bear label, stamp, or other markings of specified testing agency.

C. Comply with FM's "Approval Guide" or UL's "Fire Protection Equipment Directory" for fire-service-main products.

D. NFPA Compliance: Comply with NFPA 24 for materials, installations, tests, flushing, and valve and hydrant supervision for fire-service-main piping for fire suppression.

E. NSF Compliance:

   1. Comply with NSF 61 for materials for piping and specialties for domestic water.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Preparation for Transport: Prepare valves according to the following:

   1. Ensure that valves are dry and internally protected against rust and corrosion.
   2. Protect valves against damage to threaded ends and flange faces.
   3. Set valves in best position for handling. Set valves closed to prevent rattling.

B. During Storage: Use precautions for valves according to the following:

   1. Do not remove end protectors unless necessary for inspection; then reinstall for storage.
   2. Protect from weather. Store indoors and maintain temperature higher than ambient dew-point temperature. Support off the ground or pavement in watertight enclosures when outdoor storage is necessary.

C. Handling: Use sling to handle valves if size requires handling by crane or lift. Rig valves to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

D. Deliver piping with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe-end damage and to prevent entrance of dirt, debris, and moisture.

E. Protect stored piping from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor when storing inside.

F. Protect flanges, fittings, and specialties from moisture and dirt.

PART 2 - PRODUCTS

2.1 GENERAL

A. Valves: All valves shall be certified by the National Sanitation Foundation for potable water service (NSF 61) and the same shall be so indicated on the valve.

2.2 PRESSURE RELIEF VALVES

A. The pressure relief valves shall be equal to Cla-Val 50-01 Pressure Relief & Pressure Sustaining Valve as manufactured by Cla-Val Co., Newport Beach, CA 92659-0325, or approved equal. The valve manufacturer shall warrant the valve to be free of defects in material and workmanship for a period of three (3) years from date of shipment. A direct factory representative shall be made available for start-up service, inspection, O&M training, and necessary adjustment.

The pressure relief pilot shall be a direct-acting, adjustable, spring-loaded, diaphragm valve designed to permit flow when controlling pressure exceeds the adjustable spring setting. The pilot control is normally held closed by the force of the compression on the spring above the diaphragm and it opens when the pressure acting on the underside of the diaphragm exceeds the spring setting. Pilot control sensing shall be upstream of the pilot system strainer so accurate control may be maintained if the strainer is partially blocked. The Contractor shall connect the sensing/pilot supply connection to the main header with minimum ¾” pipe or tubing.

A full range of spring settings shall be available in ranges from 0 – 300 psi.

B. The valve manufacturer shall provide a repair kit for the main valve and both pilots as part of the submittal for each valve supplied.

2.3 GATE VALVES

A. Valves shall be either cast iron or ductile iron body, resilient seated with reinforced rubber seat

ring or permanently bonded disc, and machined seating surface, brass or bronze non-rising stems, and complying with AWWA C.509 or C.515. Body shall be self centering or shall have guides for alignment of wedge disc and have internal epoxy coating approved for potable water. Working pressure shall be at least 250 psi and hydrostatically tested to 500 psi for valves 16 inches in diameter and smaller. Valves shall have O-ring seals and open left (counterclockwise) with a 2-inch square wrench nut. Valve ends shall be of mechanical joint type with all bolts, glands, and rubber gaskets furnished in the price of the valve. Valves shall be Mueller A-2360- 20, Kennedy C509, or equal approved by Engineer.

B. All exposed valves are to be operated by a handwheel.

C. Valves located on bypass lines within meter vaults are to have locking mechanisms installed to prevent operation by unauthorized personnel.

2.4 AIR RELEASE VALVES

A. Automatic air release valves shall automatically function to release to the atmosphere small amounts of entrained air, which may accumulate in the pipeline. Once the accumulated air is exhausted, valves shall seat tightly to prevent water leakage. Air release valves shall be 1” for pipe sizes 12” and smaller; valves shall be 2” for pipe sizes larger than 12”. Such valves shall have a working pressure of not less than 250 psi or greater and shall be capable of venting 26 cubic feet per minute at 150 psi. Valves shall be installed in a vault according to the Standard Detail AR-1. Air release valves shall be as manufactured by Cla-Val, Valmatic, Crispin, Bermad, or approved equal.

2.5 SAMPLING TAPS/VALVES

A. The sampling tap shall be plain end spigot faucet, renewable seats, tee handles, polished chrome plated similar to American Standard 4221.024.

2.6 BALL VALVES

A. Ball valves shall be equal to Speedaire industrial quality, two piece forged brass ball valves. The valves shall be minimum 200 p.s.i. rated with reinforced PTFE seats, chrome plated ball for long life, separate pack nut to permit handle removal under pressure and bottom loaded stem for safety. Corrosion resistance steel handle shall be provided with a vinyl grip and 1/4” twin stop for positive control. The valve must meet Federal Spec. WW-V-35.

2.7 PRESSURE REDUCING VALVES

A. The pressure reducing valves shall be equal to Cla-Val 90-01 Pressure Reducing Valve as manufactured by Cla-Val Co., Newport Beach, CA 92659-0325, or approved equal. The valve manufacturer shall warrant the valve to be free of defects in material and workmanship for a period of three (3) years from date of shipment. A direct factory

representative shall be made available for start-up service, inspection, O&M training, and necessary adjustment.

The pressure reducing valve shall maintain a constant downstream pressure regardless of changing flow rate and/or inlet pressure. The pressure reducing pilot shall be a direct-acting, adjustable, spring-loaded, normally open diaphragm control designed to permit flow when controlled pressure is less than the spring setting. The pilot control is held open by the force of the compression on the spring above the diaphragm, and it closes when the delivery pressure acting on the underside of the diaphragm exceeds the spring setting. The pilot control system shall include a fixed orifice. Nor variable orifices shall be permitted. The pilot system shall include an opening speed control on all valves 3” and smaller as standard equipment. The pilot control shall have a second downstream sensing port which can be utilized to install a pressure gauge.

A full range of spring settings shall be available in ranges from 0 – 300 psi. All pressure reducing valves are to have check valve and strainer options included.

B. The valve manufacturer shall provide a repair kit for the main valve and pilot system as part of the submittal for each valve supplied.

2.8 ALTITUDE VALVES

A. General: One-way altitude valves shall function to control the level in a tank without the use of floats or probes in the tank itself. It shall be a one-way flow (single-acting) type, designed to open fully to fill the tank and close completely when the predetermined high level is reached. Sensing of the altitude pilot shall be by means of a field-installed sense line between the pilot and base of the tank. The altitude valve shall be equipped with an indicator assembly. The altitude valve will close when the preset high level has been reached. The valve will remain closed until the level in the tank has dropped to a preset level, at which point the altitude valve will open. The one-way altitude valve shall be sized according to the design plans.

B. Main Valve: The one-way altitude valve shall be a single-seated, line pressure operated, diaphragm actuated, pilot controlled globe valve. The valve shall seal by means of a corrosion-resistant seat and a resilient, rectangular seat disc. These, and other parts, shall be replaceable without removing the valve from the line. The stem of the main valve shall be guided top and bottom by integral bushings. Alignment of the body, bonnet and diaphragm assembly shall be by precision dowel pins. The diaphragm shall not be used as a seating surface, nor shall the pistons be used as an operating means. The pilot system shall be furnished complete and installed on the main valve. It shall include the altitude pilot, a needle valve, Y-strainer and isolation ball valves. The one-way altitude valve shall be operationally and hydrostatically tested prior to shipment.

C. Materials: The main valve body and bonnet shall be ductile iron per ASTM A536, Grade 65-45-12. End connections shall be ANSI B16.42 Class 300# flange. All ferrous surfaces shall be coated with a minimum of 4 mils of an NSF-61 approved epoxy. The main valve ring shall be bronze per ASTM B61. Elastomers (diaphragms, resilient seats and O-rings) shall be Buna-N. The pilot shall be bronze per ASTM B61. The

needle valve and isolation ball valves shall be brass and control line tubing shall be copper.

D. Operating Conditions: One-way altitude valve shall be suitable for a flow of 2,800 gpm, a maximum pressure of 250 psi, and a full tank level of 50 feet.

2.9 PRESSURE MANAGEMENT CONTROL VALVES

A. The pressure management valves shall be equal to Cla-Val 98-06 Hydraulic Pressure Management Control Valve With Hydraulically Dampened Switching Between Dual Set Points as manufactured by Cla-Val Co., Newport Beach, CA 92659-0325, or approved equal. The valve manufacturer shall warrant the valve to be free of defects in material and workmanship for a period of three (3) years from date of shipment. A direct factory representative shall be made available for start-up service, inspection, O&M training, and necessary adjustment.

The pressure management control valve shall be capable of controlling downstream pressure to a low pressure set point or high pressure set point with varying flow rate. As flow increase from a low flow condition to a high flow condition, the regulated outlet pressure shall increase from the low set point pressure to the high set point pressure. The low set point pressure, high set point pressure, and flow (based on valve position) at which pressure increases to the high set point pressure shall be adjustable. The rate of change between the two set points shall be hydraulically damped to gradually increase or decrease pressure to prevent downstream piping system surges.

The valve shall not have an orifice plate or other restriction in the main line as part of the valve control. It shall operate only under hydraulic control without electrical or electronic (powered or battery operated) controls. It shall control downstream pressure to either the low pressure set point or high pressure set point depending on whether the flow is below or above the adjustable switch point.

The pilot system adjustments shall only require simple tools to make changes and allow for changes to be made to the flow switch point without resizing an orifice plate, readjusting a restriction in the line, or reprogramming electronic control. The dual outlet pressure reducing pilot control shall be a direct-acting adjustable, spring loaded, normally open, diaphragm valve designed to permit flow at predetermined pressure set points when controlled pressure is less than the spring setting. The pilot control system shall include separate adjustments for setting the high pressure, low pressure, and flow rate at which pressure increases or decreases between set points. It shall have an integral bias chamber which allows switching between the low and high pressure set points. External bias chambers, either above or below the pilot, shall not be allowed. The pilot control system shall incorporate a stem valve that either blocks or allows upstream pressure into the pressure reducing pilot control bias chamber for switching between high and low set point pressures. The switching between low and high set point pressures shall be hydraulically dampened to prevent downstream pressure surges. Two separate pilot controls with no dampening shall not be allowed. The pressure reducing control shall have an adjustable low pressure setting up to 30 psi below the high pressure set point.

B. The valve manufacturer shall provide a repair kit for the main valve and pilot system as part of the submittal for each valve supplied.

2.10 COMBINATION PRESSURE REDUCING & PRESSURE SUSTAINING VALVES

A. The pressure reducing/pressure sustaining valves shall be equal to Cla-Val 92-01 Combination Pressure Reducing & Pressure Sustaining Valve as manufactured by Cla-Val Co., Newport Beach, CA 92659-0325, or approved equal. The valve manufacturer shall warrant the valve to be free of defects in material and workmanship for a period of three (3) years from date of shipment. A direct factory representative shall be made available for start-up service, inspection, O&M training, and necessary adjustment.

The combination valve shall maintain a constant downstream pressure regardless of changing flow rate and/or inlet pressure. When the upstream pressure becomes equal to the spring setting of the pressure sustaining control, the valve throttles to maintain a constant inlet pressure.

The pressure reducing pilot control shall be a direct-acting, adjustable, spring-loaded, normally open, diaphragm valve designed to permit flow when controlled pressure is less than the spring setting. The pilot control is held open by the force of the compression on the spring above the diaphragm and it closes when the delivery pressure acting on the underside of the diaphragm exceeds the spring setting. The pilot control system shall include a fixed orifice. No variable orifices shall be permitted. The pilot system shall include an opening speed control as standard equipment. The pilot control shall have a second downstream sensing port which can be utilized to install a pressure gauge.

The pressure sustaining pilot control shall be a direct-acting adjustable spring loaded control which opens when upstream pressure exceeds the spring setting on the pilot. The pilot control system shall include an X44A strainer & orifice assembly.

A full range of spring settings shall be available in ranges of 0 – 300 psi. All valves are to have a check valve option included.

B. The valve manufacturer shall provide a repair kit for the main valve and pilot system as part of the submittal for each valve supplied.

PART 3 - EXECUTION

3.1 INSPECTION

A. General: Examine the areas and conditions under which Work of this Section will be performed. Correct conditions detrimental to proper and timely completion of work. Do not proceed until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Valves shall be cleaned to remove all dirt or other foreign material. Valve installation shall comply with project details and the manufacturer's recommendations.

B. Valves: Before installation, clean valves to remove all dirt or other foreign materials.

C. Stems: Shall be oriented for accessibility as approved by the Engineer. Do not install valves with stems in the downward direction.

D. Setting of Valves: A valve box shall be provided for every valve. The valve box shall not transmit shock or stress to the valve and shall be centered and plumb over the valve, with the cover flush with the surface of the finished grade or as directed by the Engineer.

E. Transmitting Forces: Valves and valve boxes shall be installed so no forces are transmitted to the valve through the piping or valve boxes.

F. Flushing: All valves and appurtenances shall be flushed clear of all foreign material after installation.

G. Calibration: Contractor shall furnish the services of factory authorized service engineer to instruct and check out the calibration of all control valves.

H. Testing: Field test all valves and appurtenances for proper operation, proper adjustments and settings, freedom from vibration, binding, scrapings, and other defects. Check all valve supports for strength and high quality workmanship. All defects shall be corrected to the satisfaction of the Owner. Hydrostatic and leakage tests shall be in accordance with Section 331113 – Utility Distribution Piping.
   1. The Contractor shall arrange for the equipment manufacturer to furnish the services of a qualified field service representative for testing.
   2. For each valve, the representative shall inspect the installation and supervise startup, field testing, and initial operation of not less than one day and instruct the Owner in proper operation, maintenance, and repair procedures for not less than one day.

