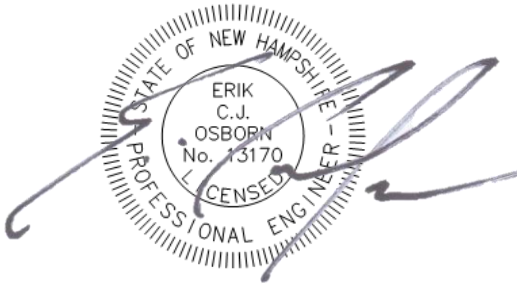
City of Portsmouth, NH
Lafayette Road Pump Station Upgrades



Bid Set

WOODARD &CURRAN

41 Hutchins Drive
Portland, ME 04102
800.426.4262

woodardcurran.com
COMMITMENT & INTEGRITY DRIVE RESULTS

227872.01
City of Portsmouth, NH
February 2017

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SECTION 00 01 10

TABLE OF CONTENTS

END OF SECTION

A. BIDDING REQUIREMENTS

February 2017

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ADVERTISEMENT FOR BIDS

CITY OF PORTSMOUTH, NH
Owner

1 Junkins Avenue, Portsmouth, NH 03801
Address

Separate sealed BIDS for the construction of the **Lafayette Road Pump Station Upgrades** which includes, but is not limited to the following, and all materials and equipment, services and construction inherent to the Work.

The Lafayette Road Pump Station is a municipal wastewater pumping station owned by the City of Portsmouth, NH. It is located at 630 Lafayette Road in the parking lot of a shopping plaza. This project will renovate the pump station to replace and update worn out mechanical, electrical, and control systems. It will also improve operations and maintenance, upgrade the architectural appearance of the station, bring building systems in compliance with modern code to the extent possible. Bypass pumping during construction will be required.

Bids will be received by at the office of: City of Portsmouth, Purchasing Department, City Hall, 1 Junkins Avenue, Portsmouth, NH 03801

until 2:00 PM, (Standard Time-Daylight Savings Time) March 9th, 2017 and then at said office publicly opened and read aloud.

1. Completion time for the project will be calculated as calendar days from the date specified in the "Notice to Proceed" as follows:

   240 calendar days for substantial completion.

   270 calendar days for final completion.

   Liquidated damages will be in the amount of $ 1,000 for each calendar day of delay from the date established for substantial completion, and $ 1,000 for each calendar day of delay from the date established for final completion.

2. Each General Bid shall be accompanied by a Bid Security in the amount of 5% of the Total Bid Price.

3. The successful Bidder must furnish 100% Performance and Payment Bonds, and will be required to execute the Contract Agreement within 10 days following notification of the acceptance of his Bid.

4. No Bidder may withdraw a Bid within 60 days after the actual date of opening thereof.

5. The owner reserves the right to reject any and all bids, to accept any bid, to waiver any informality on bids received, and to omit any item or items it may deem to be in the best interest of the Owner.
6. A mandatory pre Bid conference will be held on February 23rd, 2017 at 10:00 AM on the first floor conference room located at the City of Portsmouth Department of Public Works, 680 Peverly Hill Road, Portsmouth, New Hampshire, 03801 and followed by a visit to the project site. Bidders are encouraged to attend and participate in the conference.

7. Any questions regarding bidding should be directed to the Purchasing Department at 603-610-7227. Any technical questions regarding the plans and specifications should be directed to Woodard & Curran at 207-774-2112.

8. Electronic Contract Documents (Plans, Specifications, and Addenda) may be obtained at the City's website http://www.cityofportsmouth.com/finance/purchasing.htm. Documents are not available for pickup. Questions on the contract documents must be received no later than 4:00PM on March 3rd, 2017. Addenda to this project, if any, including written answers to questions will not be provided directly to bidders, but will be posted on City's website and listed under the project heading by March 6th, 2017. Bidders are responsible for basing their bids on the complete set of Contract Documents associated with the project and made available on the City's website.

INFORMATION FOR BIDDERS

BIDS will be received by CITY OF PORTSMOUTH, NEW HAMPSHIRE

(herein called the "OWNER"), at Purchasing Department, 1 Junkins Ave, Portsmouth, NH 03801

until 2:00 PM on March 9th, 2017 and then at said office publicly opened and read aloud.

Each BID must be submitted in a sealed envelope, addressed to:

City of Portsmouth Purchasing Department at City Hall, 1 Junkins Ave, Portsmouth, NH 03801

Each sealed envelope containing a BID must be plainly marked on the outside as BID

for Bid No. 43-17 Lafayette Road Pump Station Upgrades and the envelope should bear on the outside the BIDDER's name, address, and license number if applicable and the name of the project for which the BID is submitted. If forwarded by mail, the sealed envelope containing the BID must be enclosed in another envelope addressed to the OWNER at

City of Portsmouth, Purchasing Department, City Hall, 1 Junkins Ave, Portsmouth, NH 03801

All BIDS must be made on the required BID form. All blank spaces for BID prices must be filled in, in ink or typewritten, and the BID form must be fully completed and executed when submitted. Only one copy of the BID form is required.

The OWNER may waive any informalities or minor defects or reject any and all BIDS. Any BID may be withdrawn prior to the above scheduled time for the opening of BIDS or authorized postponement thereof. Any BID received after the time and date specified shall not be considered. No BIDDER may withdraw a BID within 60 days after the actual date of the opening thereof. Should there be reasons why the contract cannot be awarded within the specified period, the time may be extended by mutual agreement between the OWNER and the BIDDER.

BIDDERS must satisfy themselves of the accuracy of the estimated quantities in the BID SCHEDULE by examination of the site and a review of the drawings and specifications including ADDENDA. After BIDS have been submitted, the BIDDER shall not assert that there was a misunderstanding concerning the quantities of WORK or of the nature of the WORK to be done.

The OWNER shall provide to BIDDERS prior to BIDDING, all information which is pertinent to, and delineates and describes, the land owned and rights-of-way acquired or to be acquired.

The CONTRACT DOCUMENTS contain the provisions required for the construction of the PROJECT. Information obtained from an officer, agent, or employee of the OWNER or any other person shall not affect the risks or obligations assumed by the CONTRACTOR or relieve him from fulfilling any of the conditions of the contract.

Each BID must be accompanied by a BID BOND payable to the OWNER in the amount of five percent (5%) of the total amount of the BID. As soon as the BID prices have been compared, the OWNER will return the BONDS of all except the three lowest responsible BIDDERS. When the AGREEMENT is executed, the BONDS of the two remaining unsuccessful BIDDERS will be returned. The BID BOND of the successful BIDDER will be retained until the PAYMENT BOND and PERFORMANCE BOND have been executed and approved, after which it will be returned. A certified check may be used in lieu of a BID BOND.

A PERFORMANCE BOND and a PAYMENT BOND, each in the amount of 100 percent of the CONTRACT PRICE, with a corporate surety approved by the OWNER, will be required for the faithful performance of the contract.

Attorneys-in-fact who sign BID BONDS or PAYMENT BONDS and PERFORMANCE BONDS must file with each BOND a certified and effective dated copy of their power of attorney.

The party to whom the contract is awarded will be required to execute the AGREEMENT and obtain the PAYMENT BOND and PERFORMANCE BOND within ten (10) calendar days from the date when NOTICE OF AWARD is delivered to the BIDDER. The NOTICE OF AWARD shall be accompanied by the necessary AGREEMENT and BOND forms. In case of failure of the BIDDER to execute the AGREEMENT, the OWNER may at his option consider the BIDDER in default, in which case the BID BOND accompanying the proposal shall become the property of the OWNER.

The OWNER within ten (10) days of receipt of acceptable PAYMENT BOND, PEERFORMANCE BOND and AGREEMENT signed by the party to whom the AGREEMENT was awarded shall sign the AGREEMENT and return to such party an executed duplicate of the AGREEMENT. Should the OWNER not execute the AGREEMENT within such period, the BIDDER may by WRITTEN NOTICE withdraw his signed AGREEMENT. Such notice of withdrawal shall be effective upon receipt of the notice by the OWNER.

The NOTICE TO PROCEED shall be issued within ten (10) days of the execution of the Agreement by the OWNER. Should there be reasons why the NOTICE TO PROCEED cannot be issued within such period, the time may be extended by mutual agreement between the OWNER and CONTRACTOR. If the NOTICE TO PROCEED has not been issued within the ten (10) day period or within the period mutually agreed upon, the CONTRACTOR may terminate the AGREEMENT without further liability on the part of either party.

The OWNER may make such investigations as he deems necessary to determine the ability of the BIDDER to perform the WORK, and the BIDDER shall furnish to the OWNER all such information and data for this purpose as the OWNER may request. The OWNER reserves the right to reject any BID if the evidence submitted by, or investigation of, such BIDDER fails to satisfy the OWNER that such BIDDER is properly qualified to carry out the obligations of the AGREEMENT and to complete the WORK contemplated therein.

A conditional or qualified BID will <u>not</u> be accepted.

All applicable laws, ordinances, and the rules and regulations of all authorities having jurisdiction over construction of the PROJECT shall apply to the contract throughout.

Each BIDDER is responsible for inspecting the site and for reading and being thoroughly familiar with the CONTRACT DOCUMENTS. The failure or omission of any BIDDER to complete any of the foregoing shall in no way relieve any BIDDER from any obligation in respect to his BID.

The low BIDDER shall supply the names and addresses of major material SUPPLIERS and SUBCONTRACTORS when requested to do so by the OWNER.

MANUFACTURERS EXPERIENCE

Wherever it may be written that an equipment manufacturer must have a specified period of experience with his product, equipment which does not meet the specified experience period can be considered if the equipment supplier or manufacturer is willing to provide a bond or cash deposit for the duration of the specified time period which will guarantee replacement of that equipment in the event of failure.

SAFETY AND HEALTH REGULATIONS

This project is subject to all of the Safety and Health Regulations (CFR 29 Part 1926 and all subsequent amendments) as promulgated by the U.S. Department of Labor on June 24, 1974. Contractors are urged to become familiar with the requirements of these regulations.

NON-DISCRIMINATION IN EMPLOYMENT

Contracts for work under this proposal will obligate the contractors and sub-contractors not to discriminate in employment practices.

COPIES OF THE CONTRACT

There shall be at least five (5) executed copies of the Contract to be distributed as follows:

a) One (1) copy each to the Owner, Engineer, and Contractor.
b) Two (2) copies to the New Hampshire Department of Environmental Services.

BIDDERS QUALIFICATIONS

No award will be made to any Bidder who cannot meet all of the following requirements:

A. He shall not have defaulted nor turned the work over to the bonding company on any contract within three years prior to the bid date.

B. He shall maintain a permanent place of business.

C. He shall have adequate personnel and equipment to perform the work expeditiously.

D. He shall have suitable financial status to meet obligations incidental to the work.

E. He shall have appropriate technical experience satisfactory to the Engineer and the Division in the class of work involved.

F. He shall be registered with the Secretary of State to do business in New Hampshire.

G. He shall have performed to the satisfaction of the Engineer and the Division on previous contracts of a similar nature.

H. He shall not have failed to complete previous contracts on time, including approved time extensions.

WITHDRAWAL OF BIDS

Prior to Bid Opening, bids may be withdrawn upon written or telegraphic request of the Bidder provided confirmation of any telegraphic withdrawal over the signature of the Bidder is placed in the mail and postmarked prior to the time set for Bid Opening. Bid documents and security of any Bidder withdrawing his bid in accordance with the foregoing conditions will be returned.

BID

Proposal of _____ (hereinafter called "BIDDER"), organized and existing under the laws of the State of _____ doing business as _____
(Corporation, Partnership, Individual)

To the City of Portsmouth, New Hampshire (hereinafter called "OWNER").

In compliance with your Advertisement for Bids, BIDDER hereby proposes to perform all WORK For the construction of Bid No. 43-17 Lafayette Road Pump Station Upgrades in strict accordance with the CONTRACT DOCUMENTS, within the time set forth therein, and at the prices stated below.

By submission of this BID, each BIDDER certifies, and in the case of a joint BID each party thereto certifies as to his own organization, that this BID has been arrived at independently, without consultation, communication, or agreement as to any matter relating to the BID with any other BIDDER or with any competitor.

BIDDER hereby agrees to commence WORK under this contract on or before a date to be specified in the NOTICE TO PROCEED and to complete the PROJECT within:

240 consecutive calendar days for substantial completion.

270 consecutive calendar days for final completion.

Liquidated damages will be in the amount of $ 1,000 for each calendar day of delay from the date established for substantial completion and $ 1,000 for each calendar day of delay from the date established for final completion, as provided in Section 18 of the General Conditions.

BIDDER acknowledges receipt of the following ADDENDUM:

_____

_____

_____

The Bidder shall state below what works of a similar character to that of the proposed contract he has performed, and provide such references as will enable the Owner to judge his experience, skill, and business standing.

All questions must be answered and the data given must be clear and comprehensive. This statement must be notarized. If necessary, add separate sheets.

1. Name of Bidder.

2. Permanent Main Office address.

3. When organized?

4. Where incorporated?

5. Is bidder registered with the Secretary of the State to do business in New Hampshire?

6. For how many years has your firm engaged in the contracting business under its present name? Also state names and dates of previous firm names, if any.

7. Contracts on hand. (Schedule these, showing gross amount of each contract and the approximate anticipated dates of completion.)

8. General character of work performed by your company.

9. Have you ever failed to complete any work awarded you in the scheduled contract time, including approved time extensions? __(Yes) __(No).
If so, where and why?

10. Have you ever defaulted on a contract? __(Yes) __(No).
If so, where and why?

11. Have you ever had liquidated damages assessed on a contract? _____(Yes) ____(No).
If so, where and why?

12. List the more important contracts recently executed by your company, stating approximate cost for each, and the month and year completed.

13. List your major equipment <u>available for this contract</u>.

14. List your key personnel such as Project Superintendent and foreman available for this contract.

15. List any subcontractors whom you would expect to use for the following (unless this work is to be done by your own organization):

a. _____
b. _____
c. _____

16. With what banks do you conduct business?

Do you grant the Engineer and/or Owner permission to contact this (these) institutions?
___(Yes) ___(No)

NOTE: Bidders may be required to furnish their latest financial statement as part of the award process.

Respectfully submitted:

_____ _____
Signature Address

_____ _____
Title Date

_____ Being duly sworn, deposes and says that he is

_____ of _____
(Name of Organization)

and that the answers to the foregoing questions and all statements contained therein are true and correct.

Sworn to before me this _____ day of _____ , 20 _____

_____
Notary Public

My commission expires _____

(Seal - If BID is by Corporation)

ATTEST: _____

BIDDER agrees to perform all the work described in the CONTRACT DOCUMENTS for the following unit prices or lump sum:

NOTE: BIDS shall include sales tax and all other applicable taxes and fees.

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BID SCHEDULE

Bidder will complete the Work in accordance with the Contract Documents for the following price(s). **Bidder must complete all items.**

BID PRICES SHALL EXCLUDE SALES AND USE TAX.

BASE BID

Item No.	Item Description with Unit or Lump Sum Price in Written Words	Estimated Quantity & Unit	Unit Bid Price (Figures)	Total Bid Item Price (Figures)
[1]	Administration (Mobilization/Demobilization) @ _____ _____ Dollars and _____Cents PER LS	1 LS		
[2]	Pump Station Upgrades (Base Bid) @ _____ _____ Dollars and _____Cents PER LS	1 LS		
[3]	Repair Type "A" Shallow Concrete Spall Repair @ _____ _____ Dollars and _____Cents PER SF	75 SF		
[4]	Repair Type "B" Polyurethane Crack Injection @ _____ _____ Dollars and _____Cents PER LF	50 LF		
[5]	Owner's Allowance for Electric Service @ ____Thirty Thousand _____ _____ Dollars and _____Zero_____Cents PER ALLOW	1 ALLOW	$30,000	$30,000
[6]	Owner's Allowance for Instrumentation System Integrator @ ____Twenty Thousand _____ _____ Dollars and _____Zero_____Cents PER ALLOW	1 ALLOW	$20,000	$20,000
[7]	Owner's Allowance for Force Main Pigging @ _____Fifteen Thousand _____ _____ Dollars and ____Zero_____Cents PER ALLOW	1 ALLOW	$15,000	$15,000
[8]	Owner's Allowance for Testing @ ____Twenty Thousand _____ _____ Dollars and _____Zero_____Cents PER ALLOW	1 ALLOW	$20,000	$20,000

TOTAL BASE BID PRICE (Sum of Items 1 through 8)

_____

_____ Dollars and

$_____

_____ Cents *(Use figures)*

(Use words)

ADD ALTERNATE 1

Item No.	Item Description with Unit or Lump Sum Price in Written Words	Estimated Quantity & Unit	Unit Bid Price (Figures)	Total Bid Item Price (Figures)
[A-1]	Specialty H2S Coating @ _____ _____ Dollars and _____Cents PER SF	1,500 SF		

TOTAL ADD ALTERNATE 1 PRICE (Sum of Items A-1)

_____

_____ Dollars and

$_____

_____ Cents *(Use figures)*

(Use words)

TOTAL BID PRICE (Sum of Base Bid and Add Alternate 1)

_____

_____ Dollars and

$_____

_____ Cents *(Use figures)*

(Use words)

Bidder acknowledges that estimated quantities are not guaranteed, and are solely for the purpose of comparison of Bids, and final payment for unit price items will be based on actual quantities determined and based on the unit prices included above.

Bids will be compared based on Base Bid or Base Bid plus Alternate 1, whichever is in the best interest of the City.

BID BOND

KNOW ALL MEN BY THESE PRESENTS, that we, the undersigned, _____

_____ as Principal, and

_____ as Surety, are hereby

held and firmly bound unto City of Portsmouth as OWNER

in the penal sum of _____

for the payment of which, well and truly to be made, we hereby jointly and severally bind ourselves, successors and assigns.

Signed, this _____ day of _____

The Condition of the above obligation is such that whereas the Principal has submitted to

_____

a certain BID, attached hereto and hereby made a part hereof to enter into a contract in writing, for the _____

_____

_____

NOW, THEREFORE,

(a) If said BID shall be rejected, or

(b) If said BID shall be accepted and the Principal shall execute and deliver a contract in the Form of Contract attached hereto (Properly completed in accordance with said BID) and shall furnish a BOND for faithful performance of said contract, and for the payment of all persons performing labor or furnishing materials in connection therewith, and shall in all other respects perform the agreement created by the acceptance of said BID, then this obligation shall be void, otherwise, the same shall remain in force and effect; it being expressly understood and agreed that the liability of the Surety for any and all claims hereunder shall, in no event, exceed the penal amount of this obligation as herein stated.

The Surety , for value received, hereby stipulates and agrees that the obligations of said Surety and its BOND shall be in no way impaired or affected by any extension of the time within which the OWNER may accept such BID; and said Surety does hereby waive notice of any such extension.

IN WITNESS WHEREOF, the Principal and the Surety have hereunto set their hands and seals, and such of them as are corporations have caused their corporate seals to be hereto affixed and these presents to be signed by their proper officers, the day and year first set forth above.

_____
Principal

By: _____

_____
Surety

By: _____

IMPORTANT-Surety companies executing BONDS must appear on the Treasury Department's most current list (Circular 570 as amended) and be authorized to transact business in the state of New Hampshire.

B. CONTRACT

February 2017

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NOTICE OF INTENT TO AWARD

Dated _____ , 20 ____

TO: _____
(BIDDER)

ADDRESS: _____

OWNER'S PROJECT NO: 43-17

PROJECT: Lafayette Road Pump Station Upgrades

OWNER'S CONTRACT NO: 43-17

CONTRACT FOR: Lafayette Road Pump Station Upgrades, Department of Public Works,
City of Portsmouth, New Hampshire
(Insert name of contract as it appears in the Bid Documents)

You are notified that your Bid dated _____ for the above Contract has been considered. You are the apparent successful bidder and have been awarded a contract for:

Lafayette Road Pump Station Project

(Indicate total Work, alternates or sections of Work awarded)

The Contract Price of your contract is _____

_____ Dollars ($ _____).

_____ copies of each of the proposed Contract Documents (except Drawings) accompany this Notice of Award. The same number of sets of the Drawings will be delivered separately or otherwise made available to you immediately.

You must comply with the following conditions precedent within ten days of receiving this Notice of Award.

1. You must deliver to the OWNER all of the fully executed counterparts of the Agreement including all the Contract Documents. This includes the sets of Drawings. Each of the Contract Documents must bear your signature on the cover page.

2. You must deliver with the executed Agreement the Contract Security Bonds as specified in the Information for Bidders and General Conditions.

3. (List other conditions precedent).

Proof of Insurance Coverage

Failure to comply with these conditions within the time specified will entitle **OWNER** to consider your bid abandoned, to annul this Notice of Award and to declare your Bid Security forfeited.

Within ten days after receipt of acceptable performance BOND, payment BOND and agreement signed by the party to whom the Agreement was awarded, the **OWNER** will return to you one fully signed counterpart of the Agreement with the Contract Documents attached.

City of Portsmouth, New Hampshire
(OWNER)

By _____
(AUTHORIZED SIGNATURE)
Judie Belanger

Finance Director
(TITLE)

ACCEPTANCE OF NOTICE

Receipt of the above NOTICE OF AWARD is hereby acknowledged

By _____

The _____ day of _____ , 20 _____

By _____

Title _____

Copy to ENGINEER
(Use Certified Mail, Return Receipt Requested)

AGREEMENT

THIS AGREEMENT, made this _____ day of _____ ,20 _____ by and between City of Portsmouth, New Hampshire , hereinafter called **"OWNER"**
(Name of Owner)
and _____ doing business as (an individual,) or (a partnership,) or (a corporation) hereinafter called **"CONTRACTOR" .**

WITNESSETH: That for and in consideration of the payments and agreements hereinafter mentioned:

1. The **CONTRACTOR** will commence and complete the construction of

Bid No. 43-17 Lafayette Rd Pump Station Upgrades
(Project)

2. The **CONTRACTOR** will furnish all of the material, supplies, tools, equipment, labor and other services necessary for the construction and completion of the **PROJECT** described herein.

3. The **CONTRACTOR** will commence the work required by the **CONTRACT DOCUMENTS** within 30 calendar days after the date of the **NOTICE TO PROCEED** unless the period for completion is extended otherwise by the **CONTRACT DOCUMENTS.** Completion time for the project will be calculated as calendar days from the date specified in the **NOTICE TO PROCEED** as follows:

240 calendar days for substantial completion.
270 calendar days for final completion.

Liquidated damages will be in the amount of $ 1,000 for each calendar day of delay from the date established for substantial completion and $ 1,000 for each calendar day of delay from the date established for final completion

4. The **CONTRACTOR** agrees to perform all of the **WORK** described in the **CONTRACT DOCUMENTS** and comply with the terms therein for the sum of $ _____ or as shown in the **BID** schedule.

5. The term "**CONTRACT DOCUMENTS**" means and includes the following:

(A) ADVERTISEMENT FOR BIDS
(B) INFORMATION FOR BIDDERS
(C) BID
(D) BID BOND
(E) NOTICE OF AWARD
(F) AGREEMENT
(G) LABOR AND MATERIAL PAYMENT BOND
(H) PERFORMANCE BOND
(I) CERTIFICATE OF INSURANCE
(J) NOTICE TO PROCEED
(K) CHANGE ORDER(S)
(L) CERTIFICATON OF SUBSTANTIAL COMPLETION
(M) CERTIFICATION OF FINAL COMPLETION
(N) CONTRACTOR'S AFFIDAVIT
(O) CONTRACTOR'S RELEASE
(P) GENERAL CONDITIONS
(R) SPECIAL CONDITIONS
(T) DRAWINGS prepared by:

Woodard & Curran, 41 Hutchins Drive, Portland, Maine

numbered G-000 through I-113 , and dated October , 20 16

(U) SPECIFICATIONS prepared or issued by:

Woodard & Curran, 41 Hutchins Drive, Portland, Maine

, and dated October , 20 16

(V) ADDENDA:

No. _____ , dated _____ , 20 ____
No. _____ , dated _____ , 20 ____
No. _____ , dated _____ , 20 ____
No. _____ , dated _____ , 20 ____
No. _____ , dated _____ , 20 ____

6. The **OWNER** will pay to the **CONTRACTOR** in the manner and at such times as set forth in the General Conditions such amounts as required by the **CONTRACT DOCUMENTS.**

7. This Agreement shall be binding upon all parties hereto and their respective heirs, executors, administrators, successors, and assigns.

IN WITNESS WHEREOF, the parties hereto have executed, or caused to be executed by their duly authorized officials, this Agreement in 5 copies, each of which shall be deemed an original on the date first above written.

OWNER: City of Portsmouth, NH

By: _____

Name: John P. Bohenko, City Manager
(Please type)

ATTEST: _____

Name: _____

Title: _____

CONTRACTOR: _____

By: _____

Name: _____

Address: _____

_____

(SEAL)

ATTEST: _____

Name: _____

Title: _____

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B-3.1

LABOR AND MATERIAL PAYMENT BOND

KNOW ALL MEN BY THESE PRESENTS: that

_____
(Name of Contractor)

_____
(Address of Contractor)

a _____ , hereinafter called Principal,
(Corporation, Partnership or Individual)

and _____
(Name of Surety)

_____
(Address of Surety)

hereinafter called Surety, are held and firmly bound unto

City of Portsmouth, New Hampshire
(Name of Owner)

1 Junkins Avenue, Portsmouth, New Hampshire 03801
(Address of Owner)

hereinafter called **OWNER** and unto all persons, firms, and corporations who or which may furnish labor, or who furnish materials to perform as described under the contract and to their successors and assigns, in the total aggregate penal sum of _____ Dollars, ($ _____) in lawful money of the United States, for the payment of which sum well and truly to be made, we bind ourselves, our heirs, executors, administrators, successors, and assigns, jointly and severally, firmly by these presents.

THE CONDITION OF THIS OBLIGATION is such that whereas, the Principal entered into a certain contract with the **OWNER**, dated the _____ day of _____ 20 ____ , a copy of which is hereto attached and made a part hereof for the construction of:

Lafayette Road Pump Station Upgrades Project

NOW, THEREFORE, if the Principal shall promptly make payment to all persons, firms, and corporations furnishing materials for or performing labor in the prosecution of the **WORK** provided for in such contract, and any authorized extension or modification thereof, including all amounts due for materials, lubricants, oil, gasoline, coal and coke, repairs on machinery, equipment and tools, consumed or used in connection with the construction of such **WORK**, and for all labor cost incurred in such WORK including that be a subcontractor, and to any mechanic or materialman lienholder whether it acquires its lien by operation of State or Federal Law; then this obligation shall be void; otherwise to remain in full force and effect.

PROVIDED, that beneficiaries or claimants hereunder shall be limited to the subcontractors, and persons, firms, and corporations having a direct contract with the PRINCIPAL or its SUBCONTRACTORS.

PROVIDED FURTHER, that the said Surety for value received hereby stipulates and agrees that no change, extension of time, alteration or addition to the terms of the contract or to the **WORK** to be performed thereunder or the **SPECIFICATIONS** accompanying the same shall in any way affect its obligation on this **BOND**, and it does hereby waive notice of any such change, extension of time, alteration or addition to the terms of the contract or to the **WORK** or to the **SPECIFICATIONS**.

PROVIDED, FURTHER that no suit or action shall be commenced hereunder by any claimant: (a) Unless claimant, other than one having a direct contract with the PRINCIPAL shall have given written notice to any two of the following: The PRINCIPAL, the OWNER, or the SURETY above named within ninety (90) days after such claimant did or performed the last of the work or labor, or furnished the last of the materials for which said claim is made, stating with substantial accuracy the amount claimed and the name of the party to whom the materials were furnished, or for whom the work or labor was done or performed. Such notice shall be served by mailing the same by registered mail or certified mail, postage prepaid, in an envelope addressed to the PRINCIPAL, OWNER, or SURETY, at any place where an office is regularly maintained for the transaction business, or served in any manner in which legal process may be served in the state in which the aforesaid project is located, save that such service need not be made by a public officer. (b) After the expiration of one (1) year following the date on which PRINCIPAL ceased work on said CONTRACT, it being understood, however, that if any limitation embodied in the BOND is prohibited by any law controlling the construction hereof, such limitation shall be deemed to be amended so as to be equal to the minimum period of limitation permitted by such law.

PROVIDED, FURTHER, that it is expressly agreed that this BOND shall be deemed amended automatically and immediately, without formal and separate amendments hereto, upon amendment to the Contract not increasing the contract price more than 20 percent, so as to bind the PRINCIPAL and the SURETY to the full and faithful performance of the Contract as so amended. The term "Amendment", wherever used in this BOND and whether referring to this BOND, the contract or the loan Documents shall include any alteration, addition, extension or modification of any character whatsoever.

PROVIDED FURTHER, that no final settlement between the **OWNER** and the **CONTRACTOR** shall abridge the right of any beneficiary hereunder, whose claim may be unsatisfied.

IN WITNESS WHEREOF, this instrument is executed in _____ counterparts, each one of
(number)

which shall be deemed an original, this _____ day of _____ , 20 ____ .

ATTEST:

_____
Principal

By: _____
(Principal) Secretary

(SEAL) **BY** _____

_____
(Address)

By: _____
Witness as to Principal

_____
(Address)

_____
(Surety)

ATTEST: **BY** _____
Attorney - in - Fact

By _____
Witness as to Surety

_____
(Address)

_____

_____
(Address)

NOTE: Date of **BOND** must not be prior to date of Contract.
If **CONTRACTOR** is partnership, all partners should execute BOND.

IMPORTANT: Surety companies executing **BONDS** must appear on the Treasury Department's most current list (Circular 570 as amended) and be authorized to transact business in the State of New Hampshire.

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PERFORMANCE BOND

KNOW ALL MEN BY THESE PRESENTS: that

_____
(Name of Contractor)

_____
(Address of Contractor)

a _____ , hereinafter called Principal,
(Corporation, Partnership or Individual)

and _____
(Name of Surety)

_____
(Address of Surety)

hereinafter called Surety, are held and firmly bound unto

City of Portsmouth, New Hampshire
(Name of Owner)

1 Junkins Avenue, Portsmouth, New Hampshire 03801
(Address of Owner)

hereinafter called **OWNER**, in the total aggregate penal sum of _____

_____ Dollars, $ (_____)

in lawful money of the United States, for the payment of which sum well and truly to be made, we bind ourselves, our heirs, executors, administrators successors, and assigns, jointly and severally, firmly by these presents.

THE CONDITION OF THIS OBLIGATION is such that whereas, the Principal entered into a certain contract with the **OWNER**, dated the _____ day of _____ 20 ___ , a copy of which is hereto attached and made a part hereof for the construction of:

Lafayette Road Pump Station Upgrades

NOW, THEREFORE, if the Principal shall well, truly and faithfully perform its duties, all the undertakings, covenants, terms, conditions, and agreements of said contract during the original term thereof, and any extension thereof which may be granted by the **OWNER**, with or without notice to the Surety and during the one year guaranty period, and if the **PRINCIPAL** shall satisfy all claims and demands incurred under such contract, and shall fully indemnify and save harmless the **OWNER** from all costs and damages which it may suffer by reason of failure to do so, and shall reimburse and repay the **OWNER** all outlay and expense which the **OWNER** may incur in making good any default, then this obligation shall be void: otherwise to remain in full force and effect.

PROVIDED, FURTHER, that the said surety, for value received hereby stipulates and agrees that no change, extension of time, alteration or addition to the terms of the contract or to **WORK** to be performed thereunder or the specifications accompanying same shall in any way affect its obligation on this **BOND**, and it does hereby waive notice of any such change, extension of time alteration or addition to the terms of the contract or to the **WORK** or to the specifications.

PROVIDED, FURTHER, that it is expressly agreed that this **BOND** shall be deemed amended automatically and immediately, without formal and separate amendments hereto, upon amendment to the Contract not increasing the contract price more than 20 percent, so as to bind the **PRINCIPAL** and the **SURETY** to the full and faithful performance of the Contract as so amended. The term "Amendment", wherever used in this **BOND** and whether referring to this **BOND**, the contract or the loan Documents shall include any alteration, addition, extension or modification of any character whatsoever.

PROVIDED, FURTHER, that no final settlement between the **OWNER** and the **CONTRACTOR** shall abridge the right of any beneficiary hereunder, whose claim may be unsatisfied.

IN WITNESS WHEREOF, this instrument is executed in _____ (number) counterparts, each one of which shall be deemed an original, this _____ day of _____ , 20 ____ .

ATTEST:

_____
Principal

By: _____
(Principal) Secretary

(SEAL) **BY** _____

_____
(Address)

By: _____
Witness as to Principal

_____
(Address)

_____
(Surety)

ATTEST: **BY** _____
Attorney - in - Fact

By _____
Witness as to Surety

_____
(Address)

_____
(Address)

NOTE: Date of **BOND** must not be prior to date of Contract.
If **CONTRACTOR** is Partnership, all partners should execute BOND

IMPORTANT: Surety companies executing BONDS must appear on the Treasury Department's most current list (Circular 570 as amended) and be authorized to transact business in the State of New Hampshire

B-5.1

NOTICE TO PROCEED

Dated _____ , 20 ____

TO: _____
(Insert Name of Contractor as it appears in the Bid Documents)

ADDRESS: _____

OWNER'S PROJECT NO. 43-17

PROJECT: Lafayette Road Pump Stations Upgrades

OWNER'S CONTRACT NO. 43-17

CONTRACT FOR: Lafayette Road Pump Station Project

You are notified that the Contract Time under the above contract will commence to run on _____ , 20 ____ . By that date, you are to start performing your obligations under the Contract Documents. In accordance with paragraph 3 of the Agreement, the dates of Substantial Completion and Final Completion are _____ , 20 ____ and _____ , 20 ____ , respectively.

Before you may start any Work at the site, paragraph 27 of the General Conditions provides that you and Owner must each deliver to the other (with copies to ENGINEER) certificates of insurance which each is required to purchase and maintain in accordance with the Contract Documents. Also before you may start any Work at the site, you must:

Submit Preconstruction Photos and Video and appropriate demolition and staging plans

(add other requirements)

Copy to ENGINEER

(Use certified Mail, return Receipt Requested)

City of Portsmouth, New Hampshire
(owner)

By Brian Goetz
(Authorized Representative)

Deputy Director of Public Works
(Title)

ACCEPTANCE OF NOTICE

Receipt of the above NOTICE TO PROCEED is hereby acknowledged by:

_____
(Contractor)

this the _____ , 20 ____

By: _____

Employer Identification Number: _____

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B-6.1

CHANGE ORDER

No. _____

PROJECT:	Lafayette Road PS Upgrades	DATE OF ISSUANCE:	
OWNER:	City of Portsmouth, NH		
	1 Junkins Avenue (Address)		
CONTRACTOR:		OWNER's Project No.	43-17
CONTRACT FOR:	Lafayette Road PS	ENGINEER	Woodard & Curran
		ENGINEER's Project No.	227872.01

You are directed to make the following changes in the Contract Documents.
Description:
Purpose of Change Order:
Justification:
Attachments: (List documents supporting change)

CHANGE IN CONTRACT PRICE	CHANGE IN CONTRACT TIME
Original Contract Price $ _____	Original Contract Time _____ (days or date)
Previous Change Orders $ _____	Net change from previous Change Orders _____ (days)
Contract Price prior to this Change Order $ _____	Contract Time prior to this Change Order _____ (days or date)
Net Increase (Decrease) of this Change Order $ _____	Net Increase (decrease) this Change Order _____ (days)
Contract Price with all approved Change Orders $ _____	Contract Time with all Change Orders _____ (days or date)

This document will become a supplement to the CONTRACT and all provisions will apply hereto. The attached Contractor's Revised Project Schedule reflects increases or decreases in Contract Time as authorized by this Change Order.
Stipulated price and time adjustment includes all costs and time associated with the above described change. Contractor waives all rights for additional time extension for said change. Contractor and Owner agree that the price(s) and time adjustment(s) stated above are equitable and acceptable to both parties.

RECOMMENDED:	APPROVED:	APPROVED:	APPROVED:	APPROVED:
By: _____	By: _____	By: _____	By: _____	By: _____
Engineer	City Manager	Contractor	Finance Department	Dept. of Public Works
_____	_____	_____	_____	_____
Date	Date	Date	Date	Date

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B-7.1

CERTIFICATE OF SUBSTANTIAL COMPLETION

OWNER's Project No.: 43-17 ENGINEER's Project No.: 227872.01

Project: Lafayette Road Pump Station Upgrades

CONTRACTOR: _____

Contract For: Lafayette Road PS Upgrades Contract Date: _____

This Certificate of Substantial Completion applies to all Work under the Contract Documents or to the following specified parts thereof:

To: _____
(Owner)

And To: _____
(Contractor)

The Work to which this Certificate applies has been inspected by authorized representatives of OWNER, CONTRACTOR and ENGINEER, and that Work is hereby declared to be substantially complete in accordance with the Contract Documents on

_____
(Date of Substantial Completion)

A tentative list of items to be completed or corrected is attached hereto. This list may not be all-inclusive, and the failure to include an item in it does not alter the responsibility of CONTRACTOR to complete all the Work in accordance with the Contract Documents. The items in the tentative list shall be completed or corrected by CONTRACTOR within _____ calendar days of the above date of Substantial Completion.

The responsibilities between OWNER and CONTRACTOR for security, operation, safety, maintenance, heat, utilities, insurance and warranties shall be as follows:

RESPONSIBILITIES:

OWNER: _____

_____

CONTRACTOR: _____

_____

The following documents are attached to and made a part of this Certificate:

_____

_____

_____

_____

This certificate does not constitute an acceptance of Work not in accordance with the Contract Documents nor is it a release of CONTRACTOR's obligation to complete the Work in accordance with the Contract Documents.

Executed by ENGINEER on _____ , 20 _____

Woodard & Curran
(Engineer)

By: _____

CONTRACTOR accepts this Certificate of Substantial Completion on _____ , 20 _____

_____
(Contractor)

By: _____

OWNER accepts this Certificate of Substantial Completion on _____ , 20 _____

City of Portsmouth, New Hampshire
(Owner)

By: _____

CERTIFICATE OF FINAL COMPLETION
NH DEPARTMENT OF ENVIRONMENTAL SERVICES

Owner's Project No. 43-17 Engineer's Project No. 227872.01

Project Lafayette Road Pump Station Upgrades

Owner: City of Portsmouth, New Hampshire

Contractor: _____

Engineer: Woodard & Curran

Agreement Date: _____

Notice to Proceed Date: _____

Contractual Substantial Completion Date as modified by Change Orders: _____

Actual Substantial Completion Date: _____

Contractual Final Completion Date as modified by Change Orders: _____

The Work to which this Certificate applies has been inspected by authorized representatives of Owner, Contractor, Engineer and NHDES, the punch list has been completed and the Work of the Contract is hereby declared to be Finally Complete in accordance with the Contract Documents on:

_____
Date of Final Completion

This Certificate does not constitute an acceptance of any Work not in accordance with the Contract Documents nor is it a release of Contractor's obligation to complete the Work in accordance with the Contract Documents. The Warranty for all Work completed subsequent to the date of Substantial Completion expires one year from the date of this Final Acceptance.

Executed by Engineer on: _____, 20____

By:_____

Contractor Accepts this Certificate of Final Completion on: _____, 20____

By:_____

Owner Accepts this Certificate of Final Completion on: _____, 20____

By: Brian Goetz, Deputy Director of Public Works _____

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B-9.1

CONTRACTOR'S AFFIDAVIT

STATE OF: _____

COUNTY OF: _____

Before me, the undersigned, a _____
(Notary Public, Justice of Peace, Alderman)

in and for said County and State personally appeared, _____
(Individual, Partner or duly

_____ who being duly sworn according to law
authorized representative of corporate contractor)

deposes and says that the cost of all the Work, and outstanding claims and indebtedness of whatever

nature arising out of the performance of the contract between City of Portsmouth, New Hampshire
(Owner)

and _____ of _____
(Contractor) (Address)

dated _____ for the construction of the Lafayette Road Pump Station Upgrades
(Project Name)

and necessary appurtenant installations have been paid in full.

_____
(Individual, Partner, or duly authorized representative of corporate contractor)

_____
(Title)

Sworn to and subscribed before me

this _____ day of _____ , 20 ___

_____

_____
Notary Public

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CONTRACTOR'S FINAL RELEASE AND WAIVER OF LIEN

Project/Owner	Contractor
Project: Lafayette Road Pump Station Upgrades	Name_____
Address: Lafayette Road	Address:_____
Portsmouth NH 03801 City State Zip	_____ City State Zip
Owner City of Portsmouth	Contractor License:_____
1 Junkins Avenue, Portsmouth, NH 03801	Contract Date:_____

TO ALL WHOM IT MAY CONCERN:

For good and valuable consideration, the receipt and sufficiency of which is hereby acknowledged, the undersigned Contractor hereby waives, discharges, and releases any and all liens, claims, and rights to liens against the above-mentioned project, and any and all other property owned by or the title to which is in the name of the above-referenced Owner and against any and all funds of the Owner appropriated and available for the construction of said project, and any and all warrants drawn upon or issued against any such funds or monies, which the undersigned Contractor may have or may hereafter acquire or process as a result of the furnishing of labor, materials, and/or equipment, and the performance of Work by the Contractor on or in connection with said project, whether under and pursuant to the above-mentioned contract between the Contractor and the Owner pertaining to said project or otherwise, and which said liens, claims or rights of lien may arise and exist.