END OF SECTION 331250

SECTION 333000-SANITARY SEWERAGE UTILITIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section

1.2 SUMMARY

A. This Section includes gravity-flow, nonpressure and force-main, pressure sanitary sewerage outside the building, with the following components:

1. Special fittings for expansion and deflection.
2. Cleanouts.
3. Corrosion-protection piping encasement.
4. Pre-cast concrete manholes.

B. Related sections include the following:
1. Section 312000 – “Earth Moving”
2. Section 315000 – “Excavation, Support, and Protection”

1.3 DEFINITIONS

A. PVC: Polyvinyl chloride plastic.

1.4 SUBMITTALS

A. Product Data: For the following:

1. Pipe.
2. Pipe fittings
3. Pre-cast concrete manholes, including frame and cover.
4. Cast-in-place concrete manholes & other structures, including frame and cover.

B. Shop Drawings: For the following:

1. Each class of cast-in-place concrete.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Do not store plastic manholes, pipe, and fittings in direct sunlight.

B. Protect pipe, pipe fittings, and seals from dirt and damage.

C. Handle manholes according to manufacturer's written rigging instructions.

1.6 PROJECT CONDITIONS

A. Interruption of Existing Sanitary Sewerage Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:

1. Notify Construction Manager & Owner no fewer than 30 days in advance of proposed interruption of service.
2. Do not proceed with interruption of service without Construction Manager' & Owner's written permission.

B. Utility Maintenance and Coordination

1. Before the work is started, the contractor shall notify all companies, corporations, municipalities and individuals who own utilities on the construction site, in the right of way or immediately adjacent to the construction area of the work to be performed. The contractor shall arrange to have the various utilities located and identified according to the respective utility owner’s records and shall propose a method of protection to the respective owner for approval. Any cost incurred with removing, relocating, or repairing utilities shall be borne by the contractor unless indicated otherwise.
2. The location of existing utilities shown on the drawings was taken in part from existing records, proposed alignments and elevations from field surveys, and may not represent exact locations. The contractor shall excavate to locate buried utilities far enough in advance of laying pipe to allow for adjustments in pipe laying both horizontally and vertically. When the work is approaching an existing utility or structure that may be in conflict with, or connected to, the work, the Contractor shall excavate test pits to verify the location, size, and elevation of the existing utility or structure. By taking the precaution the Contractor may adjust the work or have the existing utility relocated as necessary. Failure to take such precautions may result in the Contractor adjusting the work or having the existing utility relocated, at his expense.
3. The following procedure shall be exercised when excavating to locate existing utilities.

   a. Contractor shall clear proposed utility alignment of site obstruction such as pavement, curb & gutter and any physical objects as shown on the plans. It shall be the contractor’s responsibility to maintain and/or re-establish the existing utility markings upon completion of demolition activities.
   b. Upon removal of impervious areas and other obstructions along the proposed alignment the contractor shall identify the type of utility crossing

and determine the appropriate probing equipment to sufficiently protect the existing utility from damage.

c. Contractor shall probe along the proposed utility alignment for a horizontal length of not less than 5 feet on each side of the existing utility.

4. The Contractor shall maintain the drainage structures, culverts and flows at all times during the work. The Contractor shall pay for all personal injury and all property damage which occurs as a result of failing to facilitate drainage.
5. The Contractor shall repair or replace any existing storm water, sanitary sewer or water distribution utility damaged or misaligned during or due to the work. All other utilities shall be repaired or replaced by the respective Utility Company(s) at the expense of the Contractor.
6. The Contractor shall coordinate all work within the vicinity of the existing utilities with the respective Utility Company. The work shall be conducted in a manner to avoid unnecessary service interruption and in accordance with the rules and regulations of the respective Utility Company.

1.7 PROJECT CONDITIONS

A. Separation of Water Lines and Sanitary Sewer Lines: Follow the VDH and DEQ standards for separation of water mains and sanitary sewer lines.

1. Parallel Installation
   a. Normal Conditions – Water lines shall be constructed at least 10 feet horizontally from a sewer or sewer manhole. The distance shall be measured edge-to-edge.
   b. Unusual Conditions – When local conditions prevent a horizontal separation of at least 10 feet, the water line may be laid closer to a sewer or sanitary sewer manhole provide that the bottom (invert) of the water line is at least 18 inches above the top (crown) of the sewer. When this separation cannot be obtained, the sewer shall be constructed of AWWA approved Ductile Iron Pipe pressure tested in place without leakage prior to backfilling. The sewer manhole shall be of watertight construction tested in place.
2. Crossings
   a. Normal Conditions – Water lines crossing over sewers shall be laid to provide at least 18 inches between the bottom of the water line and top of the sewer whenever possible.
   b. Unusual Conditions – When local conditions prevent a vertical separation described above, the following procedures shall be used.
      <u>Sewers under water lines</u> shall be constructed of the materials described above under Parallel Installation, Unusual Conditions.
      <u>Water Lines Under Sewers</u> shall be additionally protected by (1) a vertical separation of at least 18 inches between the bottom of the sewer and top of the water line (2) adequate structural support for the sewers to prevent excessive deflection of the joints and settling on and breaking of the water line (3) that the length of the water line be centered at the point of the crossing so that joints shall be equal distant and as afar as possible from the sewer.

B. Separation of Wells: No sewer shall pass within 50 feet of a drinking water supply well, source or structure unless special construction and pipe materials are used to obtain adequate protection.

PART 2 - PRODUCTS

2.1 GRAVITY SEWER

A. Polyvinyl Chloride (PVC) Pipe: PVC pipe shall be SDR 35 furnished in 20-foot nominal lengths, conforming to ASTM Specification D.3034.

B. Ductile Iron (DI) Pipe: Ductile iron pipe shall be centrifugally cast in accordance with AWWA C.151. Pipe. Unless noted otherwise, pipe sizes 12 inches and smaller shall be Thickness Class 50, pipe sizes greater than 12 inches shall be Pressure Class 350. Pipe shall be in nominal 18-foot or 20-foot lengths and joints shall be push-on in compliance with AWWA C.111 and be cement lined in accordance with AWWA C.104.

2.2 FORCEMAIN PIPING

A. Polyvinyl chloride (PVC) pipe: shall be made from clean, virgin, PVC compound conforming to ASTM D 1784, and meet the following requirements. Pipe shall be SDR 14 bell and spigot pressure pipe, conforming to AWWA C900 Standard, rated at 200 psi working pressure, unless otherwise shown on the plans.

B. Ductile Iron (DI) Pipe: Ductile iron pipe shall be centrifugally cast in accordance with AWWA C.151. Pipe. Unless noted otherwise, pipe sizes 12 inches and smaller shall be Thickness Class 50, pipe sizes greater than 12 inches shall be Pressure Class 350. Pipe shall be in nominal 18-foot or 20-foot lengths and joints shall be push-on in compliance with AWWA C.111 and be cement lined in accordance with AWWA C.104

2.3 FITTINGS

A. Tees or wyes installed shall be the same type as the main gravity sewer pipe. Plugs or caps used shall be those manufactured specifically for the type of pipe used. They shall be secured such that they will be watertight and will withstand the internal pressure applied by air or exfiltration testing. Pressure pipe fittings shall be cast or ductile iron in compliance with AWWA C.110 or C.153 and AWWA C.104. The proper adapter and/or transition gasket shall be supplied with PVC pressure pipe. Pipe ends shall be prepared for installation in accordance with the manufacturer's directions.

2.4 JOINTS

A. Ductile Iron Joints: Jointing material for mechanical or slip-on joints in ductile iron pipe shall conform to the requirements of AWWA C.111. Where sewer pipe is

installed in casing, locked gaskets or restrained joints such as “Mega-Lug”, “AquaGrip” or “Lock Tyton” shall be used

B. Polyvinyl Chloride Pipe Joints: PVC piping joints shall be the gasket, push-on type, such as “Ring-Tite” or equal unless otherwise indicated. Joint assembly shall be made according to the manufacturer’s directions and shall comply with the guidelines for installation of PVC pipe as developed by the Uni-Bell Plastic Pipe Association. PVC pipe joints with cast iron fittings shall be installed in accordance with manufacturer’s directions in compliance with these specifications. Integral bells shall be required. Where sewer pipe is installed in casing, locked gaskets or restrained joints such as “Mega-Lug”, “AquaGrip” or “Lock Tyton” shall be used. Alternately, Yellowmine with restrained joints may be used at road crossings in steel casing

C. Pipe Couplings: Watertight, semi-flexible couplings for connection different types of sewer pipe, or plain ends, shall be FERNCO Series 1000 with #305 stainless steel clamps or approved equal.

2.5 MANHOLES

A. Normal Traffic Precast Concrete Manholes: ASTM C 478, precast, reinforced concrete, of depth indicated, with provision for sealant joints. All precast manholes shall be certified to be VDOT compliant.

1. Diameter: 48 inches minimum, unless otherwise indicated.
2. Ballast: Increase thickness of precast concrete sections or add concrete to base section, as required to prevent flotation.
3. Base Section: 6-inch minimum thickness for floor slab and 4-inch minimum thickness for walls and base riser section, and having separate base slab or base section with integral floor.
4. Riser Sections: 6-inch minimum thickness, and of length to provide depth indicated.
5. Top Section: Eccentric-cone type, unless concentric-cone or flat-slab-top type is indicated. Top of cone of size that matches grade rings.
6. Joint Sealant: ASTM C 990, bitumen or butyl rubber.
7. Resilient Pipe Connectors: ASTM C 923 cast or fitted into manhole walls, for each pipe connection.
8. Steps: All manholes shall have steps conforming to ASTM C478.
9. Grade Rings: Reinforced-concrete rings, 6- to 9-inch total thickness, to match diameter of manhole frame and cover.

2.6 FRAME & COVER

A. Standard Frame and Cover: Standard Frames and Covers: Manhole frames and covers shall be manufactured from class 30 gray iron, meeting the requirements of ASTM A48, Standard Specification for Gray Iron Castings and certified to be VDOT compliant. Standard manhole frames and covers shall be manufactured to the dimensions and configurations shown on Standard Details. The bearing surface of the frames and covers shall be machined and the cover shall seat firmly into the frame without rocking. Covers are to be embossed along the perimeter with the words “Sanitary Sewer”. Acceptable castings are the US Foundry 710 ring and DP

cover, East Jordon Iron Works 2027 frame and cover, or approved equal. All castings are to be USA made.

B. Flat Top Manhole: Standard Frames and Covers: Manhole frames and covers shall be manufactured from class 30 gray iron, meeting the requirements of ASTM A48, Standard Specification for Gray Iron Castings. Standard manhole frames and covers shall be manufactured to the dimensions and configurations shown on Standard Details. The bearing surface of the frames and covers shall be machined and the cover shall seat firmly into the frame without rocking. Covers are to be embossed along the perimeter with the words “Sanitary Sewer”. Acceptable castings are Vulcan V-1883 or approved equal.

C. Water Proof : Standard Frames and Covers: Manhole frames and covers shall be manufactured from class 30 gray iron, meeting the requirements of ASTM A48, Standard Specification for Gray Iron Castings. Standard manhole frames and covers shall be manufactured to the dimensions and configurations shown on Standard Details. The bearing surface of the frames and covers shall be machined and the cover shall seat firmly into the frame without rocking. Covers are to be embossed along the perimeter with the words “Sanitary Sewer”. Acceptable castings are Capitol Foundry MH-3000-WT/C or approved equal.

2.7 MARKING TAPE

A. Marking tape shall be required on all pipelines. Detectable mylar marking tape shall be similar to Lineguard, Inc. utility marking tape, Type II or equal. The tape shall bear the printed identification “CAUTION: SEWER LINE BELOW”. The printing shall be under mylar (reverse printed) so as to be readable through the clear mylar. Surface painting on the tape is not acceptable. The tape shall comply with the color coding of the Underground Utilities Damage Prevention Act.

2.8 VALVES

A. Plug Valves: provide eccentric plug valves that are cast iron or ductile iron body, resilient seated as per ASTM D2000-BG and AWWA C517 suitable for wastewater service. Working pressure shall be at least 250-psi and have a minimum of 85 percent full port opening. Valves shall have cast iron valve boxes and operate with a two-inch square wrench nut. Plug valves shall be quarter-turn, non-lubricated with a resilient encapsulated plug. Plug valves 4-inches and larger shall include a totally enclosed and sealed worm gear actuator with position indicator and externally adjustable open and close stops. Exposed valves shall be operated with a hand wheel or lever operator. Buried service actuators shall be packed with grease and sealed for temporary submergence to 20 feet of water. Exposed worm shafts shall be stainless steel. Valve ends shall be mechanical joint or flanged as indicated on the drawings. Valves exterior shall be coated with an epoxy coating. Valves shall be Val-Matic Series # 5800R (Flanged) and 5900R (Mechanical Joint), Dezurik PEC, or equal.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Excavating, trenching, and backfilling are specified in Section 312333.

3.2 PIPING APPLICATIONS

A. Pipe couplings and special pipe fittings with pressure ratings at least equal to piping rating may be used in applications below, unless otherwise indicated.

1. Use watertight joints to join gravity-flow, sewer piping.
2. Use pressure-type pipe couplings for force-main joints.
3. Refer to part 2 of this section for detailed specifications for pipe & fitting products. Use pipe, fittings, and joining methods according to applications indicated.

3.3 PIPING AND JOINT CONSTRUCTION AND INSTALLATION

A. General Locations and Arrangements: Drawing plans and details indicate general location and arrangement of underground sanitary sewerage piping. Location and arrangement of piping layout take design considerations into account. Install piping as indicated, to extent practical. Where specific installation is not indicated, follow piping manufacturer's written instructions.

B. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for using lubricants, cements, and other installation requirements.

C. Install manholes for changes in direction, unless fittings are indicated. Use fittings for branch connections, unless direct tap into existing sewer is indicated.

D. Install proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.

E. Tunneling: Install pipe under streets or other obstructions that cannot be disturbed by tunneling, jacking, or combination of both.

F. Install gravity-flow, drainage piping according to the following:

1. Install piping pitched down in direction of flow, at indicated slope.
2. Install piping with 36-inch minimum cover.

G. Install force-main, pressure piping according to the following:

1. Install piping with restrained joints at tee fittings and at horizontal and vertical changes in direction. Use corrosion-resistant rods, pipe or fitting

manufacturer's proprietary restraint system, or cast-in-place-concrete supports or anchors.
2. Install piping with 36-inch minimum cover.
3. Install PVC pressure piping according AWWA M23 or ASTM D 2774 and ASTM F 1668.

3.4 MANHOLE INSTALLATION

A. General: Install manholes complete with appurtenances and accessories indicated.

B. Install precast concrete manhole sections with sealants according to ASTM C 891.

C. Construct cast-in-place manholes as indicated.

D. Form continuous concrete channels and benches between inlets and outlet.

E. Set tops of frames and covers flush with finished surface of manholes that occur in pavements. Set tops 3 inches above finished surface elsewhere, unless otherwise indicated.

F. Install manhole cover inserts in frame and immediately below cover.

3.5 CLEANOUT INSTALLATION

A. Install cleanouts and riser extensions from sewer pipes to cleanouts at grade. Install piping so cleanouts open in direction of flow in sewer pipe.

1. Use light-duty, top-loading classification cleanouts in earth or unpaved foot-traffic areas.

B. Set cleanout frames and covers in earth in cast-in-place-concrete block, 18 by 18 by 12 inches deep. Set with tops 1 inch above surrounding grade.

3.6 CONNECTIONS

A. Connect nonpressure, gravity-flow drainage piping to existing building's sanitary drains.

B. Connect force-main piping to existing sanitary force mains.

C. Make connections to existing piping and underground manholes.

1. Use commercially manufactured wye fittings for piping branch connections. Remove section of existing pipe, install wye fitting into existing piping, and encase entire wye fitting plus 6-inch overlap with not less than 6 inches of concrete with 28-day compressive strength of 3000 psi.
2. Make branch connections from side into existing piping, NPS 4 to NPS 20. Remove section of existing pipe, install wye fitting into existing piping, and

encase entire wye with not less than 6 inches) of concrete with 28-day compressive strength of 3000 psi).

3. Make branch connections from side into existing piping, NPS 21 or larger, or to underground manholes by cutting opening into existing unit large enough to allow 3 inches of concrete to be packed around entering connection. Cut end of connection pipe passing through pipe or structure wall to conform to shape of and be flush with inside wall unless otherwise indicated. On outside of pipe or manhole wall, encase entering connection in 6 inches of concrete for minimum length of 12 inches to provide additional support of collar from connection to undisturbed ground.

    a. Use concrete that will attain a minimum 28-day compressive strength of 3000 psi unless otherwise indicated.
    b. Use epoxy-bonding compound as interface between new and existing concrete and piping materials.

4. Protect existing piping and manholes to prevent concrete or debris from entering while making tap connections. Remove debris or other extraneous material that may accumulate.

3.7 CLOSING ABANDONED SANITARY SEWERAGE SYSTEMS

A. Abandoned Piping: Close open ends of abandoned underground piping indicated to remain in place. Include closures strong enough to withstand hydrostatic and earth pressures that may result after ends of abandoned piping have been closed. Use either procedure below:

    1. Close open ends of piping with at least 8-inch thick, brick masonry bulkheads.
    2. Close open ends of piping with threaded metal caps, plastic plugs, or other acceptable methods suitable for size and type of material being closed. Do not use wood plugs.

B. Abandoned Manholes: Excavate around manhole as required and use either procedure below:

    1. Remove manhole and close open ends of remaining piping.
    2. Remove top of manhole down to at least 36 inches below final grade. Fill to within 12 inches of top with stone, rubble, gravel, or compacted dirt. Fill to top with concrete.

C. Backfill to grade according to Section 312000 Earth Moving.

3.8 FIELD QUALITY CONTROL

A. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches of backfill is in place, and again at completion of Project.

    1. Submit separate report for each system inspection.

2. Defects requiring correction include the following:
   1) Alignment: Less than full diameter of inside of pipe is visible between structures.
   2) Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.
   3) Crushed, broken, cracked, or otherwise damaged piping.
   4) Infiltration: Water leakage into piping.
   5) Exfiltration: Water leakage from or around piping.

3. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.
4. Reinspect and repeat procedure until results are satisfactory.

B. Test new piping systems, and parts of existing systems that have been altered, extended, or repaired, for leaks and defects.

1. Do not enclose, cover, or put into service before inspection and approval.
2. Test completed piping systems according to requirements of authorities having jurisdiction.
3. Schedule tests and inspections by authorities having jurisdiction with at least 24 hours' advance notice.
4. Submit separate report for each test.
5. Hydrostatic Tests: Test sanitary sewerage according to requirements of authorities having jurisdiction and the following:

a. Allowable leakage is maximum of 50 gallons per inch of nominal pipe size per mile of pipe, during 24-hour period.
b. Close openings in system and fill with water.
c. Purge air and refill with water.
d. Disconnect water supply.
e. Test and inspect joints for leaks.
f. Option: Test ductile-iron piping according to AWWA C600. Use test pressure of at least 10 psig.

6. Air Tests: Test sanitary sewerage according to requirements of authorities having jurisdiction, UNI-B-6, and the following:

a. Option: Test plastic gravity sewer piping according to ASTM F 1417.

7. Force Main: Perform hydrostatic test after thrust blocks, supports, and anchors have hardened. Test at pressure not less than 1-1/2 times the maximum system operating pressure, but not less than 150 psig.

a. Ductile-Iron Piping: Test according to AWWA C600.
b. PVC Piping: Test according to AWWA M23.

8. Manholes: Perform hydraulic test according to ASTM C 969.

C. Leaks and loss in test pressure constitute defects that must be repaired.

D. Replace leaking piping using new materials, and repeat testing until leakage is within allowances specified.

3.9 CLEANING

A. Clean interior of piping of dirt and superfluous material. Flush with potable water.

PART 4 - METHOD OF MEASUREMENT

4.1 The quantity of sanitary sewer piping to be paid for shall be the number of linear feet, placed in accordance with the specifications and accepted by the Engineer. All fittings and connectors associated with sanitary sewer piping shall not be measured for payment.

PART 5 - BASIS OF PAYMENT (Payment will be made under the following:)

5.1 SANITARY SEWER PIPING

A. Payment shall be made at the contract unit price per each, which price and payment shall be full compensation for all labor, equipment, tools, and incidentals necessary to complete the work prescribed in this item.

Item 333000-1: 4-inch Sanitary Sewer Line – per linear foot

END OF SECTION

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SECTION 334100 - STORM UTILITY DRAINAGE PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Pipe and fittings.
2. Expansion joints and deflection fittings.
3. Backwater valves.
4. Cleanouts.
5. Drains.
6. Encasement for piping.
7. Manholes.
8. Stormwater inlets.
9. Pipe outlets.

1.3 DEFINITIONS

A. FRP: Fiberglass-reinforced plastic.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings:

1. Manholes: Include plans, elevations, sections, details, frames, and covers.
2. Stormwater inlets: Include plans, elevations, sections, details, frames, covers, and grates.
3. Stormwater Detention Structures: Include plans, elevations, sections, details, frames, covers, design calculations, and concrete design-mix reports.

C. Coordination Drawings: Show pipe sizes, locations, and elevations. Show other piping in same trench and clearances from storm drainage system piping. Indicate interface and spatial relationship between manholes, piping, and proximate structures.

D. Profile Drawings: Show system piping in elevation. Draw profiles at horizontal scale of not less than 1 inch equals 50 feet (1:50) and vertical scale of not less than 1 inch

equals 5 feet (1:50). Indicate manholes and piping. Show types, sizes, materials, and elevations of other utilities crossing system piping.

E. Product Certificates: For each type of cast-iron soil pipe and fitting, from manufacturer.

F. Field quality-control reports.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Protect pipe, pipe fittings, and seals from dirt and damage.

B. Handle manholes according to manufacturer's written rigging instructions.

C. Handle stormwater inlets according to manufacturer's written rigging instructions.

1.6 PROJECT CONDITIONS

A. Interruption of Existing Storm Drainage Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:

1. Notify Owner no fewer than two days in advance of proposed interruption of service.
2. Do not proceed with interruption of service without Owner's written permission.

PART 2 - PRODUCTS

2.1 PVC PIPE AND FITTINGS

A. PVC Profile Sewer Piping:

1. Pipe: ASTM F 794, PVC profile, gravity sewer pipe with bell-and-spigot ends for gasketed joints.
2. Fittings: ASTM D 3034, PVC with bell ends.
3. Gaskets: ASTM F 477, elastomeric seals.

B. PVC Water-Service Piping:

1. Pipe: ASTM D 1785, Schedule 40 PVC, with plain ends for solvent-cemented joints.
2. Fittings: ASTM D 2466, Schedule 40 PVC, socket type.

2.2 CONCRETE PIPE AND FITTINGS

A. Reinforced-Concrete Sewer Pipe and Fittings: ASTM C 76 (ASTM C 76M).

1. Bell-and-spigot or tongue-and-groove ends and gasketed joints with ASTM C 443 (ASTM C 443M), rubber gaskets.
2. Class III, Wall B.
3. Class IV, Wall B.
4. Class V, Wall B.

2.3 PE PIPE AND FITTINGS

A. Corrugated PE Drainage Pipe and Fittings NPS 12 to NPS 36: AASHTO M 252M, Type S, For NPS 42-48 AASHTO MP-94, type pipe shall have smooth interior and corrugated exterior with smooth waterway for coupling joints.

1. Silttight Couplings: PE sleeve with ASTM D 1056, Type 2, Class A, Grade 2 gasket material that mates with tube and fittings.

2.4 EXPANSION JOINTS AND DEFLECTION FITTINGS

A. Ductile-Iron Flexible Expansion Joints:

1. Manufacturers: Subject to compliance with requirements.
2. Basis-of-Design Product: Subject to compliance with requirements, provide Ductile-Iron Flexible Expansion Joint as indicated on the Drawings or comparable product by one of the following:

   a. EBAA Iron Sales, Inc.
   b. Romac Industries, Inc.
   c. Star Pipe Products.

3. Description: Compound fitting with combination of flanged and mechanical-joint ends complying with AWWA C110 or AWWA C153. Include two gasketed ball-joint sections and one or more gasketed sleeve sections, rated for 250-psig (1725-kPa) minimum working pressure and for offset and expansion indicated.

B. Ductile-Iron Expansion Joints:

1. Manufacturers: Subject to compliance with requirements.
2. Basis-of-Design Product: Subject to compliance with requirements, provide Ductile-Iron Expansion Joint as indicated on the Drawings or comparable product by one of the following:

   a. Dresser, Inc.
   b. EBAA Iron Sales, Inc.
   c. JCM Industries, Inc.
   d. Smith-Blair, Inc.; a Sensus company.

3. Description: Three-piece assembly of telescoping sleeve with gaskets and restrained-type, ductile-iron, bell-and-spigot end sections complying with AWWA C110 or AWWA C153. Include rating for 250-psig (1725-kPa) minimum working pressure and for expansion indicated.

C. Ductile-Iron Deflection Fittings:

1. Manufacturers: Subject to compliance with requirements.
2. Basis-of-Design Product: Subject to compliance with requirements, provide Ductile-Iron Deflection Fittings as indicated on the Drawings or comparable product by one of the following:

   a. EBAA Iron Sales, Inc.

3. Description: Compound-coupling fitting, with ball joint, flexing section, gaskets, and restrained-joint ends, complying with AWWA C110 or AWWA C153. Include rating for 250-psig (1725-kPa) minimum working pressure and for up to 15 degrees of deflection.

2.5 BACKWATER VALVES

A. Cast-Iron Backwater Valves:
1. Manufacturers: Subject to compliance with requirements.
2. Basis-of-Design Product: Subject to compliance with requirements, provide Backwater Valve as indicated on the drawings or comparable product by one of the following:
   a. Josam Company.
   b. Smith, Jay R. Mfg. Co.
   c. Tyler Pipe.
   d. Watts Water Technologies, Inc.
   e. Zurn Specification Drainage Operation; Zurn Plumbing Products Group.
3. Description: ASME A112.14.1, gray-iron body and bolted cover, with bronze seat.
4. Horizontal type; with swing check valve and hub-and-spigot ends.
5. Combination horizontal and manual gate-valve type; with swing check valve, integral gate valve, and hub-and-spigot ends.
6. Terminal type; with bronze seat, swing check valve, and hub inlet.

2.6 CLEANOUTS

A. Plastic Cleanouts:

1. Manufacturers: Subject to compliance with requirements.
2. Basis-of-Design Product: Subject to compliance with requirements, provide Plastic Cleanout as indicated on the Drawings or comparable product by one of the following:

   a. Canplas LLC.
   b. IPS Corporation.
   c. NDS Inc.
   d. Plastic Oddities; a division of Diverse Corporate Technologies, Inc.
   e. Sioux Chief Manufacturing Company, Inc.
   f. Zurn Light Commercial Products Operation; Zurn Plumbing Products Group.

3. Description: PVC body with PVC threaded plug. Include PVC sewer pipe fitting and riser to cleanout of same material as sewer piping.

2.7 DRAINS

A. Cast-Iron Trench Drains:

1. Manufacturers: Subject to compliance with requirements.
2. Basis-of-Design Product: Subject to compliance with requirements, provide Cast-Iron Trench Drain as indicated on the Drawings or comparable product by one of the following:

   a. Josam Company.
   b. MIFAB, Inc.
   c. Smith, Jay R. Mfg. Co.
   d. Tyler Pipe.
   e. Watts Water Technologies, Inc.
   f. Zurn Specification Drainage Operation; Zurn Plumbing Products Group.

3. Description: ASME A112.6.3, 6-inch- wide top surface, rectangular body with anchor flange or other anchoring device, and rectangular secured grate. Include units of total length indicated and quantity of bottom outlets with inside calk or spigot connections, of sizes indicated.
4. Top-Loading Classification(s): Heavy Duty.