The undersigned further hereby acknowledges that the sum of

_____

Dollars ($_____) constitutes the entire ***unpaid*** balance due the undersigned in Connection with said project whether under said contract or otherwise and that the payment of said sum to the Contractor will constitute payment in full and will fully satisfy any and all liens, claims, and demands which the Contractor may have or assert against the Owner in connection with said contract or project.

Dated this ___ day of _____20__

_____
Contractor

Witness to Signature

By_____ By_____

Title_____ Title_____

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C. GENERAL CONDITIONS

May 2015

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GENERAL CONDITIONS

Index

GENERAL CONDITIONS

42. Protection of Lives and Health
43. OSHA Construction Safety Program
44. Equal Employment Opportunity
45. Interest of Federal, State or Local Officials
46. Other Prohibited Interests
47. Use and Occupancy Prior to Acceptance
48. Suspension of Work
49. [Reserved]
50. [Reserved]
51. [Reserved]
52. Project Sign
53. [Reserved]
54. Public Convenience and Traffic Control
55. Pre-Construction Conference
56. Maintenance During construction
57. Cooperation with Utilities
58. Work Performed at Night, and on Sundays and Holidays
59. Laws to be Observed
60. Permits
61. Control of Pollution
62. Use of Explosives
63. Arbitration by Mutual Agreement
64. Taxes
65. Separate Contracts

GENERAL CONDITIONS

1. Contract and Contract Documents. The plans, information for bidders, bids, advertisement for bids, bid payment and performance bonds, Agreements, change orders, notice to proceed, specifications and addenda, hereinafter enumerated in the Agreement, shall form part of this Contract and the provisions thereof shall be as binding upon the parties hereto as if they were herein fully set forth. The table of contents, titles, headings, running headlines and marginal notes contained herein and in said documents are solely to facilitate reference to various provisions of the Contract Documents and in no way affect, limit or cast light on the interpretation of the provisions to which they refer.

2. Definitions.

2.1 "Addenda" means written or graphic instruments issued prior to the execution of the Agreement which modify or interpret the Contract Documents, drawings and specifications, by additions, deletions, clarifications or corrections. Such written or graphic instruments will be issued no less than five days before the bid opening.

2.2 "Bid" means the offer or proposal of the bidder submitted on the prescribed form setting forth the prices for the work to be performed.

2.3 "Bidder" means any person, firm or corporation submitting a bid for the work.

2.4 "Bonds" means bid, performance, and payment bonds and other instruments of security, furnished by the Contractor and his surety in accordance with the Contract Documents.

2.5 "Change Order" means a written order to the Contractor authorizing an addition, deletion or revision in the work within the general scope of the Contract Documents, or authorizing an adjustment in the Contract Price or Contract Time.

2.6 "Contract Documents" means the Contract, including any advertisement for bids, information for bidders, bid, bid bond, Agreement, payment bond, performance bond, notice of award, notice to proceed, change orders, drawings, specifications and addenda.

2.7 "Contract Price" means the total monies payable to the Contractor under the terms and conditions of the Contract Documents.

2.8 "Contract Time" means the number of calendar days stated in the Contract Documents for the completion of the Work.

2.9 "Contractor" means the person, firm or corporation with whom the Owner has executed the Agreement.

2.10 "Division" means the state of New Hampshire Department of Environmental Services, Water Division.

2.11 “Drawings” mean the part of the Contract Documents which show the characteristics and scope of the work to be performed and which have been prepared or approved by the Engineer.

2.12 “Engineer” means the person, firm or corporation named as such in the contract documents.

2.13 “Field order” means a written order effecting a change in the work not relating to an adjustment in the contract price or an extension of the contract time and issued by the Engineer to the Contractor during construction.

2.14 “Notice of Award” means the written notice of the acceptance of the Bid from the Owner to the successful Bidder.

2.15 “Notice to Proceed” means the written communication issued by the Owner to the Contractor authorizing him to proceed with the Work and establishing the date of commencement of the Work.

2.16 “Owner” means a public or quasi-public body or authority, corporation, association, partnership, or individual for whom the work is to be performed.

2.17 “Plans” means the contract drawings or exact reproductions thereof which show the scope, character, dimensions and details of the work and which have been prepared or approved by the Engineer.

2.18 “Project” means the undertaking to be performed as provided in the Contract Documents.

2.19 “Resident Project Representative” means the authorized representative of the Owner who is assigned to the Project site or any part thereof.

2.20 “Shop Drawings” means all drawings, diagrams, illustrations, brochures, schedules and other data which are prepared by the Contractor, a Subcontractor, manufacturer, supplier or distributor, which illustrates how specific portions of the Work shall be fabricated or installed.

2.21 “Special conditions” means revisions or additions to these general conditions, Supplemental General Conditions or specifications applicable to an individual project.

2.22 “Specifications” means a part of the contract documents consisting of written descriptions of a technical nature of materials, equipment, construction systems, standards and workmanship.

2.23 “Subcontractor” means an individual, firm or corporation having a direct contract with the Contractor or with any other Subcontractor for the performance of a part of the Work at the site.

2.24 “Substantial Completion” means that date as certified by the Engineer when the construction of the Project or a specified part thereof is sufficiently completed, in

accordance with the Contract Documents, so that the Project or specified part can be utilized for the purposes for which it is intended.

2.25 "Supplemental General Conditions" means modifications to these general conditions required by a Federal agency for participation in the PROJECT and approved by the agency in writing prior to inclusion in the CONTRACT DOCUMENTS, or such documents that may be imposed by applicable State laws.

2.26 "Supplier" means any person or organization who supplies materials or equipment for the Work, including that fabricated to a special design, but who does not perform labor at the site.

2.27 "Work" means all labor necessary to produce the construction required by the contract documents, and all materials and equipment incorporated or to be incorporated in the project.

2.28 "Written Notice" means any notice to any party of the Agreement relative to any part of this Agreement in writing and considered delivered and the service thereof completed, when posted by certified or registered mail to the said party at his last given address, or delivered in person to said party or his authorized representative on the Work.

3. Additional Instructions and Detail Drawings. The Contractor may be furnished additional instructions and detail drawings as necessary to carry out the work included in the contract. 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 part thereof.

4. Shop or Setting Drawings. Shop or setting drawings shall be in accordance with the following:

4.1 The Contractor shall furnish 6 copies of the manufacturer's shop drawings, specific design data as required in the detailed specifications, and technical literature covering all equipment and fabricated materials which he proposes to furnish under this contract in sufficient detail to indicate full compliance with the specifications. Shop drawings shall indicate the method of installing, the exact layout dimensions of the equipment or materials, including the location, size and details of valves, pipe connections, etc.

4.2 No equipment or materials shall be shipped until the manufacturer's shop drawings and specifications or other identifying data, assuring compliance with these specifications, are approved by the Engineer.

4.3 The Contractor shall check and verify all field measurements and shall be responsible for the prompt submission of all shop and working drawings so that there shall be no delay in the work.

4.4 Regardless of corrections made in or approval given to such drawings by the Engineer, the Contractor will nevertheless be responsible for the accuracy of such

drawings and for their conformity to the plans and specifications. The Contractor shall notify the Engineer in writing of any deviations at the time he furnishes such drawings. He shall remain responsible for the accuracy of the drawings showing the deviations but not for the acceptance of the deviations from the original design shown in the plans and specification. Approval by the Engineer and the Owner of any deviation in material, workmanship or equipment proposed subsequent to approval of the shop drawings or design data, shall be requested in writing by the Contractor.

4.5 When submitted for the Engineer's review, Shop Drawings shall bear the Contractor's certification that he has reviewed, checked and approved the Shop Drawings and that they are in conformance with the requirements of the Contract Documents.

5. Materials, Services, Facilities and Workmanship shall be furnished as follows:

5.1 Except as otherwise specifically stated in the contract documents, the Contractor shall provide and pay for all materials, labor, tools, equipment, water, light, power, transportation, superintendence, temporary construction of every nature, and all other services and facilities of every nature whatsoever necessary to execute, complete, and deliver the work within the specified time.

5.2 Unless otherwise specifically provided for in the specifications, all workmanship, equipment, materials and articles incorporated in the work shall be new and the best grade of the respective kinds for the purpose.

5.3 The Contractor shall furnish to the Engineer for approval the manufacturer's detailed specifications for all machinery, mechanical and other special equipment, which he contemplates installing together with full information as to type, performance characteristics, and all other pertinent information as required.

5.4 Materials which are specified by reference to the number or symbol of a specific standard, such as an ASTM standard, a federal specification or other similar standard, shall comply with requirements in the latest revision thereof and any amendment or supplement thereto in effect on the date of the advertisement for bids, except as limited to type, class or grade, or modified in such reference. The standards referred to shall have full force and effect as though printed therein.

5.5 For equipment or for materials, when requested by the Engineer, the Contractor shall submit certificates of compliance from the manufacturer, certifying that the equipment or the materials comply with the requirements of the specifications or the standards.

5.6 Manufactured articles, materials, and equipment shall be applied, installed, connected, erected, used, cleaned and conditioned as directed by the manufacturer.

5.7 Materials, supplies, and equipment shall be in accordance with samples submitted by the Contractor and approved by the Engineer.

6. Contractor's Title To Materials. No material, supplies, or equipment to be installed or furnished under this contract shall be purchased subject to any chattel mortgage or under a conditional sale, lease purchase or other agreement by which an interest therein or in any part thereof is retained by the seller or supplier. The Contractor shall warrant good title to all materials, supplies, and equipment installed or incorporated in the work and upon completion of all work, shall deliver the same together with all improvements and appurtenances constructed or placed thereon by him to the Owner free from any claims, liens, or charges. Neither the Contractor nor any person, firm or corporation furnishing any material or labor for any work covered by this contract shall have any right to a lien upon any improvement or appurtenance thereon. Nothing contained in this paragraph, however, shall defeat or impair the right of persons furnishing materials or labor to recover under any bond given by the Contractor for their protection or any rights under any law permitting such persons to look to funds due the Contractor in the hands of the Owner. The provisions of this paragraph shall be inserted in all subcontracts and material contracts and notice of its provisions shall be given to all persons furnishing materials for the work when formal contract is entered into for such materials.

7. Inspection and Testing of Materials shall be as follows:

7.1 All materials and equipment used in the construction of the project shall be subject to inspection and testing by the Engineer in accordance with accepted standards at any and all times during manufacture or during the project construction and at any or all places where such manufacture is carried on.

7.2 The Contractor shall furnish promptly upon request by the Engineer, all materials required to be tested. All tests made by the Engineer shall be performed in such manner and ahead of scheduled installation, as not to delay the work of the Contractor. When required, testing of concrete, masonry, soils, pipe and pipe materials will be made in accordance with provisions in the specifications.

7.3 Material required to be tested which is delivered to the job site shall not be incorporated into the work until the tests have been completed and approval or acceptance given in writing by the Engineer.

7.4 Each sample submitted by the Contractor for testing shall carry an identification label containing such information as is requested by the Engineer. It shall also include a statement that the samples are representative of the remaining materials to be used on the project.

7.5 Approval of any materials shall be general only and shall not constitute a waiver of the Owner's right to demand full compliance with the contract requirements.

7.6 The Engineer may, at his own discretion, undertake the inspection of materials at the source. In the event plant inspection is undertaken, the following conditions shall be met:

a. The Engineer shall have the cooperation and assistance of the Contractor and the producer with whom he has contracted for materials.

b. The Engineer shall have full entry at all reasonable times to such areas as may concern the manufacture or production of the materials being furnished.

c. If required, the Contractor shall arrange for a building for the use of the inspector; such building to be located near the plant, independent of any building used by the material producer, in which to house and use the equipment necessary to carry on the required tests. Cost for such arrangement shall be paid by the Owner as a stated allowance in the bid.

d. Adequate safety measures shall be provided and maintained at all times.

7.7 Except as otherwise specifically stated in the contract, the costs of sampling and testing will be divided as follows:

a. The Contractor shall furnish the Engineer, without extra cost, all samples required for testing purposes. All sampling and testing including the number and selection of samples shall be determined by the Engineer for his own information and use.

b. When testing of materials is specified in the appropriate section of the specifications, the cost of the same shall be charged to the Owner or Contractor, as detailed in the specifications. However, costs of equipment performance tests shall be borne by the Contractor, as detailed in the appropriate section of the specifications.

c. When the Contractor proposes a material, article or component as equal to the ones specified, reasonable tests may, or may not, be required by the Engineer. If the Engineer requires tests of a proposed equal item, the Contractor will be required to assume all costs of such testing.

d. Any material, article or component which fails to pass tests required by the Engineer or by the specifications, will be rejected and shall be removed from the project site. However, if, upon request of the Contractor, retesting or further tests are permitted by the Engineer, the Contractor shall assume all costs related to such retesting or further tests.

e. Neither the Owner nor the Engineer will in any way be charged for the manufacturer's costs in supplying certificates of compliance.

7.8 If the Contract Documents, laws, ordinances, rules, regulations or orders of any public authority having jurisdiction require any Work to specifically be inspected, tested or approved by someone other than the Contractor, the Contractor will give the Engineer

timely notice of readiness. The Contractor will then furnish the Engineer with the required certificates of inspection, testing or approval.

7.9 Inspections, tests, or approvals by the engineer or others shall not relieve the Contractor from obligations to perform the Work in accordance with the requirements of the Contract Documents.

8. "Or Equal" Clause, Substitutions and Contractor Options.

8.1 Whenever a material, article, or piece of equipment is identified on the plans or in the specifications by reference to manufacturer's or vendor's names, trade names, catalogue numbers, etc., it is intended merely to establish a standard of quality and performance. Any material, article, or equipment of other manufacturers and vendors, which will perform satisfactorily the duties imposed by the general design, shall be considered equally acceptable provided the material, article, or equipment so proposed is, in the opinion of the Engineer, of equal quality and function. The Engineer shall determine equality based on such information, tests, or other supporting data that may be required of the Contractor.

8.2 Upon acceptance and approval by the Engineer of an equal product, it shall remain the responsibility of the Contractor to coordinate installation of the item with all other items to be furnished to assure proper fitting together of all items. Similar responsibility applies to items which are left to the Contractor's option. Any additional cost of equal items and any additional cost incidental to the coordination and/or fitting together of such items shall be borne by the Contractor at no extra cost to the Owner.

8.3 If a specified or equal item is not available to meet the construction schedule, the Contractor may propose a substitute item of less than equal performance and quality. If this substitute is acceptable to the Engineer, any difference in purchase cost or costs incidental to the installation of such item will be negotiated between the parties to the contract.

8.4 Neither equal nor substitute items shall be installed without written approval of the Engineer.

8.5 The Contractor shall warrant that if substitutes are approved, no major changes in the function or general design of the Project will result.

9. Patents. Patent information is as follows:

9.1 The Contractor shall hold and save the Owner and its officers, agents, servants, and employees harmless from liability of any nature or kind, including cost and expenses for, or on account of, any patented or unpatented invention, process, article, or appliance manufactured or used in the performance of the contract, including its use by the Owner, unless otherwise specifically stipulated in the contract documents.

9.2 License and/or royalty fees for the use of a process used in wastewater plant design which is authorized by the Owner for the project, must be reasonable, and paid to the holder of the patent, or his authorized licensee.

9.3 If the Contractor uses any design, device or materials in the construction methods for the project covered by patents or copyrights, he shall provide for such use by suitable agreement with the owner of such patented or copyrighted design, device or material. It is mutually agreed and understood, that, without exception, the contract prices shall include all royalties or costs arising from the use of such design, device or materials, in any way involved in the work. The Contractor and/or his sureties shall indemnify and save harmless the Owner of the project from any and all claims for infringement by reason of the use of such patented or copyrighted design, device or materials or any trademark or copyright in connection with work agreed to be performed under this contract, and shall indemnify the Owner for any cost, expense or damage which it may be obliged to pay by reason of such infringement at any time during the construction of the work or after completion of the work.

10. Surveys. Surveys of land, property and construction shall be as follows:

10.1 The Owner will provide all land surveys and will establish and locate all property lines relating to the project.

10.2 For structures, the Engineer will establish and stake out one or more base lines as needed and will establish bench marks in and around the project site for the use of the Contractor and for the Engineer's own reference in checking the work in progress. For structures such as pipelines, the Engineer will establish the location of the pipe, manholes and other appurtenances, and will establish bench marks along the route of the pipeline at intervals for the using of the Contractor and for his own reference in checking the pipe and manhole inverts and other elevations throughout the project. The Contractor shall utilize the lines and bench marks established by the Engineer to set up whatever specific detail controls he may need for establishing location, elevation lines and grades of all structures. All this work is subject to checking, approval, and continuous surveillance by the Engineer to avoid error. The Contractor shall provide the Engineer with a qualified man or men to assist in this checking as needed and on request of the Engineer.

10.3 For construction other than pipelines and appurtenances in roadways and cross country, the Contractor shall be responsible for the location and setting lines and grades. The Contractor shall establish the location for pump station and wastewater treatment facility structures, associated yard piping including electrical conduits, internal piping and all equipment. Base lines and benchmarks for setting of the lines and grades for the above shall be provided by the Engineer.

10.4 Protection of stakes. The Contractor shall protect and preserve all of the established baseline stakes, bench marks, or other controls placed by the Engineer. Any of these items destroyed or lost through fault of the Contractor will be replaced by the Engineer at the Contractor's expense.

11. Contractor's Obligations are as follows: The Contractor shall and in good workmanlike manner, do and perform all work and furnish and pay for all supplies and materials, machinery, equipment, facilities and means, except as herein otherwise expressly specified, necessary or proper to perform and complete all the work required by this contract, within the time stated in the proposal in accordance with the plans and drawings covered by this contract, and any and all supplemental plans and drawings, in accordance with the directions of the Engineer as given from time to time during the progress of the work, whether or not he considers the direction in accordance with the terms of the contract. He shall furnish, erect, maintain and remove such construction plant and such temporary works as may be required. The Contractor shall observe, comply with, and be subject to all terms, conditions, requirements, and limitations of the contract documents, and shall do, carry on and complete the entire work to the satisfaction of the Engineer and Owner.

Contractor shall carry on the work and adhere to the progress schedule during all disputes, disagreements or unresolved claims with the Owner. No work shall be delayed or postponed pending the resolution of any disputes, disagreements, or claims except as the Owner and Contractor may otherwise agree in writing.

12. Weather Conditions. In the event of temporary suspension of work, or during inclement weather, or whenever the Engineer shall direct, the Contractor and his Subcontractors shall protect their work and materials against damage or injury from the weather. If, in the opinion of the Engineer, any work or material shall have been damaged or injured by reason of failure on the part of the Contractor or any of his Subcontractors to so protect his work, such materials shall be removed and replaced at the expense of the Contractor.

13. Protection of Work and Property shall be provided as follows:

13.1 The Contractor shall at all times safely guard the Owner's property from injury or loss in connection with this contract. He shall at all times safely guard and protect his own work, and that of adjacent property, from damage. The Contractor shall replace or make good any such damage, loss or injury unless caused directly by errors contained in the contract, or by the Owner, or his authorized representatives. The Contractor will notify owners of adjacent utilities when prosecution of the Work may affect them.

13.2 The Contractor shall take all necessary precautions for the safety of employees on the work site, and shall comply with all applicable provisions of federal, state and municipal safety laws and building codes to prevent accidents or injury to persons on, about or adjacent to the premises where the work is being performed. He shall erect and properly maintain at all times, as required by the conditions and progress of the work, all necessary safeguards for the protection of the workmen and the public and shall post danger signs warning against the hazards created by such features of construction as protruding nails, hoists, well holes, elevator hatchways, scaffolding, window openings, stairways, trenches and other excavations, and falling materials, and he shall designate a responsible member of his organization on the work, whose duty shall be the prevention of accidents. The name and position of any person so designated shall be reported to the

Engineer by the Contractor. The person so designated shall be available by phone during nonworking hours.

13.3 In case of emergency which threatens loss or injury of property, and/or safety of life, the Contractor is allowed to act, without previous instructions from the Engineer. He shall notify the Engineer immediately thereafter. Any claim for compensation by the Contractor due to such extra work shall be promptly submitted in writing to the Engineer for approval.

13.4 When the Contractor has not taken action but has notified the Engineer of an emergency threatening injury to persons or damage to the work or any adjoining property, he shall act as instructed or authorized by the Engineer.

13.5 The intention is not to relieve the Contractor from acting, but to provide for consultations between Engineer and Contractor in an emergency which permits time for such consultations.

13.6 The amount of reimbursement claimed by the Contractor on account of any emergency action shall be determined in the manner provided in Article 17 (extra work and change orders) of the general conditions.

14. Inspection of work for conformance with plans and specifications.

14.1 For purposes of inspection and for any other purpose, the Owner, the Engineer, and agents and employees of the Division or of any funding agency may enter upon the work and the premises used by the Contractor, and the Contractor shall provide safe and proper facilities therefore. The Engineer shall be furnished with every facility for ascertaining that the work is in accordance with the requirements and intention of this contract, even to the extent of uncovering or taking down portions of finished work.