2.8 MANHOLES

A. Standard Precast Concrete Manholes:

1. Description: ASTM C 478, precast, reinforced concrete, of depth indicated, with provision for sealant joints.
2. Diameter: 48 inches minimum unless otherwise indicated.
3. Ballast: Increase thickness of precast concrete sections or add concrete to base section as required to prevent flotation.
4. Base Section: 6-inch minimum thickness for floor slab and 4-inch minimum thickness for walls and base riser section, and separate base slab or base section with integral floor.
5. Riser Sections: 4-inch minimum thickness, and lengths to provide depth indicated.
6. Top Section: Eccentric-cone type unless concentric-cone or flat-slab-top type is indicated, and top of cone of size that matches grade rings.
7. Joint Sealant: ASTM C 990, bitumen or butyl rubber.
8. Resilient Pipe Connectors: ASTM C 923, cast or fitted into manhole walls, for each pipe connection.
9. Steps: Individual FRP steps; FRP ladder; or ASTM A 615/A 615M, deformed, 1/2-inch steel reinforcing rods encased in ASTM D 4101, PP, wide enough to allow worker to place both feet on one step and designed to prevent lateral slippage off step. Cast or anchor steps into sidewalls at 12- to 16-inch intervals.

Omit steps if total depth from floor of manhole to finished grade is less than 60 inches .

10. Adjusting Rings: Interlocking HDPE rings with level or sloped edge in thickness and diameter matching manhole frame and cover, and of height required to adjust manhole frame and cover to indicated elevation and slope. Include sealant recommended by ring manufacturer.
11. Grade Rings: Reinforced-concrete rings, 6- to 9-inch total thickness, to match diameter of manhole frame and cover, and height as required to adjust manhole frame and cover to indicated elevation and slope.

B. Manhole Frames and Covers:

1. Description: Ferrous; 24-inch ID by 7- to 9-inch riser with 4-inch- minimum width flange and 26-inch- diameter cover. Include indented top design with lettering cast into cover, using wording equivalent to "STORM SEWER."
2. Material: ASTM A 536, Grade 60-40-18 ductile iron unless otherwise indicated.

2.9 CONCRETE

A. General: Cast-in-place concrete according to ACI 318, ACI 350/350R (ACI 350M/350RM), and the following:

1. Cement: ASTM C 150, Type II.
2. Fine Aggregate: ASTM C 33, sand.
3. Coarse Aggregate: ASTM C 33, crushed gravel.
4. Water: Potable.

B. Portland Cement Design Mix: 4000 psi minimum, with 0.45 maximum water/cementitious materials ratio.

1. Reinforcing Fabric: ASTM A 185/A 185M, steel, welded wire fabric, plain.
2. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 deformed steel.

2.10 STORMWATER INLETS

A. Curb Inlets: Made with vertical curb opening, of materials and dimensions according to utility standards.

B. Gutter Inlets: Made with horizontal gutter opening, of materials and dimensions according to utility standards. Include heavy-duty frames and grates.

C. Combination Inlets: Made with vertical curb and horizontal gutter openings, of materials and dimensions according to utility standards. Include heavy-duty frames and grates.

D. Frames and Grates: Heavy duty, according to utility standards.

2.11 PIPE OUTLETS

A. Head Walls: Cast-in-place reinforced concrete, with apron and tapered sides.

B. Riprap Basins: Broken, irregularly sized and shaped, graded stone according to NSSGA's "Quarried Stone for Erosion and Sediment Control."

1. Average Size: NSSGA No. R-3, screen opening 2 inches (51 mm).
2. Average Size: NSSGA No. R-4, screen opening 3 inches.
3. Average Size: NSSGA No. R-5, screen opening 5 inches.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Excavation, trenching, and backfilling are specified in Division 31 Section "Earth Moving."

3.2 PIPING INSTALLATION

A. General Locations and Arrangements: Drawing plans and details indicate general location and arrangement of underground storm drainage piping. Location and arrangement of piping layout take into account design considerations. Install piping as indicated, to extent practical. Where specific installation is not indicated, follow piping manufacturer's written instructions.

B. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements.

C. Install manholes for changes in direction unless fittings are indicated. Use fittings for branch connections unless direct tap into existing sewer is indicated.

D. Install proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.

E. When installing pipe under streets or other obstructions that cannot be disturbed, use pipe-jacking process of microtunneling.

F. Install gravity-flow, nonpressure drainage piping according to the following:

1. Install piping pitched down in direction of flow.
2. Install piping NPS 6 and larger with restrained joints at tee fittings and at changes in direction. Use corrosion-resistant rods, pipe or fitting manufacturer's proprietary restraint system, or cast-in-place concrete supports or anchors.
3. Install piping with 24-inch minimum cover.

4. Install PE corrugated sewer piping according to ASTM D 2321.
5. Install PVC sewer piping according to ASTM D 2321 and ASTM F 1668.
6. Install PVC water-service piping according to ASTM D 2321 and ASTM F 1668.
7. Install reinforced-concrete sewer piping according to ASTM C 1479 and ACPA's "Concrete Pipe Installation Manual."

3.3 PIPE JOINT CONSTRUCTION

A. Join gravity-flow, nonpressure drainage piping according to the following:

1. Join corrugated PE piping according to ASTM D 3212 for push-on joints.
2. Join PVC sewer piping according to ASTM D 2321 and ASTM D 3034 for elastomeric-seal joints or ASTM D 3034 for elastomeric-gasketed joints.
3. Join reinforced-concrete sewer piping according to ACPA's "Concrete Pipe Installation Manual" for rubber-gasketed joints.
4. Join dissimilar pipe materials with nonpressure-type flexible couplings.

B. Join force-main pressure piping according to the following:

1. Join PVC water-service piping according to ASTM D 2855 for solvent-cemented joints.
2. Join dissimilar pipe materials with pressure-type couplings.

3.4 BACKWATER VALVE INSTALLATION

A. Install horizontal-type backwater valves in piping where indicated.

B. Install combination horizontal and manual gate-valve type in piping and in manholes where indicated.

C. Install terminal-type backwater valves on end of piping and in manholes where indicated.

3.5 CLEANOUT INSTALLATION

A. Install cleanouts and riser extensions from sewer pipes to cleanouts at grade. Use cast-iron soil pipe fittings in sewer pipes at branches for cleanouts and cast-iron soil pipe for riser extensions to cleanouts. Install piping so cleanouts open in direction of flow in sewer pipe.

1. Use Heavy-Duty, top-loading classification cleanouts in vehicle-traffic service areas.

B. Set cleanout frames and covers in earth in cast-in-place concrete block, 18 by 18 by 12 inches deep. Set with tops 1 inch above surrounding earth grade.

C. Set cleanout frames and covers in concrete pavement and roads with tops flush with pavement surface.

3.6 DRAIN INSTALLATION

A. Install type of drains in locations indicated.
   1. Use Heavy-Duty, top-loading classification drains in vehicle-traffic service areas.

B. Embed drains in 4-inch minimum concrete around bottom and sides.

C. Fasten grates to drains if indicated.

D. Set drain frames and covers with tops flush with pavement surface.

E. Assemble trench sections with flanged joints.

F. Embed trench sections in 4-inch minimum concrete around bottom and sides.

3.7 MANHOLE INSTALLATION

A. General: Install manholes, complete with appurtenances and accessories indicated.

B. Install precast concrete manhole sections with sealants according to ASTM C 891.

C. Where specific manhole construction is not indicated, follow manhole manufacturer's written instructions.

D. Set tops of frames and covers flush with finished surface of manholes that occur in pavements. Set tops 3 inches above finished surface elsewhere unless otherwise indicated.

3.8 STORMWATER INLET AND OUTLET INSTALLATION

A. Construct inlet head walls, aprons, and sides of reinforced concrete, as indicated.

B. Construct riprap of broken stone, as indicated.

C. Install outlets that spill onto grade, anchored with concrete, where indicated.

D. Install outlets that spill onto grade, with flared end sections that match pipe, where indicated.

3.9 CONCRETE PLACEMENT

A. Place cast-in-place concrete according to ACI 318.

3.10 CONNECTIONS

A. Connect nonpressure, gravity-flow drainage piping in building's storm building drains specified in Division 22 Section "Facility Storm Drainage Piping."

B. Make connections to existing piping and underground manholes.

1. Use commercially manufactured wye fittings for piping branch connections. Remove section of existing pipe; install wye fitting into existing piping; and encase entire wye fitting, plus 6-inch overlap, with not less than 6 inches of concrete with 28-day compressive strength of 3000 psi.
2. Make branch connections from side into existing piping, NPS 4 to NPS 20. Remove section of existing pipe, install wye fitting into existing piping, and encase entire wye with not less than 6 inches of concrete with 28-day compressive strength of 3000 psi .
3. Make branch connections from side into existing piping, NPS 21 or larger, or to underground manholes and structures by cutting into existing unit and creating an opening large enough to allow 3 inches of concrete to be packed around entering connection. Cut end of connection pipe passing through pipe or structure wall to conform to shape of and be flush with inside wall unless otherwise indicated. On outside of pipe, manhole, or structure wall, encase entering connection in 6 inches of concrete for minimum length of 12 inches to provide additional support of collar from connection to undisturbed ground.

    a. Use concrete that will attain a minimum 28-day compressive strength of 3000 psi unless otherwise indicated.
    b. Use epoxy-bonding compound as interface between new and existing concrete and piping materials.

4. Protect existing piping, manholes, and structures to prevent concrete or debris from entering while making tap connections. Remove debris or other extraneous material that may accumulate.

C. Pipe couplings, expansion joints, and deflection fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.

1. Use nonpressure-type flexible couplings where required to join gravity-flow, nonpressure sewer piping unless otherwise indicated.

    a. Unshielded flexible couplings for same or minor difference OD pipes.
    b. Unshielded, increaser/reducer-pattern, flexible couplings for pipes with different OD.
    c. Ring-type flexible couplings for piping of different sizes where annular space between smaller piping's OD and larger piping's ID permits installation.

2. Use pressure-type pipe couplings for force-main joints.

3.11 IDENTIFICATION

A. Materials and their installation are specified in Division 31 Section "Earth Moving." Arrange for installation of green warning tape directly over piping and at outside edge of underground structures.

1. Use warning tape or detectable warning tape over ferrous piping.

2. Use detectable warning tape over nonferrous piping and over edges of underground structures.

3.12 FIELD QUALITY CONTROL

A. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches of backfill is in place, and again at completion of Project.

1. Submit separate reports for each system inspection.
2. Defects requiring correction include the following:

   a. Alignment: Less than full diameter of inside of pipe is visible between structures.
   b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.
   c. Damage: Crushed, broken, cracked, or otherwise damaged piping.
   d. Infiltration: Water leakage into piping.
   e. Exfiltration: Water leakage from or around piping.

3. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.
4. Reinspect and repeat procedure until results are satisfactory.

B. Test new piping systems, and parts of existing systems that have been altered, extended, or repaired, for leaks and defects.

1. Do not enclose, cover, or put into service before inspection and approval.
2. Test completed piping systems according to requirements of authorities having jurisdiction.
3. Schedule tests and inspections by authorities having jurisdiction with at least 24 hours' advance notice.
4. Submit separate report for each test.
5. Gravity-Flow Storm Drainage Piping: Test according to requirements of authorities having jurisdiction, UNI-B-6, and the following:

   a. Exception: Piping with soiltight joints unless required by authorities having jurisdiction.
   b. Option: Test plastic piping according to ASTM F 1417.
   c. Option: Test concrete piping according to ASTM C 924.

C. Leaks and loss in test pressure constitute defects that must be repaired.

D. Replace leaking piping using new materials, and repeat testing until leakage is within allowances specified.

3.13 CLEANING

A. Clean interior of piping of dirt and superfluous materials. Flush with potable water.

PART 4 - METHOD OF MEASUREMENT

4.1 The length of pipe shall be measured in linear feet (meters) of pipe in place, completed, and approved. It shall be measured along the centerline of the pipe from end or inside face of structure to the end or inside face of structure, whichever is applicable. The several classes, types and size shall be measured separately. All fittings shall be included in the footage as typical pipe sections in the pipe being measured.

4.2 Manholes, catch basins, inlets, and inspection holes shall be measured by the unit, completed in place and accepted. All required excavation, sheeting and bracing, all required backfilling, restoration of all surfaces, all required connections and dewatering shall be included as part of the unit completed.

PART 5 - BASIS OF PAYMENT (Payment will be made under the following:)

5.1 PIPING

A. Payment will be made at the contract unit price per linear foot (meter) for each kind of pipe of the type and size designated. These prices shall fully compensate the Contractor for furnishing all materials and for all preparation, excavation, all bedding and select backfill, and installation of these materials; and for all labor, equipment, tools, and incidentals necessary to complete the item.

Item 331400-1: 12-inch Class III RCP – per linear foot

Item 331400-2: 24-inch Class III RCP – per linear foot

Item 331400-3: 8-inch HDPE Storm Pipe – per linear foot

Item 331400-4: 6-inch HDPE Storm Pipe – per linear foot

5.2 STRUCTURE

A. The accepted quantities of manholes, catch basins, inlets, and inspection holes will be paid for at the contract unit price per each in place when completed. This price shall be full compensation for furnishing all materials and for all preparation, excavation, backfilling and placing of the materials; furnishing and installation of such specials and connections to pipes and other structures as may be required to complete the item as shown on the plans; and for all labor equipment, tools and incidentals necessary to complete the structure.