14.2 During construction and on its completion, all work shall conform to the location, lines, levels and grades indicated on the drawings or established on the site by the Engineer and shall be built in a workmanlike manner, in accordance with the drawings and specifications and the supplementary directions given from time to time by the Engineer. In no case shall any work which exceeds the requirements of the drawings and specifications be paid for as extra work unless ordered in writing by the Engineer.

14.3 Unauthorized work and work not conforming to plans and specifications shall be handled as follows:

a. Work considered by the Engineer to be outside of or different from the plans and specifications and done without instruction by the Engineer, or in wrong location, or done without proper lines or levels, may be ordered by the Engineer to be uncovered or dismantled.

b. Work done in the absence of the Engineer or his agent may be ordered by the Engineer to be uncovered or dismantled.

c. Should the work thus exposed or examined prove satisfactory, the uncovering or dismantling and the replacement of material and rebuilding of the work shall be considered as "Extra Work" to be processed in accordance with article 17.

d. Should the work thus exposed or examined prove to be unsatisfactory the uncovering or dismantling and the replacement of material and rebuilding of the work shall be at the expense of the Contractor.

15. Reports, Records and Data shall be furnished as follows: The Contractor shall submit to the Owner such schedule of quantities and costs, progress schedules, payrolls, reports, estimates, records and other data as are required by the Contract Documents or as the Owner, Division or any funding agency may request concerning work performed or to be performed under this contract.

16. Superintendence by Contractor shall be furnished as follows: At the site of the work, the Contractor shall employ a competent construction superintendent or foreman who shall have full authority to act for the Contractor. The superintendent or foreman shall have been designated in writing by the Contractor as the Contractor's representative at the site. It is understood that such representative shall be acceptable to the Engineer and shall be the one who can be continued in that capacity for the particular job involved unless he ceases to be on the Contractor's payroll. Such representative shall be present on the site at all times as required to perform adequate supervision and coordination of the Work.

17. Extra Work and Change Orders shall be processed as follows:

17.1 The Engineer may at any time by written order and without notice to the sureties require the performance of such extra work or changes in the work as may be found necessary. The amount of compensation to be paid to the Contractor for any extra work so ordered shall be made in accordance with one or more of the following methods in the order of precedence listed below:

a. A price based on unit prices previously approved; or

b. A lump sum price agreed upon between the parties and stipulated in the order for the extra work;

c. A price determined by adding 15 percent to the "reasonable cost" of the extra work performed, such "reasonable cost" to be determined by the Engineer in accordance with the following paragraph.

17.2 The Engineer shall include the reasonable cost to the Contractor of all materials used, of all labor, both common and skilled, of foreman, trucks, and the fair-market rental rate for all machinery and equipment for the period employed directly on the work. The reasonable cost for extra work shall include the cost to the Contractor of any additional

insurance that may be required covering public liability for injury to persons and property, the cost of workmen's compensation insurance, federal social security, and any other costs based on payrolls, and required by law. The cost of extra work shall not include any cost or rental of small tools, buildings, or any portion of the time of the Contractor, his project supervisor or his superintendent, as assessed upon the amount of extra work, these items being considered covered by the 15 percent added to the reasonable cost. The reasonable cost for extra work shall also include the premium cost, if any, for additional bonds and insurance required because of the changes in the work.

17.3 In the case of extra work which is done by Subcontractors under the specific contract, or otherwise if so approved by the Engineer, the 15 percent added to the reasonable cost of the work will be allowed only to the Subcontractor. On such work an additional percentage of the reasonable cost (before addition of the 15 percent) will be paid to the Contractor for his work in directing the operations of the Subcontractor, for administrative supervision, and for any overhead costs. Such percentage shall be in accordance with the following schedule: reasonable cost up to and including $50,000—10 percent; next $50,000 to and including $100,000—7½ percent; greater than $100,000—5 percent.

17.4 The Engineer may authorize minor changes or alterations in the work not involving extra cost and not inconsistent with the overall intent of the contract documents. These shall be accomplished by a written field order. However, if the Contractor believes that any minor change or alteration authorized by the Engineer entitles him to an increase in the contract price, he may make a claim therefore as provided in article 21.

18. Time For Completion and Liquidated Damages. The following paragraphs address time for completion and liquidated damages:

18.1 It is hereby understood and mutually agreed, by and between the Contractor and the Owner, that the date of beginning and the time for completion as specified in the contract of the work to be done hereunder are Essential Conditions of this contract; and it is further mutually understood and agreed that the work embraced in this contract shall be commenced on a date to be specified in the "Notice to Proceed."

18.2 The Contractor agrees that said work shall be pursued regularly, diligently and continuously at such rate of progress as will insure full completion thereof within the time specified. It is expressly understood and agreed, by and between the Contractor and the Owner, that the time for the completion of the work described herein is a reasonable time, taking into consideration the average climatic range and usual industrial conditions prevailing in this locality.

18.3 If the Contractor shall neglect, fail or refuse to complete the work within the time herein specified, or any proper extension thereof granted by the Owner, then the Contractor does hereby agree, as a part consideration for the awarding of this contract, to pay to the Owner the amount specified in the contract, not as a penalty but as liquidated damages for such breach of contract as hereinafter set forth, for each and every calendar day that the Contractor shall be in default after the time stipulated in the contract for completing the work.

18.4 The liquidated damages amount is fixed and agreed upon by and between the Contractor and the Owner because of the impracticability and extreme difficulty of fixing

and ascertaining the actual damages the Owner would in such event sustain. Said amount is agreed to be the amount of damages which the Owner would sustain and said amount shall be deducted from time to time by the owner from current periodical payments.

18.5 It is further agreed that "time is of the essence" of each and every portion of this contract and of the specifications wherein a definite and certain length of time is fixed for the performance of any act whatsoever; and where under the contract an additional time is allowed for the completion of any work, the new time limit fixed by such extension shall "be of the essence". Provided, that the Contractor shall not be charged with liquidated damages or any excess cost when the Owner determines that the Contractor is without fault and the Contractor's reasons for the time extension are acceptable to the Owner; provided, further, that the Contractor shall not be charged with liquidated damages or any excess cost when the delay in the completion of the work is due to:

a. A preference, priority or allocation order duly issued by the government;

b. An unforeseeable cause beyond the control and without the fault or negligence of the Contractor, including, but not restricted to, acts of God, or of the public enemy, acts of the Owner, acts of another Contractor in the performance of a contract with the Owner, fires, floods, epidemics, quarantine restrictions, strikes, freight embargoes, and severe weather;

c. Any delays of Subcontractors or suppliers occasioned by any of the causes specified in subsections (a) and (b) of this article:

18.6 The Contractor shall promptly notify the Owner in writing of the causes of the delay. The Owner shall ascertain the facts and extent of the delay and notify the Contractor within a reasonable time of his decision in the matter.

19. Defective Work. Defective work shall be processed as follows:

19.1 The Contractor shall promptly remove from the premises all materials and work condemned by the Engineer as failing to meet contract requirements, whether incorporated in the work or not, and the Contractor shall promptly replace and re-execute his own work in accordance with the contract and without expense to the Owner and shall bear the expense of making good all work of other Contractors which was destroyed or damaged by such removal or replacement.

19.2 All removal and replacement work shall be done at the Contractor's expense. If the Contractor does not take action to remove such condemned work and materials within 10 days after receipt of written notice, the Owner may remove them and store the material at the expense of the Contractor. If the Contractor does not pay the expense of such removal and storage within 10 days time thereafter, the Owner may, upon 10 days written notice, sell such materials at auction or at private sale and shall pay to the Contractor any net proceeds thereof, after deducting all the costs and expenses that should have been borne by the Contractor.

20. Differing Site Conditions. Claims for differing site conditions shall be processed as follows:

20.1 The Contractor shall promptly and before such conditions are disturbed, notify the Engineer in writing of:

a. Subsurface or latent physical conditions at the site differing materially from those indicated in this contract; or,

b. Unknown physical conditions at the site, differing materially from those ordinarily encountered and generally recognized as inherent in the type of work provided for in this contract.

20.2 The Engineer shall promptly investigate the conditions. If he finds that conditions differ materially and will cause an increase or decrease in the Contractor's cost or the time required to perform any part of the work under this contract whether or not changed as a result of such conditions, the Engineer shall make an equitable adjustment and modify the contract in writing.

20.3 No claim of the Contractor under this clause shall be allowed unless the Contractor has given proper notice as required in paragraph 20.1 of this clause.

20.4 No claim by the Contractor for an equitable adjustment shall be allowed if asserted after final payment under this contract.

21. Claims For Extra Cost. Claims for extra cost shall be processed as follows:

21.1 No claim for extra work or cost shall be allowed unless the same was done pursuant to a written order by the Engineer, approved by the Owner and the claim presented for payment with the first estimate after the changed or extra work is done. When work is performed under the terms of article 17, the Contractor shall furnish satisfactory bills, payrolls and vouchers covering all items of cost when requested by the Owner and shall allow the Owner access to accounts relating thereto.

21.2 If the Contractor claims that any instructions by drawings or similar documents issued after the date of the contract involve extra cost under the contract, he shall give the Engineer written notice after the receipt of such instruction and before proceeding to execute the work, except in an emergency which threatens life or property, then the procedure shall be as provided for under article 17, "Extra Work & Change Orders." No claim shall be valid unless so made.

22. Right of Owner to Terminate Contract:

22.1 In the event that any of the provisions of this contract are violated by the Contractor, or by any of his Subcontractors, the Owner may serve written notice upon the Contractor and the surety of its intention to terminate the contract, and unless within 10 days after the serving of such notice upon the Contractor, such violation or delay shall cease and satisfactory arrangement for correction be made, the contract shall, upon the expiration of said 10 days cease and terminate. In the event of any such termination, the Owner shall immediately serve notice thereof upon the surety and the Contractor and the surety shall have the right to take over and perform the contract; provided, however, that if the surety does not commence performance thereof within 10 days from the date of the mailing to such surety of notice of termination, the Owner may take over the work and prosecute the same to completion by contract or by force account for the account and at the expense of the Contractor and the Contractor and his surety shall be liable to the Owner for any excess cost occasioned the Owner thereby, and in such event the Owner

may take possession of and utilize in completing the work, such materials, appliances, and plant as may be on the site of the work and necessary therefore.

22.2 If the Contractor should be adjudged 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, or if he should refuse or should fail, except in cases for which extensions of time are provided, to supply enough skilled workmen or materials, or if he should fail to make payments to Subcontractors or for material or labor, so as to affect the progress of the work, or be guilty of a violation of the contract, then the Owner, upon the written notice of the Engineer that sufficient cause exists to justify such action may, without prejudice to any other right or remedy and after giving the Contractor and his surety 7 days' written notice, terminate the employment of the Contractor and take possession of the premises and of all materials, tools, equipment and other facilities installed on the work and paid for by the Owner, and finish the work by whatever method he may deem expedient. In the case of termination of this contract before completion from any cause whatever, the Contractor, if notified to do so by the Owner, shall promptly remove any part or all of his equipment and supplies at the expense of the Contractor. If such expense exceeds such unpaid balance, the Contractor shall pay the difference to the Owner. The expense incurred by the Owner as herein provided, and the damage incurred through the Contractor's default, shall be approved by the Engineer.

22.3 Where the contract has been terminated by the Owner, said termination shall not affect or terminate any of the rights of the Owner as against the Contractor or his surety then existing or which may thereafter accrue because of such default. Any retention or payment of monies by the Owner due the Contractor under the terms of the contract, shall not release the Contractor or his surety from liability for his default.

22.4 After ten (10) days from delivery of a Written Notice to the Contractor and the Engineer, the Owner may, without cause and without prejudice to any other remedy, elect to abandon the Project and terminate the Contract. In such case the Contractor shall be paid for all Work executed and any expense sustained plus reasonable profit.

22.5 If through no act or fault of the Contractor, the Work is suspended for a period of more than ninety (90) days by the Owner or under an order of court or other public authority, or the Engineer fails to act on any request for payment within thirty (30) days after it is submitted, or the Owner fails to pay the Contractor substantially the sum approved by the Engineer or awarded by arbitrators within thirty (30) days of its approval and presentation, then the Contractor may, after ten (10) days from delivery of a Written Notice to the Owner and the Engineer terminate the Contract and recover from the Owner payment for all Work executed and all expenses sustained. In addition and in lieu of terminating the Contract, if the Engineer has failed to act on a request for payment or if the Owner has failed to make any payment as aforesaid, the Contractor may upon ten (10) days written notice to the Owner and the Engineer stop the Work until paid all amounts then due, in which event and upon resumption of the Work Change Orders shall be issued for adjusting the Contract Price or Extending the Contract Time or both to compensate for the costs and delays attributable to the stoppage of the Work.

22.6 If the performance of all or any portion of the Work is suspended, delayed, or interrupted as a result of failure of the Owner or Engineer to act within the time specified in the Contract Documents, or if no time is specified, within a reasonable time, an adjustment in the Contract Price or an extension of the Contract Time, or both, shall be

made by Change Order to compensate the Contractor for the costs and delays necessarily caused by the failure of the Owner or Engineer.

23. Construction Schedule and Periodic Estimates shall provide for the following:

23.1 Before starting the work or upon request by the Engineer during its progress, the Contractor shall submit to the Engineer a work plan showing construction methods and the various steps he intends to take in completing the work.

23.2 Before the first partial payment is made, the Contractor shall prepare and submit to the Engineer:

a. A written schedule fixing the dates for submission of drawings; and

b. A written schedule fixing the respective dates for the start and completion of segments of the work. Each such schedule shall be subject to review and change during the progress of the work.

c. Respective dates for submission of Shop Drawings and for the beginning of manufacture, the testing, and the installation of materials, supplies, and equipment.

d. A schedule of payments that the Contractor anticipates will be earned during the course of the Work.

24. Payments to Contractor. Payments to the Contractor shall be made as follows:

24.1 Progress payments. The Owner will once each month make a progress payment to the Contractor on the basis of an estimate of the total amount of work done to the time of the estimate and its value as prepared by the Contractor and approved by the Engineer.

24.2 Retainage by Owner. The Owner will retain a portion of the progress payment, each month, in accordance with the following procedures:

a. The Owner will establish an escrow account in the bank of the Owner's choosing. The account will be established such that interest on the principal will be paid to the Contractor. The principal will be the accumulated retainage paid into the account by the Owner. The principal will be held by the bank, available only to the Owner, until termination of the contract.

b Until the work is 50% complete, as determined by the Engineer, retainage shall be 10% of the monthly payments claimed. The computed amount of retainage will be deposited in the escrow account established above.

c. After the work is 50% complete, and provided the Contractor has satisfied the Engineer in quality and timeliness of the work, and provided further that there is no specific cause for withholding additional retainage no further amount will be withheld. The escrow account will remain at the same balance throughout the remainder of the project, unless drawn upon by the Owner in accordance with articles 19, 22, and 58.

d. Upon substantial or final completion (as defined in article 25), the amount of retainage will be reduced to 2% of the total Contract Price plus an additional retainage based on the Engineer's estimate of the fair value of the punch list items and the cost of completing and/or correcting such items of work, with specified amounts for each incomplete or defective item of work. As these items are completed or corrected, they shall be paid for out of the retainage until the entire project is declared completed (See article 25). The final 2% retainage shall be held during the one-year warranty period and released only after the Owner has accepted the project.

24.3 In reviewing monthly estimates for payments of the value of work done, the Engineer may accept in the estimate, prior to subtracting the retainage, the delivered cost of certain equipment and nonperishable material which have been delivered to the site or off-site location and which are properly stored and protected from damage. With the estimate, the Contractor shall submit to the Engineer invoices as evidence that the material has been delivered to the site. Prior to submitting the next monthly estimate, the Contractor shall provide the Engineer with paid invoices or other evidence that the materials have been paid for. If the Contractor fails to submit such evidence, the Engineer may then subtract the value of such materials or equipment for which the Owner has previously paid, from the next monthly estimate. The type of equipment and material eligible for payment prior to being incorporated in the work will be at the Engineer's discretion. Material and equipment made specifically for the subject job will be eligible for payment.

24.4 All material and work for which partial payments have been made shall thereupon become the sole property of the Owner. This provision shall not be construed as relieving the Contractor from the sole responsibility for the care and protection of materials and work upon which payments have been made or for the restoration of any damaged work, or as a waiver of the right of the Owner to require compliance with all of the terms of the contract.

24.5 Owner's right to withhold payments and make application. The Contractor agrees that he will indemnify and save the Owner or the Owner's agents harmless from all claims growing out of the lawful demands of Subcontractors, laborers, workmen, mechanics, material men, and furnishers of machinery and parts, equipment, power, tools and all supplies, including commissary, incurred in the furtherance of the performance of this contract. The Contractor shall, at the Owner's request, furnish satisfactory evidence that all claims of the nature hereinabove designated have been paid, discharged, or waived. If the Contractor fails to do so, then the Owner may, upon written notice to the Contractor either pay unpaid bills of which the Owner has written notice directly, or withhold from the Contractor's unpaid compensation a sum of money to pay any and all such lawful claims until satisfactory evidence is furnished that all liabilities have been fully discharged. Payment to the Contractor shall then be resumed in accordance with the terms of this contract but in no event shall the above provisions be construed to impose any obligations upon the Owner to either the Contractor or his surety or any third party. In paying any unpaid bills of the Contractor, the Owner shall be deemed the agent of the Contractor, and any payment so made by the Owner shall be considered as payment made under contract by the Owner to the Contractor and the Owner shall not be liable to the Contractor for any such payments made in good faith.

24.6 If the Owner fails to make payment forty-five (45) days after approval by the Engineer, in addition to other remedies available to the Contractor, there shall be added to

each such payment interest at an annual rate of 10% commencing on the first day after said payment is due and continuing until the payment is received by the Contractor.

25. Acceptance and Final Payment provisions shall be as follows:

25.1 Substantial completion and payment.

a. Substantial completion shall be that point, as certified by the Engineer, at which the contract has been completed to the extent that the Owner may occupy and/or make use of the work performed for the purposes for which it was intended. Upon substantial completion there may be minor items, such as seeding, landscaping, etc., yet to be completed or items of work to be corrected.

b. Upon receipt of written notice from the Contractor that the work is substantially complete, the Engineer shall promptly make an inspection, and when he finds the work complies with the terms of the contract and the contract is substantially completed, he will issue a signed and dated certificate, and a list of all items to be completed or corrected, stating that the work required by this contract has been substantially completed and is accepted by him.

c. Upon substantial completion, the entire balance due and payable to the Contractor less 2 percent of the Contract Price, and less a retention based on the Engineer's estimate of the fair value for the cost of completing or correcting listed items of work with specified amounts for each incomplete or defective item of work shall be made.

d. The general guarantee period for the work shall begin on the date certified by the Engineer that the work is substantially completed.

25.2 Final completion shall be that point at which all work has been completed and all defective work has been corrected. Unless the Engineer has issued a certificate of substantial completion, the general guarantee period shall begin upon certification by the Engineer of final completion.

25.3 At the end of the general guarantee period for the entire contract which has been certified finally completed or substantially completed, the Owner, through the Engineer, shall make a guarantee inspection of all or portions of the work. When it is found that the work is satisfactory and that no work has become defective under the terms of the contract, the Owner will accept the entire project and make final payment, including the reimbursement of monies retained pursuant to the guarantee period.

25.4 If the guarantee inspection discloses any work as being unsatisfactory, the Engineer will give the Contractor the necessary instructions for correction of such work, and the Contractor shall immediately execute such instructions. Upon correction of the work, another inspection will be made which shall constitute the guarantee inspection, provided the work has been satisfactorily completed.

25.5 Before issuance of final payment, the Contractor shall certify in writing to the Engineer that all payrolls, material bills, and other indebtedness connected with the work have been paid or otherwise satisfied; except that in case of disputed indebtedness or liens, if the contract does not include a payment bond, the Contractor may submit in lieu of certification of payment a surety bond in the amount of the disputed indebtedness or

liens, guaranteeing payment of all such disputed amounts, including all related costs and interest in connection with said disputed indebtedness or liens which the Owner may be compelled to pay upon adjudication.

25.6 If upon substantial completion, full completion is delayed through no fault of the Contractor, and the Engineer so certifies, the Owner may, upon certificate of the Engineer, and without termination of the contract, make payment of the balance due for that portion of the work fully completed and accepted. Such payment shall be made under the terms and conditions governing final payment, except that it shall not constitute a waiver of claims.

25.7 The acceptance by the Contractor of final payment shall release the Owner from all claims and all liability to the Contractor for all things relating to this work and for every act and neglect of the Owner and others relating to or arising out of this work. No payment, however, final or otherwise, shall operate to release the Contractor or his sureties from any obligations of the performance and payment bond under this contract.