Item 331400-5: Inlet – per each

Item 331400-6: Storm Manhole – per each

Item 331400-7: Storm Pipe Clean-out Stack – per each

END OF SECTION 334100

SECTION 334600 - SUBDRAINAGE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes subdrainage systems for the following:

1. Foundations.
2. Retaining walls.
3. Landscaped areas.

B. Related Sections include the following:

1. Division 07 Waterproofing Sections for molded-sheet drainage panels.

1.3 DEFINITIONS

A. ABS: Acrylonitrile-butadiene-styrene plastic.

B. HDPE: High-density polyethylene plastic.

C. PE: Polyethylene plastic.

D. PP: Polypropylene plastic.

E. PS: Polystyrene plastic.

F. PVC: Polyvinyl chloride plastic.

G. Subdrainage: Drainage system that collects and removes subsurface or seepage water.

1.4 SUBMITTALS

A. Product Data: For the following:

1. Perforated-wall pipe and fittings.
2. Solid-wall pipe and fittings.
3. Drainage conduits.

4. Drainage panels.
5. Geotextile filter fabrics.

B. Approval of waterproofing manufacturer's service agent for use of drainage panels against and for waterproofing membrane protection.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 PIPING MATERIALS

A. Refer to the "Piping Applications" Article in Part 3 for applications of pipe, tube, fitting, and joining materials.

2.3 PERFORATED-WALL PIPES AND FITTINGS

A. Perforated PE Pipe and Fittings:

1. NPS 6 and Smaller: ASTM F 405 or AASHTO M 252, Type CP; corrugated, for coupled joints.
2. NPS 8 and Larger: ASTM F 667; AASHTO M 252, Type CP; or AASHTO M 294, Type CP; corrugated; for coupled joints.
3. Couplings: Manufacturer's standard, band type.

B. Perforated PVC Sewer Pipe and Fittings: ASTM D 2729, bell-and-spigot ends, for loose joints.

C. Perforated Concrete Pipe and Fittings: ASTM C 444 Type 1, and applicable requirements in ASTM C 14 Class 2, socket-and-spigot ends for gasketed joints.

1. Gaskets: ASTM C 443, rubber.

2.4 SOLID-WALL PIPES AND FITTINGS

A. ABS Sewer Pipe and Fittings: ASTM D 2751.

1. Solvent Cement: ASTM D 2235.

2. Gaskets: ASTM F 477, elastomeric seal.

B. Cast-Iron Soil Pipe and Fittings: ASTM A 74, Service and Extra-Heavy classes, hub-and-spigot ends, gray, for gasketed joints.

1. Gaskets: ASTM C 564, rubber, of thickness matching class of pipe.

C. PE Drainage Tubing and Fittings: AASHTO M 252, Type S, corrugated, with smooth waterway, for coupled joints.

1. Couplings: AASHTO M 252, corrugated, band type, matching tubing and fittings.

D. PE Pipe and Fittings: AASHTO M 294, Type S, corrugated, with smooth waterway, for coupled joints.

1. Couplings: AASHTO M 294, corrugated, band type, matching tubing and fittings.

E. PVC Sewer Pipe and Fittings: ASTM D 3034, SDR 35, bell-and-spigot ends, for gasketed joints.

1. Gaskets: ASTM F 477, elastomeric seal.

2.5 SPECIAL PIPE COUPLINGS

A. Comply with ASTM C 1173, elastomeric, sleeve-type, reducing or transition coupling, for joining underground nonpressure piping. Include ends of same sizes as piping to be joined and corrosion-resistant metal tension band and tightening mechanism on each end.

1. Sleeve Materials:

a. For Concrete Pipes: ASTM C 443, rubber.
b. For Cast-Iron Soil Pipes: ASTM C 564, rubber.
c. For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
d. For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.

2. Unshielded Flexible Couplings: Elastomeric sleeve with stainless-steel shear ring and corrosion-resistant metal tension band and tightening mechanism on each end.
3. Shielded Flexible Couplings: ASTM C 1460, elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant metal tension band and tightening mechanism on each end.

2.6 CLEANOUTS

A. Cast-Iron Cleanouts: ASME A112.36.2M; with round-flanged, cast-iron housing; and secured, scoriated, Medium-Duty Loading class, cast-iron cover. Include cast-iron ferrule and countersunk, brass cleanout plug.

B. PVC Cleanouts: ASTM D 3034, PVC cleanout threaded plug and threaded pipe hub.

2.7 SOIL MATERIALS

A. Backfill, drainage course, impervious fill, and satisfactory soil materials are specified in Division 31 Section "Earth Moving."

2.8 ROOFING FELTS

A. ASTM D 226, Type I, asphalt or ASTM D 227, coal-tar-saturated roofing felt.

2.9 GEOTEXTILE FILTER FABRICS

A. Description: Fabric of PP or polyester fibers or combination of both, with flow rate range from 110 to 330 gpm/sq. ft. (4480 to 13 440 L/min. per sq. m) when tested according to ASTM D 4491.

1. Structure Type: Nonwoven, needle-punched continuous filament
2. Style(s): Flat and sock.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine surfaces and areas for suitable conditions where subdrainage systems are to be installed.

B. If subdrainage is required for landscaping, locate and mark existing utilities, underground structures, and aboveground obstructions before beginning installation and avoid disruption and damage of services.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 EARTHWORK

A. Excavating, trenching, and backfilling are specified in Division 31 Section "Earth Moving."

3.3 PIPING APPLICATIONS

A. Underground Subdrainage Piping:

1. Perforated PE pipe and fittings, couplings, and coupled joints.
2. Perforated PVC sewer pipe and fittings for loose, bell-and-spigot joints.

B. Header Piping:

1. ABS pipe and fittings, gaskets, and gasketed joints.
2. PE drainage tubing and fittings, couplings, and coupled joints.
3. PVC sewer pipe and fittings, couplings, and coupled joints.

3.4 CLEANOUT APPLICATIONS

A. In Underground Subdrainage Piping:

1. At Grade in Earth: PVC cleanouts.
2. At Grade in Paved Areas: Cast-iron cleanouts.

3.5 FOUNDATION DRAINAGE INSTALLATION

A. Place impervious fill material on subgrade adjacent to bottom of footing after concrete footing forms have been removed. Place and compact impervious fill to dimensions indicated, but not less than 6 inches deep and 12 inches wide.

B. Place impervious fill on subgrade adjacent to bottom of footing and compact to dimensions indicated, but not less than 6 inches deep and 12 inches wide after concrete footing forms have been removed.

C. Lay flat-style geotextile filter fabric in trench and overlap trench sides.

D. Place supporting layer of drainage course over compacted subgrade and geotextile filter fabric, to compacted depth of not less than 4 inches.

E. Encase pipe with sock-style geotextile filter fabric before installing pipe. Connect sock sections with adhesive.

F. Install drainage piping as indicated in Part 3 "Piping Installation" Article for foundation subdrainage.

G. Add drainage course to width of at least 6 inches on side away from wall and to top of pipe to perform tests.

H. After satisfactory testing, cover drainage piping to width of at least 6 inches on side away from footing and above top of pipe to within 12 inches of finish grade.

I. Install drainage course and wrap top of drainage course with flat-style geotextile filter fabric.

J. Place layer of flat-style geotextile filter fabric over top of drainage course, overlapping edges at least 4 inches.

K. Install vertical drainage panels as follows:

1. Coordinate placement with other drainage materials.

2. Lay perforated drainage pipe at base of footing. Install as indicated in Part 3 "Piping Installation" Article. Do not install aggregate.
3. Separate 4 inches of fabric at beginning of roll and cut away 4 inches of core. Wrap fabric around end of remaining core.
4. Wrap bottom of panel around drainage pipe.
5. Attach panel to wall at horizontal mark and at beginning of pipe. Place core side of panel against wall. Use concrete nails with washers through product cylinders to attach panel to wall. Place nails from 2 to 6 inches below top of panel, approximately 48 inches apart. Construction adhesives, metal stick pins, or double- double-sided tape may be used instead of nails. Do not penetrate waterproofing. Before using adhesives, discuss with waterproofing manufacturer.
6. If additional panels are required on same row, cut away 4 inches of installed panel core, install new panel against installed panel, and overlap new panel with installed panel fabric.
7. If additional rows of panels are required, overlap lower panel with 4 inches of fabric.
8. Cut panel as necessary to keep top 12 inches below finish grade.
9. For inside corners, bend panel. For outside corners, cut core to provide 3 inches for overlap.

L. Do not use drainage panels as protection for waterproof membrane unless approved by factory-authorized service representative of waterproofing membrane manufacturer. Submit approval if so used.

M. Place initial backfill material over compacted drainage course. Place material in loose-depth layers not exceeding 6 inches. Thoroughly compact each layer. Final backfill to finish elevations and slope away from building.

3.6 RETAINING-WALL DRAINAGE INSTALLATION

A. Lay flat-style geotextile filter fabric in trench and overlap trench sides.

B. Place supporting layer of drainage course over compacted subgrade to compacted depth of not less than 4 inches.

C. Encase pipe with sock-style geotextile filter fabric before installing pipe. Connect sock sections with adhesive.

D. Install drainage piping as indicated in Part 3 "Piping Installation" Article for retaining-wall subdrainage.

E. Add drainage course to width of at least 6 inches on side away from wall and to top of pipe to perform tests.

F. After satisfactory testing, cover drainage piping to width of at least 6 inches on side away from footing and above top of pipe to within 12 inches of finish grade.

G. Place drainage course in layers not exceeding 3 inches in loose depth; compact each layer placed and wrap top of drainage course with flat-style geotextile filter fabric.

H. Place layer of flat-style geotextile filter fabric over top of drainage course, overlapping edges at least 4 inches.

I. Install vertical drainage panels as follows:

1. Coordinate placement with other drainage materials.
2. Lay perforated drainage pipe at base of footing as described elsewhere in this Specification. Do not install aggregate.
3. If weep holes are used instead of drainage pipe, cut 1/2-inch- diameter holes on core side at weep-hole locations. Do not cut fabric.
4. Mark horizontal calk line on wall at a point 6 inches less than panel width above footing bottom. Before marking wall, subtract footing width.
5. Separate 4 inches of fabric at beginning of roll and cut away 4 inches of core. Wrap fabric around end of remaining core.
6. Wrap bottom of panel around drainage pipe.
7. Attach panel to wall at horizontal mark and at beginning of wall corner. Place core side of panel against wall. Use concrete nails with washers through product. Place nails from 2 to 6 inches below top of panel, approximately 48 inches apart. Construction adhesives, metal stick pins, or double-sided tape may be used instead of nails. Do not penetrate waterproofing. Before using adhesives, discuss with waterproofing manufacturer.
8. If another panel is required on same row, cut away 4 inches of installed panel core and wrap fabric over new panel.
9. If additional rows of panel are required, overlap lower panel with 4 inches of fabric.
10. Cut panel as necessary to keep top 12 inches below finish grade.
11. For inside corners, bend panel. For outside corners, cut core to provide 3 inches for overlap.
12. Do not use drainage panels as protection for waterproof membrane unless approved by factory-authorized service representative of waterproofing membrane manufacturer. Submit approval if so used.

J. Fill to Grade: Place satisfactory soil fill material over compacted drainage course. Place material in loose-depth layers not exceeding 6 inches. Thoroughly compact each layer. Fill to finish grade.

3.7 LANDSCAPING DRAINAGE INSTALLATION

A. Provide trench width to allow installation of drainage conduit. Grade bottom of trench excavations to required slope, and compact to firm, solid bed for drainage system.

B. Lay flat-style geotextile filter fabric in trench and overlap trench sides.

C. Place supporting layer of drainage course over compacted subgrade and geotextile filter fabric, to compacted depth of not less than 4 inches.

D. Install drainage conduits as indicated in Part 3 "Piping Installation" Article for landscaping subdrainage with horizontal distance of at least 6 inches between conduit and trench walls. Wrap drainage conduits without integral geotextile filter fabric with

flat-style geotextile filter fabric before installation. Connect fabric sections with adhesive.

E. Add drainage course to top of drainage conduits.

F. After satisfactory testing, cover drainage conduit to within 12 inches of finish grade.

G. Install drainage course and wrap top of drainage course with flat-style geotextile filter fabric.

H. Place layer of flat-style geotextile filter fabricover top of drainage course, overlapping edges at least 4 inches.

I. Fill to Grade: Place satisfactory soil fill material over drainage course. Place material in loose-depth layers not exceeding 6 inches. Thoroughly compact each layer. Fill to finish grade.

3.8 PIPING INSTALLATION

A. Install piping beginning at low points of system, true to grades and alignment indicated, with unbroken continuity of invert. Bed piping with full bearing in filtering material. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions and other requirements indicated.

1. Foundation Subdrainage: Install piping pitched down in direction of flow, at a minimum slope of 0.5 percent and with a minimum cover of 36 inches, unless otherwise indicated.
2. Underslab Subdrainage: Install piping pitched down in direction of flow, at a minimum slope of 0.5 percent.
3. Plaza Deck Subdrainage: Install piping pitched down in direction of flow, at a minimum slope of 1.0 percent.
4. Retaining-Wall Subdrainage: When water discharges at end of wall into stormwater piping system, install piping pitched down in direction of flow, at a minimum slope of 0.5 percent and with a minimum cover of 36 inches, unless otherwise indicated. However, when water discharges through wall weep holes, pipe may be installed with a minimum slope of zero percent.
5. Landscaping Subdrainage: Install piping pitched down in direction of flow, at a minimum slope of 0.5 percent and with a minimum cover of 36 inches, unless otherwise indicated.
6. Lay perforated pipe with perforations down.
7. Excavate recesses in trench bottom for bell ends of pipe. Lay pipe with bells facing upslope and with spigot end entered fully into adjacent bell.

B. Use increasers, reducers, and couplings made for different sizes or materials of pipes and fittings being connected. Reduction of pipe size in direction of flow is prohibited.

C. Install PE piping according to ASTM D 2321.

D. Install PVC piping according to ASTM D 2321.

E. Install concrete piping according to ACPA's "Concrete Pipe Handbook."

3.9 PIPE JOINT CONSTRUCTION

A. Cast-Iron Soil Pipe and Fittings: Hub and spigot, with rubber compression gaskets according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook." Use gaskets that match class of pipe and fittings.

B. Join PE pipe, tubing, and fittings with couplings for soil-tight joints according to AASHTO's "Standard Specifications for Highway Bridges," Division II, Section 26.4.2.4, "Joint Properties."

C. Join perforated, PE pipe and fittings with couplings for soil-tight joints according to AASHTO's "Standard Specifications for Highway Bridges," Division II, Section 26.4.2.4, "Joint Properties"; or according to ASTM D 2321.