26. Payments by Contractor. The Contractor shall pay the costs:

26.1 For all transportation and utility services not later than the 20th day of the calendar month following that in which services are rendered;

26.2 For all materials, tools, and other expendable equipment to the extent of 90 percent of the cost thereof, not later than the 20th day of the calendar month following that in which such materials, tools and equipment are delivered at the site of the work and the balance of the cost thereof not later than the 30th day following the completion of that part of the work in or on which such materials, tools and equipment are incorporated or used; and

26.3 To each of his Subcontractors, not later than the 5th day following each payment to the Contractor, the respective amounts allowed the Contractor on account of the work performed by his Subcontractors to the extent of each Subcontractor's interest therein.

27. Insurance. The Contractor and any Subcontractor shall obtain all the insurance required under this article and such insurance shall be approved by the Owner.

27.1 The Contractor and all Subcontractors shall procure and shall maintain during the life of this contract workmen's compensation insurance as required by applicable state law. The Contractor shall provide and shall cause each Subcontractor to provide adequate employer's liability insurance.

Limits of Liability: $100,000 each accident;
$500,000 disease - policy limit;
$100,000 disease - each employee.

27.2 The Contractor shall procure and shall maintain during the life of this contract Commercial General liability insurance to include contractual liability, explosion, collapse and underground coverages.

Limits of liability: $1,000,000 each occurrence bodily injury and property damage;
$2,000,000 general aggregate - include per project aggregate endorsement;
$2,000,000 products/completed operations aggregate.

If blasting or demolition or both is required by the contract, the Contractor or Subcontractor shall obtain the respective coverage and shall furnish the Engineer a certificate of insurance evidencing the required coverages prior to commencement of any operations involving blasting or demolition or both.

27.3 The Contractor shall procure and shall maintain during the life of this contract comprehensive automobile liability insurance to include all motor vehicles including owned, hired, borrowed and non-owned vehicles.

Limits of liability: $1,000,000 combined single limit for bodily injury and property damage.

27.4 The Contractor shall either:

a. Require each of his Subcontractors to procure and to maintain during the life of his subcontract commercial general liability insurance and comprehensive automobile liability insurance of the type and in the amounts specified in articles 27.2 and 27.3; or

b. Insure the activities of his Subcontractors in his policy.

27.5 The required insurance shall provide adequate protection for the Contractor and his Subcontractors, respectively, against damage claims which may arise from work under this contract, whether such work be by the insured or by anyone employed by him and also against any of the special hazards which may be encountered in the performance of this contract.

27.6 The Contractor shall furnish the Owner with certificates showing the type, amount, class of operations covered, effective dates and dates of expiration of policies. Such insurance shall not be canceled or materially altered, except after 10 days written notice has been received by the Owner.

27.7 For builder's risk insurance (fire and extended coverage) and until the work is completed and accepted by the Owner, the Contractor is required to maintain builder's risk type insurance on a 100 percent completed value basis on the insurable portion of the work for the benefit of the Owner, the Contractor, and Subcontractors as their interests may appear.

27.8 The Contractor shall take out and furnish to the Owner and maintain during the life of this contract, complete Owner's protective liability insurance.

Limits of Liability: $1,000,000 each occurrence;
$2,000,000 aggregate.

28. Contract Security. The Contractor shall within ten (10) days after the receipt of the Notice of Award furnish the Owner with a performance bond and a payment bond in penal sums equal to the amount of the contract price conditioned upon the performance by the Contractor of all undertakings, covenants, terms, conditions and agreements of the Contract Documents, and upon the prompt payment by the Contractor to all persons supplying labor and materials in the prosecution of the Work provided by the contract Documents. Such Bonds shall be executed by the Contractor and a corporate bonding company licensed to transact business in the state in which the Work is to be performed

and named on the current list of "Surety Companies Acceptable on Federal Bonds" as published in the Treasury Department Circular Number 570. The expense of these Bonds shall be borne by the Contractor.

29. Additional or Substitute Bond. If at any time a surety on any such Bond is declared as bankrupt or loses its right to do business in the state in which the Work is to be performed, or is removed from the list of Surety Companies accepted on Federal Bonds, the Contractor shall within ten (10) days after notice from the Owner to do so, substitute an acceptable bond (or bonds) in such form and sum and signed by such other surety or sureties as may be satisfactory to the Owner. The premiums on such bond shall be paid by the Contractor. No further payments shall be deemed due nor shall be made until the new surety or sureties shall have furnished such an acceptable bond to the Owner.

30. Assignments. The Contractor shall not assign the whole or any part of this contract or any monies due or to become due hereunder without written consent of the Owner. In case the Contractor assigns all or any part of any monies due or to become due under this contract, the instrument of assignment shall contain a clause substantially to the effect that it is agreed that the right of the assignee in and to any monies due or to become due to the Contractor shall be subject to prior claims of all persons, firms and corporations for services rendered or materials supplied for the performance of the work called for in this contract.

31. Mutual Responsibility of Contractors. If, through acts of neglect on the part of the Contractor, any other Contractor or any Subcontractor shall suffer loss or damage on the work site, the Contractor agrees to settle with such other Contractor or Subcontractor by agreement or arbitration if such other Contractor or Subcontractors will so settle. If such other Contractor or Subcontractors shall assert any claim against the Owner on account of any damage alleged to have been sustained, the Owner shall notify the Contractor, who shall indemnify and save harmless the Owner against any such claim.

32. Subcontracting. When subcontracting, the Contractor:

32.1 May utilize the services of specialty Subcontractors on those parts of the work which, under usual contracting practices, are performed by specialty Subcontractors.

32.2 Shall be as fully responsible to the Owner for the acts and omissions of his Subcontractors, and of persons either directly or indirectly employed by them, as he is for the acts and omissions of persons directly employed by him.

32.3 Shall cause appropriate provisions to be inserted in all subcontracts relative to the work to bind Subcontractors to the Contractor by the terms of the contract documents insofar as applicable to the work of Subcontractors and to give the Contractor the same power as regards terminating any subcontract that the Owner may exercise over the Contractor under any provision of the contract documents.

32.4 Shall not create any contractual relation between any Subcontractor and the Owner.

32.5 Shall not award Work to Subcontractor(s), in excess of fifty percent (50%) of the Contract Price, without prior written approval of the Owner.

33. Authority of the Engineer. In performing his duties, the Engineer or his representative shall:

33.1 Have the authority to suspend the work in whole or in part for such periods as he may deem necessary due to the failure of the Contractor to carry out provisions of the Contract or for failure of the Contractor to suspend work in weather conditions considered by the Engineer to be unsuitable for the prosecution of the work. The Engineer shall give all orders and directions under this contract, relative to the execution of the work. The Engineer shall determine the amount, quality, acceptability, and fitness of the several kinds of work and materials which are to be paid for under this contract and shall decide all questions which may arise in relation to the work. The Engineer's estimates and decisions shall be final and conclusive, except as otherwise provided. In case any question shall arise between the parties hereto relative to said contract or specifications, the determination or decision of the Engineer shall be a condition precedent to the right of the Contractor to receive any money or payment for work under this contract affected to any extent by such question. The Engineer shall decide the meaning and intent of any portion of the specifications and of any plans or drawings where the same may be found unclear. Any differences or conflicts in regard to their work which may arise between the Contractor under this contract and other Contractors performing work for the Owner shall be adjusted and determined by the Engineer.

a. The purpose of the above article is not in any way to relieve the Contractor of his responsibilities for the safety of workmen or general public in the execution of the work. Attention is drawn to Article 13 of these Conditions which refers to the safety obligations of the Contractor.

b. The Engineer, acting on behalf of the Owner, has the authority to enforce corrective action for work not in accordance with the specifications.

c. In addition, the Engineer, acting on behalf of the Owner, is to ensure that the work is in accordance with the Contract documents. He is not held responsible, however, for the methods of construction, sequences, schedules and procedures in the execution of the work. The Engineer does have the opportunity under 33.1 to reject the method of construction, work plan schedule, procedures, as he thinks appropriate.

33.2 Appoint assistants and representatives as he desires, and they shall be granted full access to the work under the contract. They have the authority to give directions pertaining to the work, to approve or reject materials, to suspend any work that is being improperly performed, to make measurements of quantities, to keep records of costs, and otherwise represent the Engineer in all matters except as provided below. The Contractor may, however, appeal from their decision to the Engineer himself, but any work done pending its resolution is at the Contractor's own risk. Except as permitted and instructed by the Engineer, the assistants and representatives are not authorized to revoke, alter, enlarge, relax, or release any requirements of these specifications, nor to issue instructions contrary to the plans and specifications. They are not authorized to act as superintendents or foremen for the Contractor, or to interfere with the management of the work by the Contractor. Any advice which the assistants or representatives of the Engineer may give the Contractor shall not be construed as binding the Engineer or the Owner in any way, nor as releasing the Contractor from the fulfillment of the terms of the contract. All transactions between the Contractor and the representatives of the Engineer which are liable to protest or where payments are involved shall be made in writing.

34. Stated Allowances. The Contractor shall include in his proposal for costs of materials not shown in his bid under "cash allowances" or "allowed materials," any cash allowances stated in the supplemental general conditions or other contract documents. The Contractor shall purchase the "allowed materials" as directed by the Owner on the basis of the lowest and best bid of at least 3 competitive bids. If the actual price for purchasing the "allowed materials" is more or less than the "cash allowance," the contract price shall be adjusted accordingly. The adjustment in contract price shall be made on the basis of the purchase price without additional charges for overhead, profit, insurance or any other incidental expenses. The cost of installation of the "allowed materials" shall be included in the applicable sections of the contract specifications covering this work.

35. Use of Premises, Removal of Debris, Sanitary Conditions. In the use of premises or removal of debris, the Contractor expressly undertakes at his own expense: to take every precaution against injuries to persons or damage to property; to maintain sanitary conditions; to store his apparatus, materials, supplies and equipment in such orderly fashion at the site of the work as will not interfere with the progress of his work or the work of any other Contractors; to place upon the work or any part thereof only such loads as are consistent with the safety of that portion of the work; to clean up frequently all refuse, rubbish, scrap materials and debris caused by his operations, to the end that at all times the site of the work shall present an orderly and workmanlike appearance; before final payment to remove all surplus material falsework, temporary structures, including foundations thereof, plant of any description and debris of every nature resulting from his operations, and to put the site in an orderly condition; to effect all cutting, fitting or patching of his work required to make the same conform to the plans and specifications and, except with the consent of the Engineer, not to cut or otherwise alter the work of any other Contractor; to provide and maintain in a sanitary condition such toilet accommodations for the use of his employees as may be necessary to comply with the requirements of the state and local boards of health, or of other bodies or authorities having jurisdiction.

36. Quantities of Estimate. Wherever the estimated quantities of work to be done and materials to be furnished under this contract are shown in any of the documents including the proposal, they are given for use in comparing bids and the right is specifically reserved except as herein otherwise specifically limited, to increase or decrease them as may be deemed reasonably necessary by the Owner to complete the work contemplated by this contract, and such increase or decrease shall in no way invalidate this contract, nor shall any such increase or decrease give cause for claims or liability for damages. Such increases or decreases shall not exceed 25 percent of the estimated quantities of work. An increase or decrease in quantities for subsurface materials (e.g. ledge, unsuitable backfill), which overrun or underrun by 25% or more of the bid quantity may be the basis for a contract price adjustment, at the rate of a negotiated adjusted unit rate. Negotiated unit price rates shall be equitable and shall take into account, but not be limited to the following factors; bid unit rate, distribution of rates and bid balance, and the scope of work as affected by the changed quantities. Claims for extra work resulting from changed quantities shall be processed under article 21.

37. Lands and Rights-of-Way. Acquisition and usage of lands and rights-of-way shall be as follows:

37.1 Prior to issuing the Notice to Proceed, the Owner shall legally obtain all lands and rights-of-way necessary for carrying out and completing the work to be performed under this contract.

37.2 The Contractor shall not (except after written consent from the Owner) enter or occupy with men, tools, materials, or equipment, any land outside the rights-of-way or property of the Owner. A copy of the written consent shall be given to the Engineer.

37.3 The Owner shall provide to the Contractor information which delineates and describes the lands owned and the rights-of-way acquired.

37.4 The Contractor shall provide at its own expense and without liability to the Owner any additional land and access thereto that the Contractor may desire for temporary construction facilities, or for storage of materials.

38. General Guarantee. With reference to warranties, neither the final certificate of payment nor any provision in the contract documents, nor partial or entire occupancy of the premises by the Owner, shall constitute an acceptance of work not done in accordance with the contract documents or relieve the Contractor of liability in respect to any express warranties or responsibility for faulty materials or workmanship. The Contractor shall remedy any defects in the work and pay for any damage to other work resulting therefrom, which appear within the warranty period one year or longer if required by the contract, from the certified date of completion or substantial completion of the work. The Owner will give notice of observed defects within two working days of their discovery.

39. Errors and Inconsistencies. With reference to errors and inconsistency in contract documents, any provisions in any of the contract documents which may be in conflict with the paragraphs in these general conditions shall be subject to the following order of precedence for interpretation:

39.1 Drawings will govern technical specifications.

39.2 General conditions will govern drawings and technical specifications.

39.3 Supplemental general conditions will govern general conditions, drawings and technical specifications.

39.4 Special conditions will govern supplemental general conditions, general conditions, drawings and technical specifications.

39.5 The Contractor shall take no advantage of any apparent error or omission in the plans or specifications. In the event the Contractor discovers such an error or omission, he shall notify the Engineer. The Engineer will then make such corrections and interpretations as may be deemed necessary for fulfilling the intent of the plans and specifications.

39.6 Figure dimensions on Drawings shall govern over general drawings.

40. Notice and Service Thereof. Any notice to the Contractor from the Owner relative to any part of this contract will be in writing and will be considered delivered and the service completed, when said notice is mailed, by certified registered mail, to the Contractor at

his last given address, or delivered in person to the Contractor or his authorized representative on the work.

41. Required Provisions 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 (example; miswording, etc.), then upon the application of either party the contract shall forthwith be physically amended to make such insertion or correction.

42. Protection of Lives and Health. The work under this contract is subject to the safety and health regulations (CRF 29, part 1926, and all subsequent amendments) as promulgated by the U.S. Department of Labor on June 24, 1974. Contractors are urged to become familiar with the requirements of these regulations.

43. OSHA Construction Safety Program.

43.1 Pursuant to NHRSA 277:5-a, the Contractor shall provide an Occupational Health and Safety Administration (OSHA) 10-hour construction safety program for its on-site employees. All employees are required to complete the program prior to beginning work. The training program shall utilize an OSHA-approved curriculum. Graduates shall receive a card from OSHA certifying the successful completion of the training program.

43.2 Any employee required to complete the OSHA 10-hour construction safety program, and who can not within 15 days provide documentation of completion of such program, shall be subject to removal from the job site.

43.3 The following individuals are exempt from the requirements of the 10-hour construction safety program: law enforcement officers involved with traffic control or jobsite security; flagging personnel who have completed the training required by the Department of Transportation; all relevant federal, state and municipal government employees and inspectors; and all individuals who are not considered to be on the site of work under the federal Davis-Bacon Act, including, but not limited to, construction and non-construction delivery personnel and non-trade personnel.

44. Equal Employment Opportunity. Under equal employment opportunity requirements and during the performance of this contract the Contractor agrees to the following:

44.1 The Contractor will not discriminate against any employee or applicant for employment because of race, creed, color, national origin, or sex. The Contractor will take affirmative action to ensure that applicants are employed, and that employees are treated during employment, without regard to their race, creed, color, national origin, or sex. 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.

44.2 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 consideration for employment, without regard to race, creed, color, national origin, or sex.

44.3 The Contractor will send to each labor union or representative of workers with which he has a collective bargaining agreement or other contract or understanding, a notice to be provided advising the labor union or worker's representative of the Contractor's commitment under section 202 of executive order no. 11246 of September 24, 1965, and 11375 of October, 13, 1967, and shall post copies of the notice in conspicuous places available to employees and applicants for employment.

44.4 The Contractor will comply with all provisions of executive orders no. 11246 and 11375.

44.5 The Contractor will furnish all information and reports required by executive orders no. 11246 and 11375.

44.6 In the event of the Contractor's noncompliance with the nondiscrimination clauses of this contract or with any of such rules, regulations, or orders, this contract may be canceled, terminated, or suspended in whole or in part by the Owner or the Department of Labor and the Contractor may be declared ineligible for further government contracts or federally-assisted construction, however, that in the event the Contractor becomes involved in, or is threatened with, litigation with a Subcontractor or vendor as a result of such direction by the Department of Labor, the Contractor may request the United States to enter into such litigation to protect the interests of the United States.

44.7 A breach of this article may be grounds for termination of this contract and for debarment as provided in 29 CFR 5.6.

45. Interest of Federal, State or Local Officials. No federal, state or local official shall be admitted to any share or part of this contract or to any benefit that may arise therefrom, but this provision shall not be construed to extend to this contract if made with a corporation for its general benefit.

46. Other Prohibited Interests. No official of the Owner who is authorized in such capacity and on behalf of the Owner to negotiate, make, accept or approve, or to take part in negotiating, making, accepting, or approving any architectural, Engineering, inspection, construction or material supply contract or any subcontract in connection with the construction of the project, shall become directly or indirectly interested personally in this contract or in any part hereof. No officer, employee, architect, attorney, Engineer or inspector of or for the Owner who is authorized in such capacity and on behalf of the Owner to exercise any legislative, executive, supervisory or other similar functions in connection with the construction of the project, shall become directly or indirectly interested personally in this contract or in any part thereof, any material supply contract, subcontract, insurance contract, or any other contract pertaining to the project.

47. Use and Occupancy Prior to Acceptance. Use and occupancy of a portion or unit of the project, upon completion of that portion or unit, and before substantial completion of the project, shall be a condition of this contract with the following provisions:

47.1 The Owner will make his request for use or occupancy to the Contractor in writing.

47.2 There must be no significant interference with the Contractor's work or performance of duties under the contract.

47.3 The Engineer, upon request of the Owner and agreement by the Contractor, will make an inspection of the complete part of the work to confirm its status of completion.

47.4 Consent of the surety and endorsement of the insurance carrier must be obtained prior to use and/or occupancy by the Owner. Also, prior to occupancy, the Owner will secure the required insurance coverage on the building.

47.5 The Owner will have the right to exclude the Contractor from the subject portion of the project after the date of occupancy but will allow the Contractor reasonable access to complete or correct items.

47.6 The warranty period shall begin upon substantial completion.

48. Suspension of Work. The Owner may, at any time and without cause, suspend the work or any portion thereof for a period of not more than 90 days by notice in writing to the Contractor and the Engineer. The Owner shall fix the date on which work shall be resumed. The Contractor will be allowed an increase in the contract price or an extension of the contract time, or both, directly attributable to any suspension if he makes a claim therefore as provided in articles 17 and 21.

49. [Reserved]

50. [Reserved]

51. [Reserved]

52. Project Sign. Furnish and erect a sign at the project site to identify the project and to indicate that the State Government is participating in the development of the project. Place the sign in a prominent location as directed by the Engineer. Do not place or allow the placement of other advertising signboards at the project site or along rights-of-way furnished for the project work. See Exhibit 1 for details of construction.

53. [Reserved]

54. Public Convenience and Traffic Control requirements:

54.1 The Contractor shall at all times so conduct his work as to assure minimal obstruction to traffic. The safety and convenience of the general public and the residents along the work site route and the protection of property shall be provided for by the Contractor. The Contractor shall be responsible for timely notification to local residents before causing any interruptions of their access.

54.2 Fire hydrants and water holes for fire protection on or adjacent to the work site shall be kept accessible to fire apparatus at all times, and no obstructions shall be placed within 10 feet of any such facility. No footways, gutters, drain inlets, or portions of highways adjoining the work site shall be obstructed. In the event that all or part of a roadway is officially closed to traffic during construction, the Contractor shall provide and maintain safe and adequate traffic accessibility, satisfactory to the Engineer, for residences and businesses along and adjacent to the roadway so closed.

54.3 When the maintenance of traffic is considered by the Engineer to be minimal, the contract may not show this work as a pay item. In such cases, the Contractor shall bear all expense of maintaining traffic over the sections of road undergoing improvement and of constructing and maintaining such approaches, crossings, intersections, and other features as may be necessary, without direct reimbursement.

55. Pre-Construction Conference. The Contractor shall not commence work until a pre-construction conference has been held at which representatives of the Contractor, Engineer, Division and Owner are present. The pre-construction conference shall be scheduled by the Engineer.

56. Maintenance During Construction.

56.1 The Contractor shall maintain the work during construction and until it is accepted by the Owner. This maintenance shall be continuous and effective work prosecuted day by day, with adequate equipment and forces, to the end that roads or structures are kept in satisfactory condition at all times.

56.2 All cost of maintenance during construction and before the work is accepted by the Owner shall be included in the unit prices bid on the various pay items and the Contractor shall not be paid an additional amount for such maintenance.

56.3 If the Contractor, at any time, fails to comply with the provisions above, the Engineer may direct the Contractor to do so. If the Contractor fails to remedy unsatisfactory maintenance within the time specified by the Engineer, the Engineer may immediately cause the project to be maintained and the entire cost of this maintenance will be deducted from money to become due the Contractor on this contract.

57. Cooperation with Utilities.

57.1 The Owner will notify all utility companies, all pipe line owners, or other parties affected, and have all necessary adjustments of the public or private utility fixtures, pipe lines, and other appurtenances within or adjacent to the limits of construction made as soon as practicable.

57.2 Water lines, gas lines, wire lines, service connections, water and gas meter boxes, water and gas valve boxes, light standards, cableways, signals, and all other utility appurtenances within the limits of the proposed construction which are to be relocated or adjusted are to be moved by the owners of such utilities at their expense, except as may otherwise be provided for in the special conditions or as noted on the plans.

57.3 It is understood and agreed that the Contractor has considered in his bid all of the permanent and temporary utility appurtenances in their present or relocated positions as shown on the plans and as evident on the site, and that no additional compensation will be allowed for any delays, inconvenience, damage sustained by him due to any interference from such utility appurtenances or the operation of moving them.

57.4 The Contractor shall cooperate with the Owners of any underground or overhead utility lines in their removal and rearrangement operations in order that these operations may progress in a reasonable manner, that duplication of rearrangements may be reduced to a minimum, and that services rendered by those parties will be minimal.

57.5 In the event of interruption to a water or utility service as a result of accidental breakage or as a result of being exposed or unsupported, the Contractor shall promptly notify the proper authority and shall cooperate with said authority in the restoration of services. If water service is interrupted, repair work shall be continuous until the service is restored. No work shall be undertaken around fire hydrants until provisions for continued service have been approved by the local fire authority. If any utility service is interrupted for more than 4 hours, the Contractor shall make provisions for temporary service at his own expense until service is resumed.

58. Work Performed at Night and on Sundays and Holidays shall comply with the following:

58.1 No work will be permitted at night or on Sundays or holidays except as approved in writing by the Engineer, and provided such work is not in violation of a local ordinance. When working at night, the Contractor shall provide flood lighting sufficient to insure the same quality of workmanship and the same conditions regarding safety as would be achieved in daylight.

58.2 Whenever Memorial Day or Fourth-of-July is observed on a Friday or a Monday and during the weekend of Labor Day, the Contractor may be required to suspend work for the 3 calendar days. Prior to the close of work, the work site shall be placed in a condition acceptable to the Engineer for the comfort and safety of the traveling public. An arrangement shall be made for responsible personnel acceptable to the Engineer to maintain the project in the above conditions.

59. Laws to be Observed. With reference to laws that shall be observed:

59.1 The Contractor shall keep fully informed of all federal and state laws, all local laws, ordinances, and regulations, and all orders and decrees of tribunals having any jurisdiction or authority, which in any manner affect those engaged or employed on the work. He shall at all times observe and comply with all such laws, ordinances, regulations, orders, and decrees; and shall protect and indemnify the state and its representatives against any claim or liability arising from or based on the violation of any such law, ordinance, regulation, order, or decree, whether by himself or his employees.

59.2 Indemnification

The Contractor will indemnify and hold harmless the Owner and the Engineer and their agents and employees from and against all claims, damages, losses, and expenses including attorney's fees arising out of or resulting from the performance of the Work, provided that any such claims, damage, loss or expense is attributable to bodily injury, sickness, disease or death, or to injury to or destruction of tangible property including the loss of use resulting therefrom; and is caused in whole or in part by any negligent or willful act or omission of the Contractor, and Subcontractor, anyone directly or indirectly employed by any of them or anyone for whose acts any of them may be liable.

In any and all claims against the Owner or the Engineer, or any of their agents of employees, by any employees of the Contractor, and Subcontractor, anyone directly or indirectly employed by any of them, or anyone for whose acts any of them may be liable, the indemnification obligation shall not be limited in any way by any limitation on the amount or type of damages, compensation or benefits payable by disability benefit or other employee benefit acts.

The obligation of the Contractor under this paragraph shall not extend to the liability of the Engineer, his agents or employees arising out of the preparation or approval of maps, Drawings, opinions, reports, surveys, Change Orders, designs or Specifications.

60. Permits. Permits to be obtained by the Contractor shall be in accordance with the following:

60.1 Permits and licenses of a temporary nature necessary for the prosecution of the work shall be obtained and paid for by the Contractor. Permits, licenses and easements for permanent structures or permanent changes in existing facilities will be secured and paid for by the Owner. Permits may include:

a. New Hampshire Department of Transportation Highway Trench Permits.

b. RSA 485-A:17 and 483-A N.H. DES Wetlands Bureau Dredge and Fill Permit.

c. RSA 485-A:17 - N.H. DES Site Specific Permit (Water Quality)

d. RSA 149-M:10 N.H. DES Solid Waste Management Bureau - disposal of construction debris and/or demolition waste.

e. N.H. Department of Environmental Services Air Resources Division (burning permits).

f. Other permits, as required by State and Local laws and ordinances.

g. Notice of intent for coverage under EPA's General NPDES Permit for construction dewatering activities.

61. Control of Pollution due to construction shall comply with the following:

61.1 During construction, the Contractor shall take precautions sufficient to avoid the leaching or runoff of polluting substances such as silt, clay, fuels, oils, bitumens, calcium chloride and any other polluting materials which are unsightly or which may be harmful to humans, fish, or other life, into groundwaters and surface waters of the State.

61.2 In waters used for public water supply or used for trout, salmon, or other game or forage fish spawning or nursery, control measures must be adequate to assure that turbidity in the receiving water will be increased not more than 10 standard turbidity units (s.t.u.) in the absence of other more restrictive locally-established limitations, unless otherwise permitted by the Division. In no case shall the classification for the surface water be violated.

61.3 In water used for other purposes, the turbidity must not exceed 25 s.t.u. unless otherwise permitted by the Division.

62. Use of Explosives.

62.1 When the use of explosives is necessary for the prosecution of the Work, exercise the utmost care not to endanger life or property. The Contractor shall be responsible for any and all damage resulting from the use of explosives.

62.2 Store all explosives in a secure manner, in compliance with all State and local laws and ordinances, and legally mark all such storage places. Storage shall be limited to such quantity as may be needed for the work underway.

62.3 Designate as a "Blasting Area" all sites where electric blasting caps are located and where explosive charges are being placed. Mark all blasting areas with signs as required by law. Place signs as required by law from each end of the blasting area and leave in place while the above conditions prevail. Immediately remove signs after blasting operations or the storage of caps is over.

62.4 Notify each property Owner and public utility company having structures in proximity to the site of the work sufficiently in advance to enable the companies to take such steps as they may deem necessary to protect their property. Such notice shall not relieve the Contractor of any of his responsibility for damage resulting from his blasting operation. Warn all persons within the danger zone of blasting operations and do not perform blasting work until the area is cleared. Provide sufficient flagmen outside the danger zone to stop all approaching traffic and pedestrians. Provide watchmen during the loading period and until charges have been exploded. Place adequate protective covering over all charges before being exploded.

63. Arbitration by Mutual Agreement.

63.1 All claims, disputes, and other matters in question arising out of, or relating to, the Contract Documents or the breach thereof, except for claims which have been waived by making an acceptance of final payment as provided in Section 25, may be decided by arbitration if the parties mutually agree. Any agreement to arbitrate shall be specifically enforceable under the prevailing arbitration law. The award rendered by the arbitrators shall be final, and judgment may be entered upon it in any court having jurisdiction thereof.

63.2 Notice of the request for arbitration shall be filed in writing with the other party to the Contract Documents and a copy shall be filed with the Engineer. Request for arbitration shall in no event be made on any claim, dispute, or other matter in question which would be barred by the applicable statute of limitations.

63.3 The Contractor will carry on the Work and maintain the progress schedule during any arbitration proceedings, unless other wise mutually agreed in writing.

64. Taxes. The Contractor shall pay all sales, consumer, use, and other similar taxes required by the laws of the place where the Work is performed.

65 Separate Contracts.

65.1 The Owner reserves the right to let other contracts in connection with this Project. The Contractor shall afford other Contractors reasonable opportunity for the introduction and storage of their materials and the execution of their Work, and shall properly connect and coordinate the Work with theirs. If the proper execution or results of any part of the Contractor's Work depends upon the Work of any other Contractor, the Contractor shall inspect and promptly report to the Engineer any defects in such Work that render it unsuitable for such proper execution and results.

65.2 The Owner may perform additional Work related to the Project or the Owner may let other contracts containing provisions similar to these. The Contractor will afford the other Contractors who are parties to such Contracts (or the Owner, if the Owner is performing the additional Work) reasonable opportunity for the introduction and storage of materials and equipment and the execution of the Work, and shall properly connect and coordinate the Work with theirs.

65.3 If the performance of the additional Work by other Contractors or the Owner is not noted in the Contract Documents prior to the execution of the Contract, written notice shall thereof be given to the Contractor prior to starting such additional Work. If the Contractor believes that the performance of such additional Work by the Owner or others involves it in additional expense or entitles it to an extension of the Contract Time, the Contractor may make a claim thereof as provided in Sections 17 and 18.

SPECIAL CONDITIONS

The modify or supplement the General Conditions. All provisions which are not so modified or supplemented remain in full force and effect. The terms used in these Special Conditions have the meanings stated in the General Conditions.

The Special Conditions may include certain provisions required by Laws and Regulations. Contractor is responsible to determine and obtain applicable Laws and Regulations and to review and interpret the full text of such Laws and Regulations.

The address system used herein is the same as the address system used in the General Conditions, with the prefix "SC" added thereto. Additional terms used in this Section have the meanings stated below, which are applicable to both the singular and plural thereof.

SC-2 Definitions: Add the following:

> "Agreement"—The written instrument which is evidence of the agreement between Owner and Contractor covering the Work.
>
> "Engineer" – Woodard & Curran, Inc. which has designed the Project, which is to act as Owner's representative, assume all duties and responsibilities, and have the rights and authority assigned to Engineer in the Contract Documents in connection with the completion of the Work in accordance with the Contract Documents.
>
> "General Requirements" – Sections of the Specifications in Division 01 (numbered beginning with 01) that apply to the Specifications and Drawings.

Add the following at the end of Article 2.

> The terms used throughout the Contract Documents, whether or not capitalized, shall have the meanings specified in Article 2 unless otherwise indicated.

SC-7 Inspection and Testing of Materials

Replace Paragraph 7.1 with the following:

> All materials and equipment used in the construction of the project shall be subject to inspection by the Engineer or Owner and independent testing in accordance with accepted standards at any and all times during manufacture or during the project construction and at any or all places where such manufacture is carried on.

In Paragraph 7.2, second line, replace "All tests made" with "All tests ordered".

In subparagraph 7.6.c., delete "Cost for such arrangement shall be paid by the Owner as a stated allowance in the bid."

SC-10 Surveys

Replace Paragraph 10.2 with the following:

For structures, the Engineer, Owner's Resident Project Representative, or Contractor's surveyor may establish and stake out one or more base lines as needed and will establish bench marks in and around the project site for reference in checking the work in progress. For structures such as pipelines, the Engineer or Owner may establish the location of the pipe, manholes and other appurtenances, and will establish bench marks along the route of the pipeline at intervals for reference in checking the pipe and manhole inverts and other elevations throughout the project. The Contractor shall utilize the lines and bench marks established by the Engineer to set up whatever specific detail controls he may need for establishing location, elevation lines and grades of all structures at the Contractor's sole risk and subject to verification by the Contractor.

A. Prior to initiating construction, engage an independent professional land surveyor registered in the state where the Project is located to provide surveys and permanent reference points for all bounds and property markers along the line of the Work that may be disturbed during construction. Submit copies of all ties to the bounds and property markers to the Engineer prior to excavation at the Site(s).

B. Maintain surveyor's log of control and other survey work. Keep log available for reference.

C. Verify layout information shown on the Drawings in relation to existing benchmarks before lay out of the Work. Locate and protect existing benchmarks and control points. Preserve permanent reference points during construction.

D. Promptly report lost or destroyed reference points, benchmarks, or control points. Promptly report requirements relocate reference and control points due to changes in grades. Promptly replace lost or destroyed bounds or markers and control points based on the original survey control points utilizing the services of a professional land surveyor registered in the state where the Project is located. The cost of replacing markers disturbed by the Contractor's operations shall be at the Contractor's expense.

All this work is subject to checking, approval, and observation of the Work by the Engineer.

In Paragraph 10.3, delete the last sentence.

In Paragraph 10.4, delete both instances of "by the Engineer".

SC-14 Inspection: In Paragraph 14.2, first sentence, delete "by the Engineer".

SC-16 Superintendence by the Contractor: In the third sentence, replace "by the Engineer" with "by the Owner".

SC-17 Extra Work and Change Orders

In Paragraph 17.1, first line, insert "or Owner" after "Engineer". In subparagraph c., delete "by the Engineer".

In Paragraph 17.2, first line, replace "Engineer" with "price".

Add the following:

17.5 The Contract shall constitute the entire understanding between the parties, and it shall not be considered modified, altered, changed, or amended in any respect unless in writing and signed by the parties hereto. Such modification shall be executed by both parties.

SC-19 Defective Work: In 19.1, second line, replace "condemned" with "determined".

SC-20 Differing Site Conditions: Add the following.

20.5 Existing Conditions

A. Underground Facilities: Existence and location of Underground Facilities and other utilities and construction indicated as existing are not guaranteed. Before beginning Work investigate and verify the existence and location of Underground Facilities and other utilities and construction. The information and data shown or indicated in the Contract Documents with respect to existing Underground Facilities at or contiguous to the Site is based on information and data furnished to Owner or Engineer by the owners of such Underground Facilities, including Owner, or by others.

1. Owner and Engineer shall not be responsible for the accuracy or completeness of any such information or data provided by others; and

2. Contractor shall have full responsibility (including cost) for reviewing and checking all such information and data; locating all Underground Facilities shown or indicated in the Contract Documents; coordination of the Work with the owners of such Underground Facilities, including Owner, during construction; and the safety and protection of all such Underground Facilities and repairing any damage thereto resulting from the Work.

3. Contact DIGSAFE (www.digsafe.com) by dialing 811 or 888-344-7233 (888-DIG-SAFE).

4. Engage a professional subsurface utility locator to verify the existence and location of underground utilities prior to starting Work;

5. Conduct test pits and other utility research as directed by Engineer and properly restore utilities interfered with or damaged during construction at no cost to the Owner; and

6. Before starting Work in existing manholes, test for gas and blow out the manholes.

7. If an Underground Facility is uncovered or revealed at or contiguous to the Site which was not shown or indicated, or not shown or indicated with reasonable accuracy in the Contract Documents, Contractor shall, promptly after becoming aware thereof and before further disturbing conditions affected thereby or performing any Work in connection therewith (except in an emergency), identify the owner of such Underground Facility and give written notice to that owner and to Owner and Engineer. Engineer will promptly review the Underground Facility and determine the extent, if any, to which a change is required in the Contract Documents to reflect and document the consequences of the existence or location of the Underground Facility. During such time, Contractor shall be responsible for the safety and protection of such Underground Facility.

8. An equitable adjustment may be made in the Contract Price or Contract Times, or both, to the extent that they are attributable to the existence or location of any Underground Facility that was not shown or indicated or not shown or indicated with reasonable accuracy in the Contract Documents and that Contractor did not know of and could not reasonably have been expected to be aware of or to have anticipated. Engineer, shall not be liable to Contractor for any claims, losses, or damages incurred by Contractor related to Underground Facilities not shown or indicated.

B. Subsurface and Physical Conditions: Subsurface information includes, but is not limited to, test boring logs, groundwater observation well log, and geotechnical laboratory testing data. Contractor may rely upon the accuracy of the "technical data" contained in such reports and drawings, but such reports and drawings are not Contract Documents. "Technical data" shall be limited to facts, measurements, field observations, boring logs, soil type and similar data and shall not include opinions regarding suitability of material, dewatering methodologies, soil stability, slope stabilization methods and other opinions or professional judgments. Except for such reliance on such "technical data," Contractor may not rely upon or make any claim against Owner or Engineer, or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors with respect to:

1. the completeness of such reports and drawings for Contractor's purposes, including, but not limited to, any aspects of the means, methods, techniques, sequences, and procedures of construction to be employed by Contractor, and safety precautions and programs incident thereto; or

2. other data, interpretations, opinions, and information contained in such reports or shown or indicated in such drawings; or

3. any Contractor interpretation of or conclusion drawn from any "technical data" or any such other data, interpretations, opinions, or information.

4. If Contractor believes that any subsurface or physical condition that is uncovered or revealed either:

   a. is of such a nature as to establish that any "technical data" on which Contractor is entitled to rely is materially inaccurate; or

   b. is of such a nature as to require a change in the Contract Documents; or

   c. differs materially from that shown or indicated in the Contract Documents; or

   d. is of an unusual nature, and differs materially from conditions ordinarily encountered and generally recognized as inherent in work of the character provided for in the Contract Documents;

   then Contractor shall, promptly after becoming aware thereof and before further disturbing the subsurface or physical conditions or performing any Work in connection therewith (except in an emergency), notify Owner and Engineer in writing about such condition. Contractor shall not further disturb such condition or perform any Work in connection therewith until receipt of written order to do so except in an emergency.

5. The Contract Price or the Contract Times, or both, will may be equitably adjusted to the extent that the existence of such differing subsurface or physical condition causes an increase or decrease in Contractor's cost of, or time required for, performance of the Work. However, Contractor shall not be entitled to any adjustment in the Contract Price or Contract Times if:

   a. Contractor knew of the existence of such conditions at the time Contractor made a final commitment to Owner with respect to Contract Price and Contract Times by the submission of a Bid and execution of the Contract; or

   b. the existence of such condition could reasonably have been discovered or revealed as a result of any examination, investigation, exploration, test, or study of the Site and contiguous areas required by the Bidding Requirements or Contract Documents to be conducted by or for Contractor prior to Contractor's making such final commitment; or

c. Contractor failed to give the written notice as required by above, or

d. written notice of such condition is submitted after final payment

C. Hazardous Environmental Conditions at the Site:

1. Contractor shall not be responsible for any hazardous environmental condition uncovered or revealed at the Site which was not shown or indicated in Drawings or Specifications or identified in the Contract Documents to be within the scope of the Work. Contractor shall be responsible for a hazardous environmental condition created with any materials brought to the Site by Contractor, Subcontractors, Suppliers, or anyone else for whom Contractor is responsible.

2. If Contractor encounters a hazardous environmental condition or if Contractor or anyone for whom Contractor is responsible creates a hazardous environmental condition, Contractor shall immediately: (i) secure or otherwise isolate such condition; (ii) stop all Work in connection with such condition and in any area affected thereby (except in an emergency); and (iii) notify Owner and Engineer. Owner shall promptly consult with Engineer concerning the necessity for Owner to retain a qualified expert to evaluate such condition or take corrective action, if any. Owner shall take such actions as are necessary to permit Owner to timely obtain required permits and provide Contractor the written notice below.

3. Contractor shall not be required to resume Work in connection with such condition or in any affected area until after Owner has obtained any required permits related thereto and delivered written notice to Contractor: (i) specifying that such condition and any affected area is or has been rendered safe for the resumption of Work; or (ii) specifying any special conditions under which such Work may be resumed safely.

SC-22 Right of Owner to Terminate Contract:

22.5 The following language is **deleted** from the first sentence in paragraph 22.5 “approved by the Engineer or awarded by arbitrators within thirty (30) days of it approval and presentation”, and **replaced** with “claimed as due”.

SC-24 Payments to the Contractor:

Add the following to Paragraph 24.1:

A. Contractor shall submit an Application for Payment within ten (10) calendar days following the end of the month and the Owner shall pay the Contractor within thirty (30) days after receipt of the Contractor’s invoice.

B. Submit 6 copies of each Application for Payment using the Application for Payment Form included in Section 01 11 06. Utilize latest approved Schedule of Values for listing items in Application for Payment. Provide supporting documentation. Submit an updated Progress Schedule with each Application for Payment.

C. The Owner's obligations to pay any amount due under a contract are contingent upon availability and continuation of funds for the purpose. The Owner may terminate the Contract at any time, due to the non-appropriation of funds, and all payment obligations of the Owner cease on the date of termination.

Delete paragraph 24.2a in its entirety.

Delete the second sentence in paragraph 24.2b.

The following is **deleted** from the first sentence in paragraph 24.6: "approval by the engineer", and replaced with "Engineer's review".

SC-27 Insurance

Add the following to subparagraph 27.1.

In no event shall employees of Contractor be deemed to be the employees of, or under the direction or control of the Owner for any purpose whatsoever. Contractor and Subcontractors at every tier shall conform with the requirements of RSA 281 Title XXIII, Section 281-A:2 with close attention to sections VI(a), VI(c) and VII(a) as well as Section 281-A:4.