D. Join PVC pipe and fittings according to ASTM D 3034 with elastomeric seal gaskets according to ASTM D 2321.

E. Join perforated PVC pipe and fittings according to ASTM D 2729, with loose bell-and-spigot joints.

F. Join perforated concrete pipe and fittings with gaskets according to ASTM C 443 (ASTM C 443M).

G. Special Pipe Couplings: Join piping made of different materials and dimensions with special couplings made for this application. Use couplings that are compatible with and fit materials and dimensions of both pipes.

3.10 CLEANOUT INSTALLATION

A. Cleanouts for Foundation and Retaining-Wall Subdrainage:

1. Install cleanouts from piping to grade. Locate cleanouts at beginning of piping run and at changes in direction. Install fittings so cleanouts open in direction of flow in piping.
2. In vehicular-traffic areas, use NPS 4 cast-iron soil pipe and fittings for piping branch fittings and riser extensions to cleanout. Set cleanout frames and covers in a cast-in-place concrete anchor, 18 by 18 by 12 inches in depth. Set top of cleanout flush with grade. Cast-iron pipe may also be used for cleanouts in nonvehicular-traffic areas.
3. In nonvehicular-traffic areas, use NPS 4 PVC pipe and fittings for piping branch fittings and riser extensions to cleanout. Set cleanout frames and covers in a cast-in-place concrete anchor, 12 by 12 by 4 inches in depth. Set top of cleanout plug 1 inch above grade.

3.11 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect low elevations of subdrainage system to building's solid-wall-piping storm drainage system.

C. Where required, connect low elevations of foundation underslab subdrainage to stormwater sump pumps.

3.12 IDENTIFICATION

A. Materials and their installation are specified in Division 31 Section "Earth Moving." Arrange for installation of green warning tapes directly over piping.

1. Install PE warning tape or detectable warning tape over ferrous piping.
2. Install detectable warning tape over nonferrous piping and over edges of underground structures.

3.13 FIELD QUALITY CONTROL

A. Testing: After installing drainage course to top of piping, test drain piping with water to ensure free flow before backfilling. Remove obstructions, replace damaged components, and repeat test until results are satisfactory.

3.14 CLEANING

A. Clear interior of installed piping and structures of dirt and other superfluous material as work progresses. Maintain swab or drag in piping and pull past each joint as it is completed. Place plugs in ends of uncompleted pipe at end of each day or when work stops.

END OF SECTION 334600

ATTACHMENTS

HURT & PROFFITT INCORPORATED

City of Lynchburg

Preston Airport Control Tower Demolition Project

Asbestos Abatement Specification and Design

Prepared For:

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RS&H

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July 13, 2015

Walter C. Nixon
Project Designer
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Expiration Date: 03/31/2016

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Appendix A: DPOR Project Designer License
Appendix B: Asbestos-Containing Materials Location Map

Preston Airport Control Tower Demolition

PART I – GENERAL

1.1 Scope of Work

A. This asbestos abatement project will be conducted prior to demolition of the current air traffic control tower, located at the Lynchburg Regional Airport. The asbestos abatement work consists of the removal and disposal of all asbestos-containing materials (ACM) associated with the interior and exterior of the facility. The following is the asbestos-containing building components found as part of the July 1, 2015 NESHAPs:

- 9”x9” Green Floor Tile and Associated Mastic – 7,300 +/- Square Feet (Cat. I Non-friable)
- Pipe Insulation Elbows and Fittings-60+/- linear Feet (RACM)
- Interior Door Caulk-50 +/- Door Frames (Cat. I Non-friable)
- ACM Rope Materials-3 Linear Feet (RACM)
- Stair Tread Material-20 +/- Square Feet (Cat. I Non-friable)
- Exterior Door Caulk-2 +/- Square Feet (Cat. I Non-friable)
- Fire Doors-20+/- Units (RACM)
- Roofing Materials to Include: Main Field, Flashings, Curb Flashings and Pitch Pockets-3,240+/- Square Feet (Cat. I Non-friable)
- Elevator Brake Shoes-4+/- Units (Cat. I Non-friable)
- Electrical Switch Boxes-20+/- Units (Cat. II Non-friable)

ALL QUANTITIES MUST BE FIELD VERIFIED BY THE ASBESTOS ABATEMENT CONTRACTOR PRIOR TO BID

NOTE:
Work practices conducted on-site shall be in strict compliance with this project design specification, state, federal, and local regulations. When conflicts occur between these project design documents and applicable state, federal, and/or local regulations, the most stringent course of action shall apply.

B. Wet methods shall be utilized to minimize airborne fiber concentrations.

C. The contractor shall conduct all work in accordance with state, federal, and local regulations. Additionally, the contractor shall comply with the design plans and specifications in this document.

D. The contractor shall supply an adequate number of asbestos abatement workers on-site on a daily basis. This is to ensure the timely completion of

this phase of the project. Subcontractors may not be utilized on this project without the written consent of the City of Lynchburg or their designee.

E. The contractor accepts that multiple means of clearance criteria may be utilized for final clearance criteria. Visual inspections AND PCM air testing/air sampling will be utilized on this project. The contractor understands that their base bid is to include all necessary labor, equipment, etc. to successfully abate and clean the area for re-occupancy by other trades.

F. The Contractor shall protect any ancillary proximate areas where abatement related activities shall be performed (this also includes damage that may be incurred in the building). Any damage incurred by the Contractor or by abatement related activities, shall result in the Contractor being held liable for all costs related to the restoration of damaged areas to their original condition. There shall be no costs incurred by the City of Lynchburg for any restoration efforts.

1.2 Contractor Responsibilities

The selected asbestos abatement contractor shall be responsible for:

A. Performing work in accordance with applicable federal, state, and local regulations pertaining to asbestos abatement work. These regulations include, but are not limited to, the laws of Virginia, the United States Environmental Protection Agency (US EPA) National Emission Standards for Hazardous Air Pollutions (NESHAPs), the Occupational Safety and Health Administration (OSHA), and local regulations.

B. Providing all labor, equipment, materials, and supervision to complete the project in a professional, safe, and timely fashion.

C. Providing supervisors and workers who are competent, trained, and medically fit to conduct asbestos abatement work.

D. Completing the project as specified in these design plans & specifications. The contractor accepts that the areas will not be considered successfully abated, until final visual inspections proves that the area(s) are considered safe for re-occupancy.

E. Packaging, transporting, and disposing all asbestos and asbestos contaminated materials, with all applicable State, Federal, and Local regulations.

F. Ensuring building security during the course of the project, so that unauthorized personnel may not enter designated work areas and subsequently the building.

G. Providing emergency plans and emergency telephone numbers to the City of Lynchburg and on-site abatement personnel.

H. Obeying the owner's policies and procedures pertaining to work on-site.

I. Complying with the contractual requirements set forth by the City of Lynchburg.

J. Notifying the Virginia Department of Labor and the USEPA about the asbestos abatement project and paying any applicable fees.

K. Ensuring compliance with OSHA regulations pertaining to worker safety and health, including worker protection to heat stress.

1.3 Personal Protective Equipment

A. The contractor shall be responsible for providing his personnel with adequate personal protective equipment (PPE) to perform the work on this project, as per federal and state regulations.

B. The contractor will be responsible for collecting OSHA personal asbestos air samples for their workers on this project. Representative samples shall be taken daily on ¼ of the workforce and sample results shall be posted in the personal decontamination unit within 48 hours of collection. The contractor is responsible for providing their employees with adequate respiratory protection based upon the sample results received.

C. "Street" Clothing is not permitted in the work area at any time.

D. With the use of amended water during asbestos abatement project, "flooring" will become slippery. The contractor shall provide their workers with non-skid footwear on this project.

E. The contractor is responsible for providing the building owner's authorized representatives, the environmental consultant, and state and/or federal inspectors with personal protective equipment. This may include some or all of the following: protective clothing, respirators, HEPA cartridges, hardhats, gloves, eye protection, and rubber disposable boots.

1.4 Project Monitoring & Air Sampling

A. The contractor shall not include the costs of asbestos abatement project monitoring and air sampling in their bid. The City of Lynchburg will be responsible for the hiring of a Virginia DPOR Licensed Asbestos Project Monitor as required by the USEPA NESHAPs regulations.

PART II – SUBMITTALS

2.1 Pre-Abatement Submittals

Upon being selected by to perform asbestos abatement activities, the contractor will be responsible for the following submissions (3 copies of each) within 48 hours:

A. Copies of both Virginia Department of Labor and Industry (VA DOLI) and the USEPA Notifications to conduct asbestos work at the Lynchburg Air Traffic Control Tower if friable asbestos is encountered during abatement activities or if means and/or methods of removal will deem the ACM friable.

B. Copies of Virginia Waste Transporter Permits and the location of the landfill where the asbestos waste will be transported to.

C. Copy of the waste manifest to be used on this project.

D. Copy of a local wastewater discharge permit. If no permit is to be used, a statement indicating how wastewater will be disposed of on this project will be required.

E. Material Safety Data Sheets (MSDS) for all chemicals and/or solvents to be utilized on-site.

F. Manufacturers certifications for all equipment to be used on the project, ie: HEPA filtration units and/or HEPA vacuums.

G. Copy of the company's Hazard Communication Program, Medical Surveillance Program and Respiratory Protection Program, and Site Emergency Response Plan.

H. Copy of notifications to the local fire and rescue that work will be conducted at the site.

I. Copies of the emergency phone numbers that will be posted on the personal decontamination unit.

J. Plans of locating the decontamination unit(s), temporary power, and waste dumpsters / trailers on-site.

K. Copies of the following workers certifications;

    1. Virginia DPOR licenses for all personnel.

2. Certificates of training for all personnel.

3. Medical Evaluations Forms to show suitability to wear respiratory protection for all personnel.

4. Fit Test Forms to show respirator suitability.

L. Proposed Supervisor on the project, including a list of at least five (5) other projects that the Supervisor has worked on.

2.2 Asbestos Abatement Submittals

The contractor shall be responsible for providing the City of Lynchburg and their environmental consultant with the following submittals;

A. Copies of OSHA personal air samples. Note – the City of Lynchburg and their environmental consultant are not responsible for the interpretation of these results, the intent is to prove that the abatement contractor is taking these required samples only.

B. A daily list of the personnel on-site accompanied with their Virginia DPOR Licenses.

C. The supervisor's daily log book that documents the checking of critical barriers and the cleaning of the decontamination unit(s) at the beginning and end of each shift, as required by 29 CFR 1926.1101.

D. An account of any asbestos handling air samples that were greater than 0.01 f/cc according to phase contrast microscopy (PCM) and the measures taken to clean the proximate area (if necessary).

2.3 Post Abatement Submittals

A. Copies of waste manifests and/or bill of lading for every waste shipment from the site project.

B. Any other submittal that the City of Lynchburg and/or their environmental consultant requests.

2.4 Close-Out Documentation

A. The City of Lynchburg will be responsible for ensuring that the contractor has met all the contractual obligations to close-out this project.

PART III - PRODUCTS

3.1 Equipment

The contractor shall be responsible for the following:

A. Providing all equipment necessary to complete the project.

B. Providing only safe and reliable equipment to the work site.

C. Providing personal protective equipment to all persons working on-site.

D. Providing air filtration devices and vacuums that are HEPA exhausted.

E. Utilizing barrier tape and danger signs to keep unauthorized personnel away from the work area. The perimeter of the work area at ground level, the decontamination units, and waste dumpster shall all be properly demarcated utilizing barrier tape and signage. Danger signs shall contain the following language as required by EPA AHERA and OSHA:

DANGER
CONTAINS ASBESTOS FIBERS
AVOID CREATING DUST
CANCER AND LUNG DISEASE HAZARD

F. Utilizing amended water to minimize airborne dust concentrations in the work area.

G. Utilizing 6 mil polyethylene sheeting for the construction of asbestos work areas, 6 mil polyethylene sheeting for decontamination units, and the lining of waste trailers.

H. Utilizing 6 mil polyethylene bags for the disposal of all waste.

I. Utilizing duct tape (or approved equivalent) to seal polyethylene sheetings and bags.

J. Utilizing safe electrical power cords throughout the site.

K. Utilizing Ground Fault Interrupters (GFI's) or Ground Fault Circuit Interrupters (GFCI's) on all power sources.

L. Any power tools utilized shall be properly HEPA exhausted, as required by 29 CFR 1926.1101.

3.2 Miscellaneous Products

A. Any miscellaneous products not covered in Subpart 3.1 of this section, must have the approval of the City of Lynchburg and/or their designated representative in writing, prior to use on-site.

B. Any miscellaneous products approved of and brought to site, must be accompanied by manufacturer's product information and/or MSDS's. This information must be submitted to the City of Lynchburg and/or their environmental representative.

PART IV – EXECUTION

4.1 Decontamination Enclosures

A. A decontamination enclosure, which meets the requirements of 29 CFR 1926.1101, shall be constructed and deemed adequate by the onsite Project Monitor, prior to the commencement of any work area preparation.

B. The personal decontamination unit shall be equipped with one shower per 6 full shift abatement workers.

C. All decontamination units shall;

1. Meet all requirements of CFR 1926.1101.

2. Be cleaned at the beginning, during, and end of each work shift. Dirt and/or debris in the decontamination unit shall not be permitted.

3. Collect and filter wastewater in accordance with Department of Environmental Quality and US EPA requirements.

4.2 Utilities

A. The City of Lynchburg shall be responsible for providing electrical power to the Contractor on this project.

B. The Contractor shall be responsible for coordinating the shutdown of electrical power in the work area, ie: Lock Out / Tag Out. In the event that the power may not be turned off, all power sources shall be wrapped in three individual layers of fire retardant 6 mil polyethylene sheeting and labeled "DANGER, LIVE ELECTRIC".

C. The City of Lynchburg shall be responsible for providing the Contractor with a water supply on this project.

D. If the power and water is provided by the Building Owner, the contractor shall be responsible for the maintenance of all electrical cords and water hoses, and keeping them in a secure location to prevent unnecessary tripping hazards.