Change the following in paragraph two, Article 27.2:

"Limits of liability: ~~$1,000,000~~	$2,000,000 each occurrence bodily injury and property damage; $2,000,000 general aggregate – include per project $2,000,000 each occurrence and aggregate Professional Liability

Add the following to Article 27.2:

"Coverage amounts may be satisfied by excess or umbrella policies provided the City of Portsmouth is listed as an additional insured on the excess/umbrella policy as well as the general liability policy. The City of Portsmouth shall be named as additional insured as follows:

City of Portsmouth
Attn: Legal Department
1 Junkins Avnue
Portsmouth, New Hampshire 03801"

Change the following in paragraph to, Article 27.3:

"Limits of liability: ~~$1,000,000~~ $2,000,000 combined single limit for bodily injury and property damage."

Add the following to Article 27.3:

"Coverage amounts may be satisfied by excess or umbrella policies provided the City of Portsmouth is satisfied with coverage."

In subparagraph 27.6., **replace** the second sentence with the following.

Such policies shall provide for cancellation only subsequent to 30 days prior written notice to the Owner and proof of subsequent insurance upon cancellation of prior policy. Owner and Engineer shall be named additional insureds, with respect to Commercial, General, Automobile, and Umbrella liability, by endorsement and shown on all insurance certificates.

Add the following to Article 27.8:

"The Engineer and Engineer's Subcontractors shall be names as Additional Insured on the Owners policy provided by the Contractor. Contractor shall procure and shall maintain during the life of the contract pollution liability insurance and such coverage shall be at least $1,000,000".

Change the following in paragraph two, Article 27.8:

"Limits of liability: $2,000,000 each occurrence;
$2,000,000 aggregate."

Add the following:

27.9 The Owner's examination of, or failure to request or demand, any evidence of insurance hereunder, shall not constitute a waiver of any requirement and the existence of any insurance shall not limit the bidder's obligation under any provision hereof. Except to the extent of comparable insurance acceptable to, or express waiver by the Owner, the bidder shall, or shall cause any carrier engaged by Contractor, to insure all shipments of materials and equipment for full value.

SC-28 Contract Security

Add the following paragraphs to Article 28 of the General Conditions:

"The payment bond and performance bond furnished by the Contractor shall be in the form of the bonds shown on Page C-2.5, C-2.6, C-2.7 and C-2.8, unless approved otherwise by Owner or Engineer.

The terms contained in the performance bond shall in no way invalidate the provisions of the contract documents or the right of the owner to terminate the contract as specified therein.

SC-33 Authority of the Engineer

In Paragraph 33.1, delete the first and second sentences in their entirety.

In Paragraph 33.2, in the third line, delete "to suspend any work that is being improperly performed,".

Add the following:

33.3 The Project has been designed by Woodard and Curran, Inc. referred to as the "Engineer". Neither Engineer's authority or responsibility under the Contract Documents nor any decision made by Engineer in good faith either to exercise or not exercise such authority or responsibility or the undertaking, exercise, or performance of any authority or responsibility by Engineer shall create, impose, or give rise to any duty in contract, tort, or otherwise owed by Engineer to Contractor, any Subcontractor, any Supplier, any other individual or entity, or to any surety for or employee or agent of any of them.

A. Engineer will not supervise, direct, control, or have authority over or be responsible for Contractor's means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of Contractor to comply with Laws and Regulations applicable to the performance of the Work. Engineer will not be responsible for Contractor's failure to perform the Work in accordance with the Contract Documents.

B. Engineer will not be responsible for the acts or omissions of Contractor or of any Subcontractor, any Supplier, or of any other individual or entity performing any of the Work.

C. Engineer will have no responsibility or authority:

to order changes in construction which will result in additional costs or which will require extensions of Contract Times;

to suspend all or any portion of Contractor's operations;

to terminate all or any portion of the Work;

to make final acceptance of all or any portion of the Work; and

to operate or maintain any portion of the Work.

D. The limitations upon authority and responsibility set forth in this Paragraph shall also apply to Engineer's representatives, if any, and assistants, if any.

E. Intent of Certain Terms or Adjectives: The Contract Documents include the terms "as allowed," "as approved," "as ordered," "as directed" or terms of like effect or import to authorize an exercise of professional judgment by Engineer. In addition, the adjectives "reasonable," "suitable," "acceptable," "proper," "satisfactory," or adjectives of like effect or import are used to describe an action or determination of Engineer as to the Work. It is intended that such exercise of professional judgment, action, or determination will be solely to evaluate, in general, the Work for compliance with the information in the Contract Documents and with the design concept of the Project as a functioning whole as shown or indicated in the Contract Documents (unless there is a specific statement indicating otherwise). The use of any such term or adjective is not intended to and shall not be effective to assign to Engineer any duty or authority to supervise or direct the performance of the Work, or any duty or authority to undertake responsibility contrary to that above or any other provision of the Contract Documents.

SC-37 Lands and Rights-of-Way:

Add the following sentence to paragraph 37.1:

"Contractor shall reference memorandum of understanding for temporary storage and staging for land rights during construction. See figure 1 in section 01 11 05A".

SC-44 Non-Discrimination:

Add the following sentence to paragraph 44.2:

"Pursuant to New Hampshire law, the Contractor shall not discriminate on the basis of sexual orientation".

Delete paragraphs 44.3-44.7 in their entirety.

SC-52 Project Sign:

Delete paragraph 52 in its entirety.

SC-58 Work Performed at Night and on Sundays and Holidays:

Delete the first paragraph in its entirety.

Replace with the following paragraph:

"No work will be permitted at night or on Saturdays or on Sundays or holidays except as approved in writing by the Engineer, and provided such work is not in violation of a local ordinance. When working at night, the Contractor shall provide flood lighting sufficient to insure the same quality of workmanship and the same conditions regarding safety as would be achieved by daylight.

SC-59 Laws to be Observed:

Add the following after Paragraph 59.1.

A. The Laws of the State of New Hampshire shall govern this Contract. Any disputes shall be resolved within the venue of the State of New Hampshire and Rockingham County.

In subparagraph 59.2, replace the first paragraph with the following:

Contractor agrees to indemnify, defend and save harmless the City, its officials, officers, agents, consultants and employees from any and all claims and losses accruing or resulting to any and all contractors, Subcontractors, Suppliers, laborers and any other person, firm, or corporation furnishing or supplying work, services, materials or supplies in connection with the performance of this contract, and from any and all claims and losses accruing or resulting to any person, firm or corporation which may be injured or damaged by the Contractor in the performance of this contract. In any case, the foregoing provisions concerning indemnification shall not be construed to indemnify the City for damage arising out of bodily injury to persons or damage to property caused by or resulting from the sole negligence of the City or its employees. This indemnification shall survive the expiration or early termination of this contract.

SC-62 Use of Explosives:

Delete section in its entirety.

SC-64 Taxes: Replace the existing paragraph with the following.

The Owner is exempt from all sales and Federal excise taxes. The Owner's tax exemption certificate will be provided to Contractor upon request. Do not include these taxes in any pricing.

END OF SECTION

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SECTION 01 11 00

SUMMARY OF WORK

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Project Description

B. Description of the Work

C. Work Sequence and Coordination

1.02 PROJECT DESCRIPTION

A. The Lafayette Road Pump Station is a municipal wastewater pumping station owned by the City of Portsmouth, NH. It is located at 630 Lafayette Road in the parking lot of a shopping plaza. It was originally constructed in 1962 and underwent major upgrades in 1981. This project will renovate the pump station to replace and update worn out mechanical, electrical, and control systems. It will also improve operations and maintenance, upgrade the architectural appearance of the station, bring building systems in compliance with modern code to the extent possible. Bypass pumping during construction will be required.

1.03 DESCRIPTION OF THE WORK

A. The Work includes services, labor, material and equipment, required for construction, testing, and commissioning of the Project in accordance with the Contract Documents and as more specifically described in the Specifications and Drawings and includes, but is not limited to, the following principal features:

1. Site work including demo, grading and paving of a driveway area, installation of a bypass connection, installation of landscaping and a fence.

2. Architectural work including demolition of part of the roof and installation of a new wood-truss roof, replacement of doors, windows, and railings, new monorails and hoists, and other miscellaneous rehab.

3. Interior structural work including reinforcement of the existing CMU walls, demolition of equipment pads, partial demolition of an elevated slab in the wet well and replacement with grating, new wetwell dividing wall, and installation of new interior CMU walls.

4. Upon completion of wetwell demolition work, providing access for Engineer to conduct an inspection of wetwell concrete. Providing concrete repair as directed by Engineer and per bid allowances. Providing H2S-protective coating for wetwell as an additive alternate.

5. Demolition of all interior process equipment including three pumps, piping, bar rack, slide gates, and grinder, and replacement with new equipment. Providing a packaged odor control system.

6. Demolition of HVAC and plumbing systems and replacement with new systems including testing, adjusting, and balancing.

7. Demolition of existing electrical systems including a generator, MCC, cable and conduit, and lighting. Installation of new systems including outdoor generator, intelligent MCC, distribution, and lighting. Coordination with Eversource to replace electrical service and provide new pad-mounted transformer.

8. Demolition of existing instrumentation and control system and replacement with new equipment.

9. The General Contractor shall engage Electrical Installation Inc. (EII) as the instrumentation system integrator, who has installed and maintained the SCADA System for the City.

10. The General Contractor shall engage Ted Berry Company for pigging of the force main after the bypass connection has been installed.

1.04 WORK SEQUENCE AND COORDINATION

A. Contractor shall comply with the City of Portsmouth noise ordinance. Normal work hours shall be between 6AM and 7PM. Notify City in advance if it necessary to work more than 8 hours in one day. Work on weekends and holidays is not permitted. Annual Federal holidays include the following; New Years' Day, Dr. Martin Luther King Jr. Day, President's Day, Good Friday (half day), Memorial Day, Independence Day, Labor Day, Columbus Day, Veteran's Day, Thanksgiving Day and Day After, Christmas Day.

B. Provide Owner with access to site at all times, including one set of all keys necessary and parking space for one truck.

C. Space available on site for Contractor activities/staging is shown on the Drawings.

D. Maintain 3.3 mgd of pumping capacity on line at all times. Provide sewage bypass pumping in accordance with Section 01 51 40.

E. Access to businesses and residences must be maintained during prosecution of the Work.

F. Schedule force main cleaning Work to avoid conflicts with other Work, bypass pumping and rain events. Work overnight as necessary to avoid daytime high flows. Pump station must remain on-line at all times. Schedule police details as necessary to access certain structures in the roadway.

END OF SECTION

SECTION 01 11 05

OVERALL GENERAL REQUIREMENTS

PART 1 – GENERAL

1.01 SUMMARY

A. This Section specifies the overall general requirements for execution of the Work, supplements some items in the General and Special Conditions, and applies to all Specifications and Drawings, including:

1. Administrative and procedural requirements (relating to the process of contract administration, and the methods of communicating, controlling, and assuring quality);

2. Temporary facilities and controls (put into place for use only during the period of construction and that will be removed when no longer required for construction operations);

3. General execution requirements; and

4. Startup/commissioning and performance testing.

B. Section Includes

1.02 PRICE AND PAYMENT PROCEDURES

Schedule of Values
Payment Procedures
Change Procedures
Measurement and Payment Procedures
Correlation of Submittals

1.03 ADMINISTRATIVE REQUIREMENTS

Project Management and Coordination; Meetings
Documentation of Progress
Submittal Procedures
Closeout Procedures

1.04 QUALITY REQUIREMENTS
Reference Standards and Regulatory Requirements
Qualifications

PART 2 - PRODUCTS

2.01 SOURCE QUALITY CONTROL

General
Independent Testing Agency Certification
Factory Testing

2.02 PRODUCT REQUIREMENTS

General
Transportation and Handling
Storage and Protection

PART 3 - EXECUTION

3.01 TEMPORARY CONSTRUCTION FACILITIES

Barriers
Protection of Work
Security
Safety Facilities
Access Roads
Parking
Field Offices
Project Identification
Progress Cleaning and Waste Removal

3.02 TEMPORARY UTILITIES

3.03 TEMPORARY CONTROLS

Dust Control
Water Control and Dewatering
Erosion and Sediment Control
Noise Control
Pollution Control
Traffic Regulation

3.04 REMOVAL OF TEMPORARY UTILITIES, FACILITIES, AND CONTROLS

3.05 OVERALL EXECUTION REQUIREMENTS

Coordination
Existing Conditions
Field Engineering
Record Documents
Cutting and Patching
Electrolytic Corrosion Prevention
Quality Assurance and Control of Installation
Manufacturers' Field Services
Independent Testing

3.06 STARTUP, TESTING, AND COMMISSIONING

Spare Parts
Consumables
Checkout and Starting Systems
Starting, Adjusting, and Balancing
Startup and Commissioning/Performance Testing
Demonstration and Training

3.07 ATTACHMENTS

1.02 PRICE AND PAYMENT PROCEDURES

A. Schedule of Values

1. Submit preliminary and final Schedule of Values.

2. Provide sufficient detail to allow for determination of the value of the Work at any degree of completion. Identify number and title of related specification sections in accordance with the Table of Contents.

3. For each line item, identify number and title of Specification section in accordance with the Table of Contents.

B. Payment Procedures

1. Utilize Payment Application included in Section 01 11 06 PROJECT FORMS.

2. Submit certified weigh slips for hot bituminous pavement ready mix concrete on a daily basis or as each truckload of pavement is placed.

3. Payment Period: at intervals stipulated in the Agreement.

C. Change Procedures

1. Utilize forms included in the Contract and Project Forms section.

a. Field Order: issued by Engineer or Owner to advise of minor changes in the Work not involving an adjustment to Contract Price or Contract Time.

b. Change Request: issued by Engineer, Owner or Contractor to request or authorize minor variations and deviations, amendments or supplements to the Contract Documents. Initiate requests for substitute items using a Change Request.

1) Engineer or Owner to include a detailed description of a proposed change with supplementary or revised Drawings and Specifications, including a change in Contract Times related to the change (with a stipulation for any overtime work required) and the period of time during which the requested price will be considered valid. Prepare and submit an estimate within 15 days.

2) Contractor to describe the proposed change and its full effect on the Work. Describe the reason for the change and the effect on the Contract Price and Contract Time with full documentation (and a statement describing the effect on Work by separate or other contractors). Document any requested substitutions.

c. Work Change Directive: issued by Engineer or Owner, signed by Engineer or Owner and instructing Contractor to proceed with a change in the Work. Work authorized in a Work Change Directive will be included in a subsequent Change Order. Document will describe changes in the Work, and designate method of determining any change in Contract Price or Contract Time. Promptly execute the change.

d. Change Order: issued by Engineer or Owner.

1) Stipulated Price Change Order: based on Contractor's maximum price quotation or Contractor's request for a Change Order as approved by Engineer or Owner.

2) Unit Price Change Order: for pre-determined unit prices and quantities and executed on a fixed unit price basis. Execute Work under a Work Change Directive for unit costs or quantities of work not pre-determined. Changes in Contract Price and Contract Time to be computed as specified for Time and Material Change Order.

3) Time and Material Change Order: based on itemized account and supporting data after completion of change. Engineer or Owner and Contractor to determine the change allowable in Contract Price and Contract Time. Maintain

detailed records of work done on this basis, provide full information required for evaluation of proposed changes, and substantiate costs for changes in the Work.

e. Substitutes and "Or Equals": Request substitute items as a Change Request in accordance with subparagraph C.1.b. above, with complete data substantiating compliance of proposed substitution with Contract Documents.

1) Substitute items will be processed in accordance with subparagraph 1.03.C.6 below.

2) Substitute items will not be considered when indicated or implied on Shop Drawing or material and equipment data submittals without separate written request, or when acceptance will require revision to the Contract Documents.

D. Correlation of Submittals

1. Promptly revise Schedule of Values (if any) and Applications for Payment to record each authorized Change Order as a separate line item and adjust the Contract Price.

2. Promptly revise Progress Schedule to reflect any change in Contract Times and revise sub schedules to adjust time for other items of the Work affected by the change.

3. Promptly enter changes in Project Record Documents.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Project Management and Coordination; Meetings

1. Contact information for Owner and other entities related to the Project and special coordination requirements and contacts during prosecution of the Work are included as an attachment to this Section.

2. Inform Owner and Engineer of the address for sending official correspondence and the address and telephone number of Contractor's representative who will be project manager and Site superintendent for the Contract and identify the 24 hour, 7 days per week emergency response telephone or cell phone number that is staffed by a person (not a passive answering machine) or provide that a phone call will be returned within one hour.

3. During periods of construction and testing keep Owner and Engineer informed in writing with name, address, and telephone number of Contractor's representative who will be responsible and available outside

of normal working hours for emergency repairs and the maintenance of safety devices.

4. Coordinate scheduling, submittals, and Work of the various Specifications to effectuate an efficient and orderly sequence for installing interdependent construction elements, with provisions for accommodating items installed later.

1. Identify correspondence, submittals, drawings, data and materials, packing slips or other items associated with this Contract as follows.

   Lafayette Road Pump Station Upgrades Project

2. Coordinate scheduling, submittals, and Work of the various Specifications to effectuate an efficient and orderly sequence for installing interdependent construction elements, with provisions for accommodating items installed later.

3. Preconstruction Conference and Site Mobilization Meeting

   a. Owner to schedule an initial preconstruction.

   b. Attendance required by Owner, Contractor, Engineer, Contractor's Superintendent, Project Manager, Subcontractors and major Suppliers as needed.

   c. Agenda

      1) Distribute Contract Documents

      2) Discuss design concepts

      3) Discuss preliminary Progress Schedule, Schedule of Submittals, Schedule of Values and preliminary cash flow projections.

      4) Designate personnel representing each party; communication procedures

      5) Procedures and processing of submittals, substitutions, applications for payments, Change Orders and Contract closeout procedures

      6) Scheduling

      7) Use of premises by Owner and Contractor

      8) Owner's requirements and partial occupancy

      9) Construction facilities and controls provided by Owner

10) Temporary utilities provided by Owner and Contractor

11) Survey and Site Layout

12) Security and housekeeping procedures

13) Schedules

14) Procedures for testing

15) Procedures for maintaining record documents

16) Requirements for start-up

17) Inspection and acceptance of equipment put into service during construction period

18) Access, laydown and coordination with others

d. Engineer will record minutes and distribute draft copies prior to the next scheduled meeting to Owner and Contractor for review, then revise as required and distribute within 2 weeks thereafter to meeting participants, with copies to Owner and Contractor, and those affected by decisions made.

4. Progress Meetings

a. Engineer to schedule progress meetings beginning no later than 60 days after the Initial Conference and continue thereafter on a monthly basis throughout progress of the Work.

b. Attendance required by Contractor, Contractor's Superintendent, major Subcontractors and Suppliers, Owner and Engineer as appropriate to agenda topics for each meeting.

c. Agenda

1) Review minutes of previous meetings

2) Unresolved Issues

3) Review Work progress

4) Observations, problems, and decisions

5) Identification of problems which impede planned progress

6) Review of Schedule of Submittals and status of submittals

7) Review of off Site fabrication and delivery schedules

8) Maintenance of progress schedule

9) Corrective measures to regain projected schedules

10) Planned progress during succeeding Work period

11) Coordination of projected progress

12) Maintenance of quality and Work standards

13) Effect of proposed changes on Progress Schedule and coordination

14) Other business relating to Work

d. Engineer will record minutes and distribute draft copies prior to the next scheduled meeting to Owner and Contractor for review, then revise as required and distribute within 2 weeks thereafter to meeting participants, with copies to Owner and Contractor, and those affected by decisions made.

5. Pre-installation Conference and Coordination Meetings

a. When required, convene a pre-installation conference at Site before commencing certain Work that requires coordination or has special requirements or approvals or convene coordination meetings as may be generally required.

b. Attendance required by parties directly affecting, or affected by, Work of the specific Specification section. Notify Owner and Engineer 5 days in advance of pre-installation conference. Party requesting general coordination meeting to notify other party.

c. Review conditions, preparation and procedures, and coordination with related Work.

B. Documentation of Progress

1. Submit preliminary and final Progress Schedules.

a. Show complete sequence of construction by activity, identifying Work of separate stages and other logically grouped activities. Indicate the early and late start, early and late finish, float dates, and duration.

b. Indicate estimated percentage of completion for each item of Work at each submission.

c. Indicate dates for fabrication, factory testing, delivery, shipping and field testing, and material and equipment delivery dates,

including those furnished by Owner. Coordinate with Schedule of Submittals.

2. Submit revised Progress Schedule on monthly basis and with each Application for Payment, identifying changes since previous version. Coordinate content with Schedule of Values, if any.

3. Provide documentation of pre-construction conditions and construction progress using Digital Video Recording.

   a. Prior to the start of construction, video record, in color, all areas of the Project Site in the presence of the Engineer to establish a record of pre-construction conditions. Ensure existing conditions of roadway surfaces, curbing, berms, sidewalks, driveways, property bounds, landscaped areas, abutters' property and any other items that might be affected by the Work are clearly recorded.

   b. Arrange for video recordings to be conducted by a professional video-photographer in digital videodisc (DVD) format. Include clear and concise audio descriptions of the existing Project Site conditions.

   c. Submit a copy of the first completed video recording to the Engineer for review of visual and audio quality. Once approved, submit 2 copies of video recordings. Re-record any recording furnished which, in the opinion of the Engineer, are poor quality or incomplete at no additional cost to Owner.