4.3 Heating, Ventilation, and Air Conditioning Systems (HVAC)

A. The Contractor shall be responsible for coordinating any HVAC shutdown and isolation with the City of Lynchburg personnel (if necessary).

4.4 Critical Barriers

A. Upon completion of the pre-cleaning, the Contractor shall be responsible for the construction of critical barriers that conform to CFR 1926.1101.

B. Two layers of 6 mil polyethylene sheeting shall be utilized to cover and/or seal any windows, doors, openings, drains, ducts, corridors, etc. to isolate the work area from other areas of the building. These barriers shall be maintained within 20 feet of the furthest most area of asbestos abatement activities during the day's activities.

C. The contractor shall be responsible for the;

a. Smoke testing of critical barriers and noting the results of these inspections in their supervisor's log book.

b. Monitoring of critical barriers during the abatement process to ensure that the critical barriers remain in place.

4.5 General Asbestos Handling & Cleaning Requirements

A. Asbestos shall be abated utilizing wet methods only.

B. Dry removal, sweeping, wire brushing, removal methods utilizing pressurized water or air, or other inappropriate asbestos abatement techniques will not be permitted.

C. Waste shall be immediately bagged and be transported to the waste decontamination enclosure. The waste bag shall then be cleaned in the waste decontamination enclosure, double bagged, labeled with a generator label, and transported to the waste dumpster, trailer, etc.

D. The contractor shall not allow asbestos debris and/or waste to accumulate inside the work area(s). Visible dust and debris shall be wet wiped and HEPA vacuumed during abatement activities to minimize fiber release.

E. Waste bag transfer shall take place inside a cart that has been lined with two layers of 6 mil polyethylene. This cart shall be covered by polyethylene during any waste transfer activities and be labeled with an approved asbestos danger sign.

F. Workers will not be required to wear PPE during work area preparation unless asbestos abatement work is being performed on another part of the same project. PPE will be required to during asbestos abatement activities, cleaning, and during any other work area activities until final air clearance criteria has been achieved.

4.6 Asbestos Waste Disposal

A. The contractor shall ensure that all asbestos-containing waste is deemed "adequately wet", in accordance with EPA definition prior to being bagged for disposal.

B. Bags, drums, or other acceptable packaging materials used for the transport of asbestos-containing waste shall be labeled as asbestos-containing and contain waste generator tags/labels.

C. Two 6 mil polyethylene bags or sheetings shall be utilized for the disposal of all asbestos-containing wastes generated as part of the asbestos abatement project.

D. Waste shall be single-bagged in the work area. The waste bags shall be transported to the waste decontamination unit where it shall be cleaned, double bagged, labeled, and immediately transported to the waste dumpster, trailer, or vehicle for disposal.

E. A daily count of waste bags/drums/containers/etc. shall be calculated by the Asbestos Abatement Supervisor. This count shall be given daily to the onsite Project Monitor.

F. All wastes shall be sent to an approved and licensed landfill that accepts asbestos-containing waste. Waste manifests shall accompany all waste that leaves site. Copies of the waste manifests shall be submitted to the City of Lynchburg within 72 Hours of leaving site, illustrating delivery to the waste facility/landfill.

G. Waste vehicles used for the transport of asbestos shall bear all appropriate licenses, labels and/or placards in accordance with US DOT requirements. Waste vehicle drivers must have asbestos-awareness training at a minimum prior to waste removal from site.

4.7 Inspections

A. The contractor shall not interfere, impede, or delay any inspections by the City of Lynchburg's designated representatives, the Project Monitor, and/or State, Federal, or Local Inspectors.

B. The contractor shall request inspections at the following intervals;

1. Upon completion of the decontamination unit(s).

2. Upon completion of the preparation of the work area, prior to abatement start.

3. Upon completion of the asbestos abatement process.

4. Upon completion of asbestos abatement work area teardown activities.

4.8 Project Monitoring and Air Sampling

A. The contractor shall not include the costs of project monitoring and/or air sampling in their bid.

B. The City of Lynchburg will be responsible for the selection and payment of the onsite Project Monitoring / Air Sampling firm.

C. The onsite Project Monitor / Air Sampling Technician will be responsible for the following;

1. Visual inspections of work area preparation completion, asbestos abatement completion and cleanliness in accordance with ASTM E11368-05 *Standard Practice for Visual Inspection of Asbestos Abatement.*

2. Conducting daily work-in-progress (WIP) environmental air sampling during the asbestos abatement process to ensure asbestos fibers are not leaving the designated work area(s).

4. Providing daily contractor oversight to ensure contractor compliance with the laws & regulations governing asbestos abatement procedures in Virginia, in accordance with this specification and the AHERA regulations.

5. Collecting PCM and/or TEM air samples inside each work area at the completion of asbestos abatement activities utilizing aggressive air sampling techniques in accordance with the US EPA AHERA regulations and NIOSH 7400 methodologies. The final clearance air

sample event(s) will be utilized to ensure asbestos abatement activities are complete following the visual inspection(s).

D. The Contractor accepts the fact the Project Monitor has been retained by the City of Lynchburg to oversee the asbestos abatement project. The City of Lynchburg has authorized the Project Monitor to stop the Contractor's work, if in their judgment, there is a risk to the health & safety of building occupants due to the Contractor's actions and/or the Contractor is not following the contractual design specifications and all applicable laws. Work shall only be permitted to commence if allowed by the City of Lynchburg or their environmental consultant and corrective actions have taken place. The Contractor acknowledges that it is their responsibility to follow all applicable laws pertaining to asbestos abatement and job specifications, and failure to do so may result in lost time and/or dismissal from site at no cost to City of Lynchburg or their environmental consultant. The Contractor shall not be compensated for any lost time, labor, materials, etc., due to inappropriate actions.

END OF SECTION

Appendix A

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Certificate of Completion

Awarded to

Walter C. Nixon

Driver's License# Certificate No. HP0001

attended and successfully passed an examination for the course entitled

8-Hour Asbestos Project Designer Refresher Training Course

(The person receiving this certificate has received the requisite training for asbestos accreditation under TSCA Title II)

Location of Course & Examination

Hurt & Proffitt, Inc.
2524 Langhorne Road
Lynchburg, VA 24501

Date of Course & Examination:

March 24, 2015

Certification Expiration Date:

March 24, 2016

Provided By:

Hurt & Proffitt, Inc.
2524 Langhorne Road
Lynchburg, VA 24501
Ph: (434) 847-7796
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Walter C. Nixon
Director of Training Services

Melissa S. Hart
Course Instructor

HURT & PROFFITT INCORPORATED

HURT & PROFFITT
INCORPORATED

DEPARTMENT OF PROFESSIONAL AND OCCUPATIONAL REGULATION
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ASBESTOS PROJECT DESIGNER LICENSE

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Jay W. DeBoer, Director

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Appendix B

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PRE-DEMOLITON ASBESTOS INSPECTION
PRESTON GLEN AIRPORT TOWER
LYNCHBURG REGIONAL AIRPORT
H&P PROJECT NO. 20140992

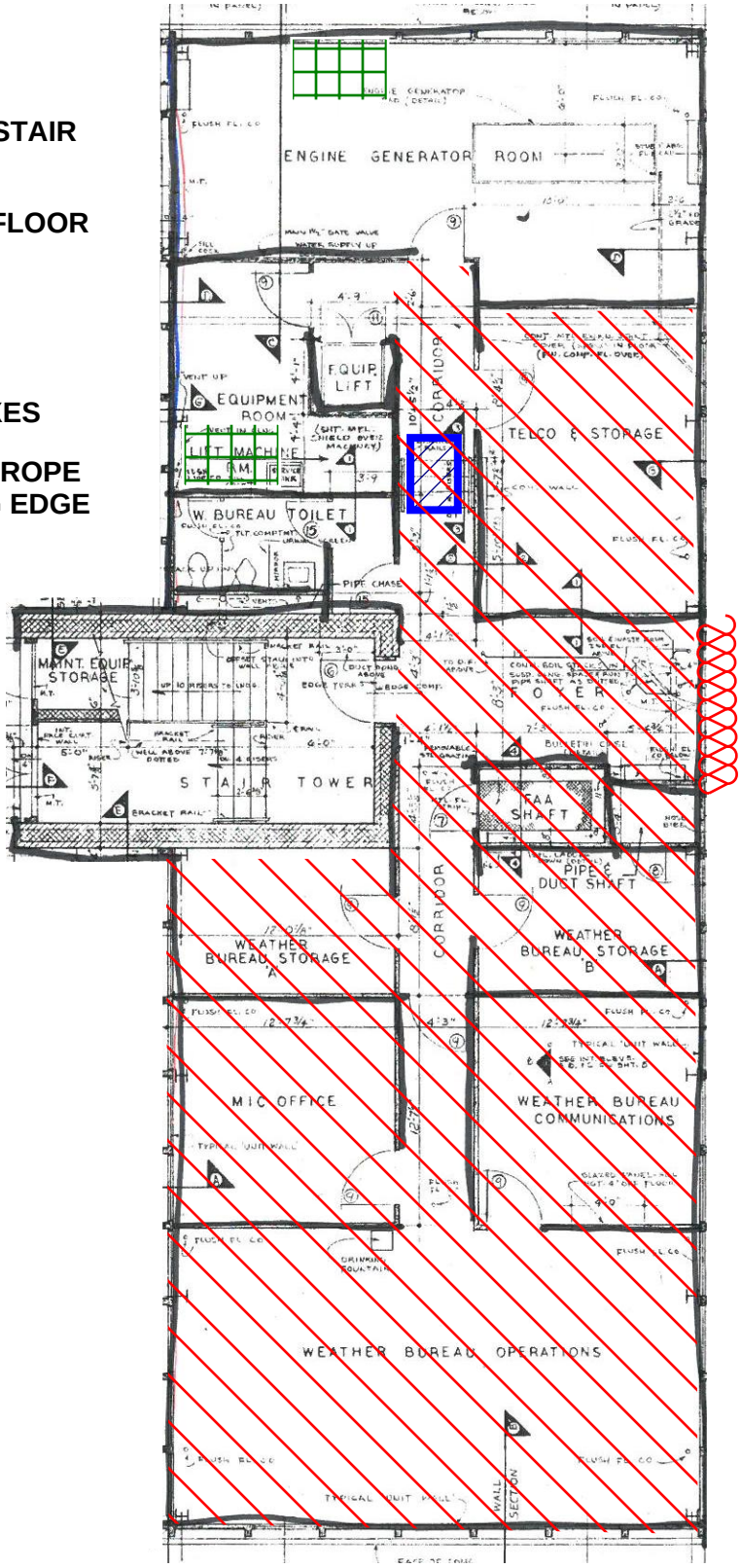
DRAWING 1- FIRST FLOOR

ASBESTOS-CONTAINING STAIR TREAD

ASBESTOS-CONTAINING FLOOR TILE AND MASTIC

PRESUMED ASBESTOS-CONTAINING ELECTRICAL SWITCHBOXES

ASBESTOS-CONTAINING ROPE GASKET ALONG AWNING EDGE



Front of Building

NOTE:

THIS DRAWING IS FOR ILLUSTRATION ONLY, NOT ALL MATERIALS ARE SHOWN.

PRESUMED FIRE DOORS WITH ACM CAULK THROUGHOUT, ACM PIPE INSULATION ELBOWS AND FITTINGS THROUGHOUT, ELEVATOR BREAKS SHOES AND ADDITIONAL ELECTRICAL SWITCHBOXES.

PRE-DEMOLITON ASBESTOS INSPECTION
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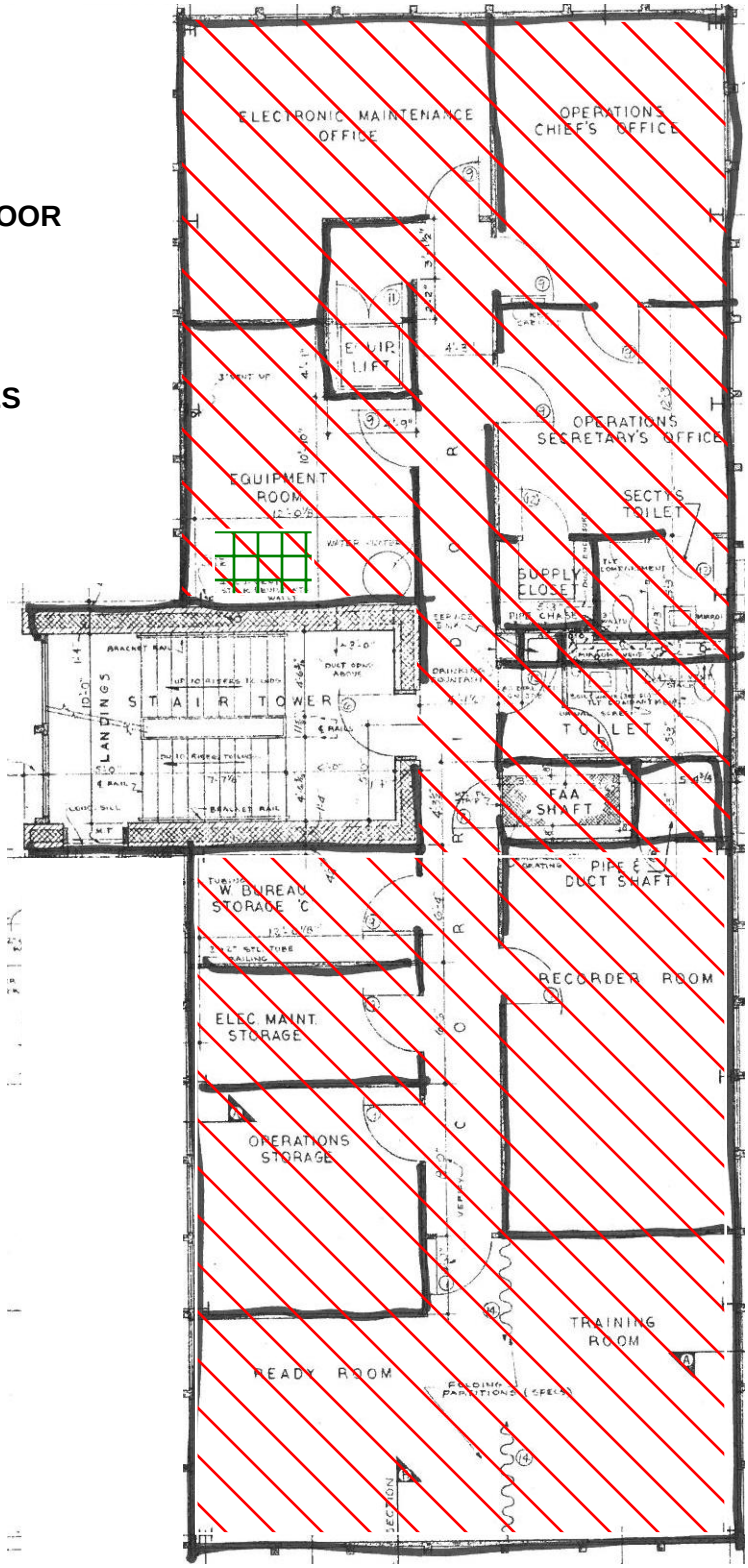
DRAWING 2- SECOND FLOOR

ASBESTOS-CONTAINING FLOOR TILE AND MASTIC

PRESUMED ASBESTOS-CONTAINING ELECTRICAL SWITCHBOXES



NOTE:

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PRESUMED FIRE DOORS WITH INTERIOR ACM CAULK THROUGHOUT, ACM PIPE INSULATION ELBOWS AND FITTING THROUGHOUT AND ADDITIONAL ELECTRICAL SWITCHBOXES.

PRE-DEMOLITON ASBESTOS INSPECTION
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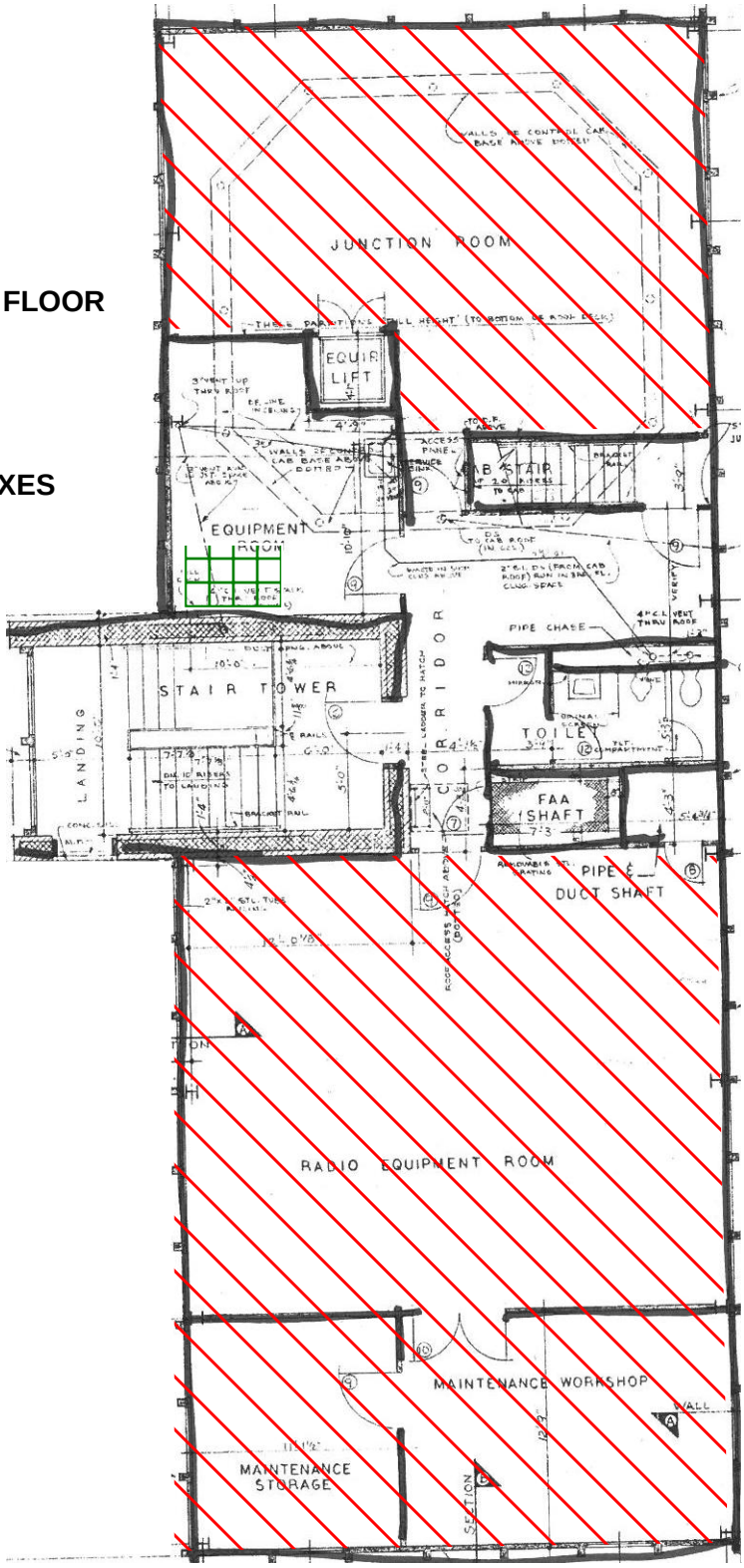
DRAWING 3- THIRD FLOOR

ASBESTOS-CONTAINING FLOOR TILE AND MASTIC

PRESUMED ASBESTOS-CONTAINING ELECTRICAL SWITCHBOXES



NOTE:

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PRESUMED FIRE DOORS WITH INTERIOR ACM CAULK THROUGHOUT, ACM PIPE INSULATION ELBOW AND FITTINGS THROUGHOUT AND ADDITIONAL ELECTRICAL SWITCHBOXES.

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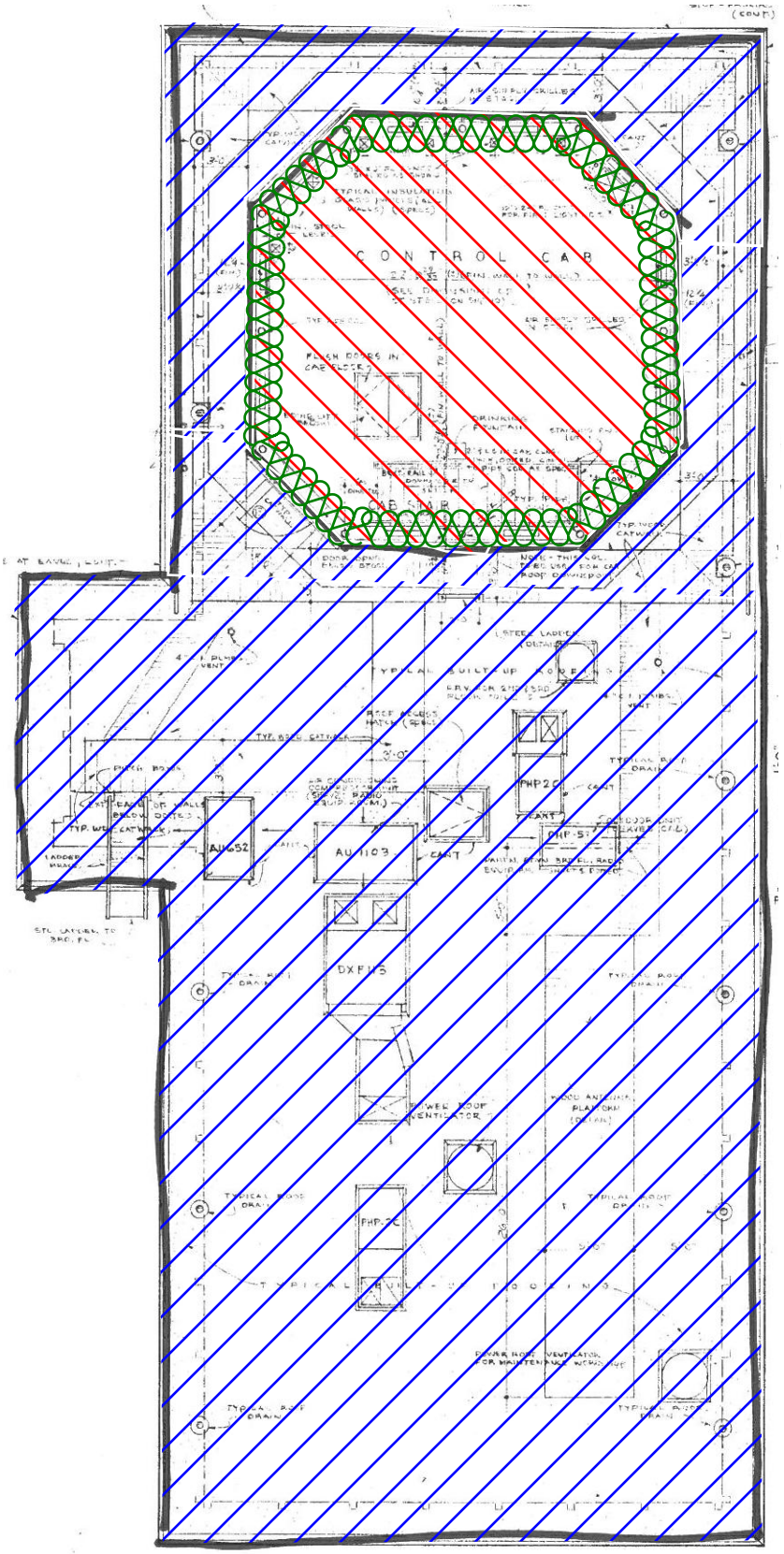
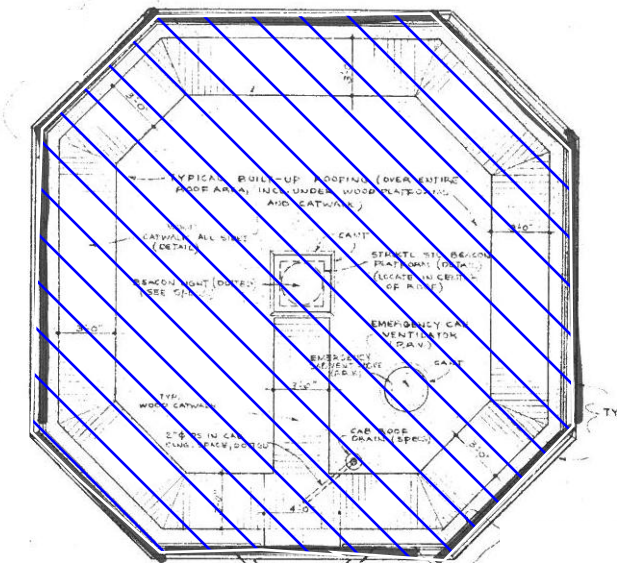
DRAWING 4- CONTROL TOWER AND ROOFS





ASBESTOS-CONTAINING FLOOR TILE AND MASTIC

PRESUMED ASBESTOS-CONTAINING ROOFING MATERIALS

PRESUMED ASBESTOS-CONTAINING ELECTRICAL SWITCHBOXES

NOTE:

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PRESUMED FIRE DOORS WITH INTERIOR ACM CAULK THROUGHOUT, ACM PIPE INSULATION ELBOW AND FITTINGS THROUGHOUT AND ADDITIONAL ELECTRICAL SWITCHBOXES.

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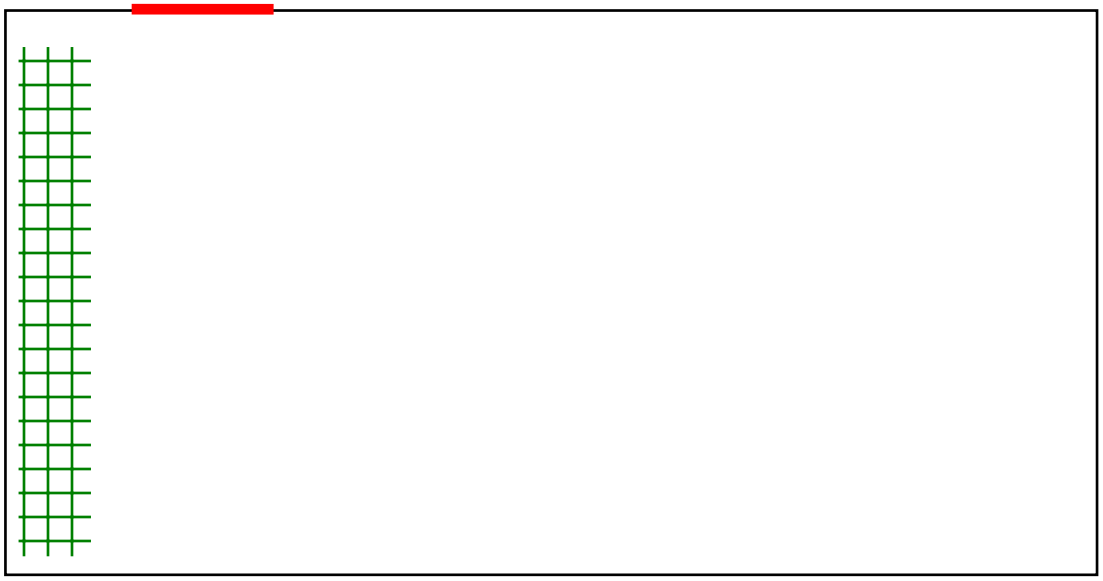
DRAWING 5- TRANSFORMER VAULT

ASBESTOS-CONTAINING DOOR CAULK

PRESUMED ASBESTOS-CONTAINING ELECTRICAL SWITCHBOXES



NOTE:

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PRESUMED FIRE DOORS WITH INTERIOR ACM CAULK THROUGHOUT AND ADDITIONAL ELECTRICAL SWITCHBOXES.