4. Submit weekly Safety Reports signed by the responsible on-Site person.

C. Submittal Procedures

1. Schedule submittals to expedite the Project and coordinate with schedules required by Paragraph 1.03.B above. Deliver each submittal in the quantity indicated to Engineer (with copy to Owner where required) as follows. Coordinate submission of related items.

Engineer:

Woodard & Curran (Engineer)

Attention: Erik Osborn, PE
Telephone: 207-774-2112
Email: eosborn@woodardcurran.com

Owner:

City of Portsmouth, New Hampshire
Donald Song, PE
Wastewater Project Manager

Telephone: 603-610-7305
Email: dsong@cityofportsmouth.com

2. Present submittals in a clear and thorough manner, in English and using English units. Use sheet size of not less than 8 1/2 by 11 inches and not more than 24 by 36 inches. Provide space for Contractor, Engineer, and Owner's review stamps.

3. Revise and resubmit documents as required. Identify all changes made since previous submittal. Distribute copies of reviewed submittals to concerned parties. Instruct parties to promptly report any inability to comply with provisions. Submittals not requested on the submittal schedule may not be recognized or processed.

4. Schedule of Submittals: Submit preliminary and final Schedule of Submittals. Include all submittals specified in Contract, General Requirements, and other Specification sections.

    a. Include description of each submittal, date by which each submittal will be delivered to Engineer and Owner date by which each submittal must be approved to maintain project schedule, and relevant section reference.

    b. Allow 15-30 days from receipt of submittal/resubmittal for Engineer review of submittals and possible resubmittal.

5. Shop Drawings and Samples: Submit 6 prints and electronic files in PDF format by email in accordance with the Schedule of Submittals required in subparagraph 1.03.C.4 above.

    a. Complete the submittal transmittal form included as an attachment to this Section as is indicated, numbering each submittal consecutively. Assign resubmittals the same transmittal number as the original with a suffix of a sequential letter to indicate the resubmittal (e.g. the first resubmittal of submittal 25 would be number 25A.) Include only those documents previously issued under original transmittal number in resubmittals. Do not combine new submittals with resubmittals.

    b. Attach a transmittal form to each group of Shop Drawings, manufacturer's literature, equipment data and Samples submitted. Use a sufficient number of transmittal forms so that: items on a single transmittal form pertain to the same equipment item, specification section or element of Work; items on a single transmittal form are either original submittals or the same number resubmittal; and each Sample is listed on a separate transmittal form. Data shown on the Shop Drawings shall be complete with respect to quantities, dimensions, specified performance and design criteria, materials, and similar data to show Engineer the services, materials, and equipment Contractor proposes to provide.

c. Submittals which do not have a fully completed transmittal form will be returned along with unreviewed attachments. Returned submittals, even though incomplete, will be counted as a submittal.

d. Before submitting each Shop Drawing or Sample, Contractor shall have:

1) reviewed and coordinated each Shop Drawing or Sample with other Shop Drawings and Samples and with the requirements of the Work and the Contract Documents;

2) determined and verified all field measurements, quantities, dimensions, specified performance and design criteria, installation requirements, materials, catalog numbers, and similar information with respect thereto;

3) determined and verified the suitability of all materials offered with respect to the indicated application, fabrication, shipping, handling, storage, assembly, and installation pertaining to the performance of the Work; and

4) determined and verified all information relative to Contractor's responsibilities for means, methods, techniques, sequences, and procedures of construction, and safety precautions and programs incident thereto.

e. Each submittal shall bear a stamp or specific written certification that Contractor has satisfied Contractor's obligations under the Contract Documents with respect to Contractor's review and approval of that submittal.

f. Engineer's Review

1) Engineer will provide timely review of Shop Drawings and Samples in accordance with the Schedule of Submittals acceptable to Engineer. Engineer's review and approval will be only to determine if the items covered by the submittals will, after installation or incorporation in the Work, conform to the information given in the Contract Documents and be compatible with the design concept of the completed Project as a functioning whole as indicated by the Contract Documents.

2) Engineer's review and approval will not extend to means, methods, techniques, sequences, or procedures of construction (except where a particular means, method, technique, sequence, or procedure of construction is specifically and expressly called for by the Contract Documents) or to safety precautions or programs incident thereto. The review and approval of a separate item as such

will not indicate approval of the assembly in which the item functions.

3) Engineer's review and approval shall not relieve Contractor from responsibility for any variation from the requirements of the Contract Documents unless Contractor has complied with the requirements of subparagraph C.6. below. Engineer's review and approval shall not relieve Contractor from errors or omissions in a Shop Drawing or Sample.

g. Resubmittal Procedures

1) Contractor shall make corrections required by Engineer and shall return the required number of corrected copies of Shop Drawings and submit, as required, new Samples for review and approval. Contractor shall direct specific attention in writing to revisions other than the corrections called for by Engineer on previous submittals.

2) Contractor shall furnish required submittals with sufficient information and accuracy in order to obtain required approval of an item with no more than 3 submittals. Engineer will record Engineer's time for reviewing subsequent submittals of Shop Drawings, samples, or other items requiring approval and Contractor shall reimburse Owner for Engineer's charges for such time.

3) In the event that Contractor requests a change of a previously approved item, Contractor shall reimburse Owner for Engineer's charges for its review time unless the need for such change is beyond the control of Contractor.

6. Variations: Clearly identify requests for "Or-Equal" and substitute items and submit per subparagraph 1.02.C.1.b above. Substitute items will not be considered when indicated or implied on Shop Drawing or material and equipment data submittals without separate written request, or when acceptance will require revision to the Contract Documents. Identify variations from Contract Documents and material and equipment or system limitations which may be detrimental to successful performance of the completed Work and identify reasons therefor at no additional cost to Owner.. Engineer will be allowed a reasonable time within which to evaluate each proposal or submittal made and may require Contractor to furnish additional data about the proposed substitute item. Engineer will be the sole judge of acceptability. No "or equal" or substitute will be ordered, installed or utilized until Engineer's review is complete, which will be evidenced by a Change Order in the case of a substitute and an approved Shop Drawing for an "or equal."

a. "Or Equal" Items: If in Engineer's sole discretion an item of material or equipment proposed by Contractor is functionally equal to that named and sufficiently similar so that no change in related Work will be required, it may be considered by Engineer as an "or equal" item, in which case review and approval of the proposed item may, in Engineer's sole discretion, be accomplished without compliance with some or all of the requirements for approval of proposed substitute items. A proposed item of material or equipment will be considered functionally equal to an item so named:

1) if in the exercise of reasonable judgment Engineer determines that it is at least equal in materials of construction, quality, durability, appearance, strength, and design characteristics; it will reliably perform at least equally well the function and achieve the results imposed by the design concept of the completed Project as a functioning whole; and it has a proven record of performance and availability of responsive service; and

2) Contractor certifies that, if approved and incorporated into the Work there will be no increase in cost to the Owner or increase in Contract Times and it will conform substantially to the detailed requirements of the item named in the Contract Documents.

b. Substitute Items: If in Engineer's sole discretion an item of material or equipment proposed by Contractor does not qualify as an "or-equal" item subparagraph 6.a above, it will be considered a proposed substitute item. Contractor shall submit sufficient information as provided below to allow Engineer to determine if the item of material or equipment proposed is essentially equivalent to that named and an acceptable substitute therefor. Requests for review of proposed substitute items of material or equipment will not be accepted by Engineer from anyone other than Contractor.

1) Contractor shall certify that the proposed substitute item will perform adequately the functions and achieve the results called for by the general design, be similar in substance to that specified, and be suited to the same use as that specified.

2) Contractor shall state the extent, if any, to which the use of the proposed substitute item will prejudice Contractor's achievement of Substantial Completion on time, whether use of the proposed substitute item in the Work will require a change in any of the Contract Documents (or in the

provisions of any other direct contract with Owner for other work on the Project) to adapt the design to the proposed substitute item, and whether incorporation or use of the proposed substitute item in connection with the Work is subject to payment of any license fee or royalty.

3) Contractor shall identify all variations of the proposed substitute item from that specified, available engineering, sales, maintenance, repair, and replacement services; and shall contain an itemized estimate of all costs or credits that will result directly or indirectly from use of such substitute item, including costs of redesign and claims of other contractors affected by any resulting change.

4) Engineer will advise Contractor in writing of any negative determination. Engineer will record Engineer's costs in evaluating a substitute proposed or submitted by Contractor. Whether or not Engineer approves a substitute so proposed or submitted by Contractor, Contractor shall reimburse Owner for the reasonable charges of Engineer for evaluating each such proposed substitute. Contractor shall also reimburse Owner for the reasonable charges of Engineer for making changes in the Contract Documents (or in the provisions of any other direct contract with Owner) resulting from the acceptance of each proposed substitute.

7. Manufacturers' Installation Instructions and Certificates: Submit 6 prints and electronic files PDF format by email of printed instructions for delivery, storage, assembly, installation, start-up, adjusting, and finishing. Indicate special procedures, perimeter conditions requiring special attention and special environmental criteria required for application or installation.

   a. Submit manufacturers' certificates for recent or previous test results on material or equipment, but they must be acceptable to Engineer and Owner. Indicate material or equipment conforms to or exceeds specified requirements and provide supporting reference date, affidavits, and certifications as appropriate.

   b. Submit test results, data, and reports and certifications to Engineer based on tests performed. Submit test reports and certifications for independent testing services specified.

8. Record Documents and Closeout Submittals: Submit record documents described in Paragraph 3.05.B. below and per Paragraph 1.03.D below.

a. As-Builts for Material and Equipment: Submit 6 prints and electronic files PDF format by email. Indicate "As-Supplied" in revision block and sign. Show all changes and revisions to Final Completion per Paragraph 3.05.B.

b. Conformed to Construction Record Drawings: Submit 6 prints and electronic files in .DWG format and PDF format on CD for Engineer's use in preparing final Record Drawings. Indicate "Conformed by Contractor to Construction Records" in revision block and sign. Show all changes and revisions to Final Completion per Paragraph 3.05.B.

c. Warranties and Guarantees: Submit duplicate notarized copies of warranty documents which are executed and transferable from Subcontractors, Suppliers, and manufacturers. For items of Work delayed beyond date of Substantial Completion, provide updated submittal within 10 days after acceptance, listing date of acceptance as start of Warranty Period. Assemble in three ring binders with durable plastic cover with a table of contents.

d. Operation and Maintenance Data

1) Submit one draft copy of completed volumes 15 days prior to final inspection. Include 2 copies of completed manuals with major equipment when equipment is shipped. Draft copies will be reviewed and returned after final inspection, with Engineer's comments. Revise content of all sets as required. For final submission. submit 6 copies of final volumes, with electronic files in .PDF format on CD, within 10 days after final inspection.

2) Submit data in ring binders with durable plastic covers with 8 1/2 by 11 inch text pages. Cover: title "OPERATION AND MAINTENANCE INSTRUCTIONS", title of Project, and subject matter of binder when multiple binders are required.

3) Subdivide binder contents with permanent page dividers, logically organized as described below with laminated plastic tabs and clearly print the contents. Prepare a Table of Contents for each volume, with material, equipment, or system description identified, in three parts as follows:

a) Part 1: Directory, listing names, addresses, and telephone numbers of Contractor, Subcontractors, and major equipment Suppliers, and service representative.

b) Part 2: Operation and maintenance instructions arranged by system and subdivided by Specification section.

- For each system, identify names, addresses, and telephone numbers of Subcontractors and Suppliers. Identify the following:
- Significant design criteria
- List of equipment with As-Builts certified "As-Supplied"
- Parts list for each component
- Operating instructions
- Inspection, maintenance and adjustment instructions for equipment and systems
- Lubrication and maintenance schedules
- Maintenance instructions for special finishes, including recommended cleaning methods and materials, and special precautions identifying detrimental agents
- Troubleshooting guides
- Schematic diagrams

c) Part 3: Material Safety Data Sheets

d) Part 4: Other Project documents and certificates, including the following:

- Certificates
- Photocopies of warranties

D. Closeout Procedures

1. Substantial Completion shall have been achieved when Work is complete, systems are successfully operating, and final testing has been successfully completed and Contractor considers the entire Work ready for its intended use; a full inventory of the spare parts and special tools purchased by the Owner are replenished and in the custody of the Owner; the Site has been restored to the satisfaction of the Owner; an inspection of the Work has

been completed by the Engineer and the Owner; and an updated Punch List is provided. The Contractor shall have sole care, custody, and control of the Work until achievement of Substantial Completion.

2. Contractor shall notify Owner and Engineer in writing that the entire Work is substantially complete (except for items specifically listed by Contractor as incomplete) using the Notice of Substantial Completion form included in the Project Forms section and request that a certificate of Substantial Completion be issued. Promptly after Contractor's notification, Owner, Contractor, and Engineer shall make an inspection of the Work to determine the status of completion. If Engineer does not consider the Work substantially complete, Engineer will notify Contractor in writing giving the reasons therefor.

3. If Engineer considers the Work substantially complete, Engineer will deliver to Owner a tentative certificate of Substantial Completion which shall fix the date of Substantial Completion using the Certificate of Substantial Completion included in the Contract section with Punch List attached. Owner shall have 7 days after receipt of the tentative certificate during which to make written objection to Engineer as to any provisions of the certificate or attached list. If, after considering such objections, Engineer concludes that the Work is not substantially complete, Engineer will, within 14 days after submission of the tentative certificate to Owner, notify Contractor in writing, stating the reasons therefor. If, after consideration of Owner's objections, Engineer considers the Work substantially complete, Engineer will, within said 14 days, execute and deliver to Owner and Contractor a definitive certificate of Substantial Completion (with a revised Punch List) reflecting such changes from the tentative certificate as Engineer believes justified after consideration of any objections from Owner.

4. The date of achieving Substantial Completion is the date set forth in the Certificate of Substantial Completion that is accepted and signed by the Owner.

5. During the period between Substantial Completion and the date for Final Completion, Contractor shall be given access to correct items on the Punch List and achieve Final Completion.

6. Upon written notice from Contractor that the entire Work or an agreed portion thereof is complete, Engineer will promptly make a final inspection with Owner and Contractor and will notify Contractor in writing of all particulars in which this inspection reveals that the Work is incomplete or defective. Contractor shall immediately take such measures as are necessary to complete such Work or remedy such deficiencies.

7. Final Completion shall have been achieved when Contractor has, in the opinion of Engineer, satisfactorily completed all corrections identified during the final inspection and has delivered, in accordance with the Contract Documents, documents including maintenance and operating instructions, schedules, guarantees, warranties, bonds, certificates or other evidence of insurance, certificates of inspection, marked up record documents, and other required documents, and Engineer has indicated that the Work is complete in accordance with the Contract Documents including the following.

   a. Final cleaning has been conducted and Contractor equipment and supplies including waste materials have been removed from the Site and legally disposed of.

   b. Inspections required by Laws and Regulations are complete. Certificates and permits to occupy and operate have been issued if required.

   c. Spare parts, maintenance and extra materials have been delivered in quantities specified to Project Site and stored as directed.

   d. A Final Application for Payment has been submitted to the Engineer identifying total adjusted Contract Price, previous payments, and balance due along with required documentation including:

      1) all documentation called for in the Contract Documents

      2) consent of the surety, if any, to final payment

      3) a list of all Claims against Owner that Contractor believes are unsettled

      4) complete and legally effective releases or waivers (satisfactory to Owner) of all Lien rights arising out of or Liens filed in connection with the Work.

8. If the final application for payment is acceptable, Engineer will give written notice to Owner and Contractor that the Work is acceptable using the Certificate of Final Completion form included in the Contract Section. Owner will thereafter make final payment and acceptance per the Contract.

1.04 QUALITY REQUIREMENTS

A. Reference Standards and Regulatory Requirements

1. Reference to standards, specifications, manuals or codes of any technical society, organization or association, or Laws or Regulations of any governmental authority are used whether such reference be specific or by

implication, shall mean the standard, specification, manual, code, or Laws or Regulations in effect at the time of opening of Bids (or on the Effective Date of the Agreement if there were no Bids), except as may be otherwise specifically stated in the Contract Documents.

2. No provision of any such standard, specification, manual, or code, or any instruction of a Supplier, shall be effective to change the duties or responsibilities of Owner, Contractor, or Engineer, or any of their subcontractors, consultants, agents, or employees, from those set forth in the Contract Documents. No such provision or instruction shall be effective to assign to Owner, Engineer, or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors, any duty or authority to supervise or direct the performance of the Work or any duty or authority to undertake responsibility inconsistent with the provisions of the Contract Documents.

3. Acronyms and abbreviations used are defined in the applicable versions of the Encyclopedia of Associations published by Gale (part of Cengage Learning) generally available in large libraries and on the internet.

B. Qualifications

1. Meet or provide capability to meet the criteria specified in connection with the Work of the Contract Documents.

2. As a minimum, Contractor shall:

a. have been regularly and actively engaged in similar Work as described in the Contract Documents, operating under the same business name and business organization structure, for the last 5 years on at least 5 projects;

b. have successfully completed at least 3 projects involving construction of similar facilities in the same state as the Project covered by the Contract Documents;

c. have a full-time project manager in responsible charge of the Work with at least 10 years' experience as project manager on comparable projects; and

d. carry at least the insurance coverage and amounts required in the Contract.

PART 2 – PRODUCTS

2.01 SOURCE QUALITY CONTROL

A. General

1. Subject material and equipment furnished under these Contract Documents to a complete factory testing program as specified.

2. Shop Drawings and submittals: reviewed by Engineer before initiating testing program.

3. Perform checks and tests in accordance with manufacturer's recommendations and referenced standards.

4. Evaluate test results and advise Owner immediately of any discrepancy between test results and test limits or the failure of any device or system under test. Include test limits for acceptability applicable to each test on the certified test records.

5. Record test information, including the evaluation of testing results, on forms approved by Owner and Engineer.

B. Independent Testing Agency Certification

1. If specified, furnish certificates from an independent testing agency.

2. Independent testing agency to certify that material and equipment components have been examined and tested and are in conformance with the requirements specified in the Contract Documents.

3. Take Samples in accordance with the requirements specified in the Contract Documents, as selected by Owner or independent testing agency. Furnish and ship at no additional cost to Owner.

C. Factory Testing

1. Provide 14 days prior written notice of factory inspections and tests to Owner and Engineer.

2. If failure to give proper written notice results in material and equipment being assembled or covered before a factory inspection or test, make material and equipment ready for inspection or test and reassemble or recover at no additional cost to Owner.

3. Owner may inspect any portion of material and equipment furnished at any reasonable time during manufacture and may witness testing of any portion of material and equipment wherever located. Owner and Engineer to witness tests only.

4. Furnish, set up and operate test equipment and facilities.

5. If facilities for conducting required tests are unavailable to the manufacturer, conduct tests elsewhere or have them performed by an independent agency approved by Owner.

6. Protect material and equipment after testing and checking to provide that subsequent testing of other equipment or systems does not disturb, damage or otherwise interfere with functional capability of material and equipment.

7. Assume responsibility for protection of material and equipment and safety of all personnel during factory testing program.

8. Grounds for rejection: failure to withstand tests; failure to meet ratings; failure to meet applicable standards.

9. In the event of failure:

    a. Submit revisions of documents requiring approval for changes required for rectification.

    b. Obtain Owner's and Engineer’s approval before making such changes.

    c. Provide written details of any changes to be made not requiring approval.

    d. Notify Owner and Engineer in writing before retesting.

    e. Furnish new material and equipment which meets requirements of the Specifications if rejected material and equipment cannot be rectified to satisfaction of Owner and Engineer.

    f. Retest after rectification in presence of Owner or Engineer.

10. Assume responsibility for all costs, including, but not limited to: loss or damage to materials and equipment resulting from testing; retesting; rectification; new material and equipment to replace damaged or non-rectifiable material and equipment; removal, furnishing, transportation, unloading, and installation of replacement material and equipment; and witness of testing by Owner and Engineer including travel, lodging, meals, and payroll.

11. Submit certified test reports which define tests, list results, and are signed by Contractor's representative, and copies of raw data collected during tests in accordance with Paragraph 1.03.C above. Submission of certified test reports does not relieve Contractor of responsibility for material and equipment meeting requirements of the Contract Documents after installation.

2.02 PRODUCT REQUIREMENTS

A. General

1. Products include new material and equipment incorporated into the Work and may also include existing material and equipment required for reuse. This does not include machinery and equipment used for preparation, fabrication, conveying, installation and erection of the Work.

2. Do not use materials and equipment removed from existing Work Site, except as specifically permitted.

3. Provide complete with accessories, trim, finished, safety guards, and other devices and details need for a complete installation and for the intended use or effect.

4. Provide standard products which have been produced and used successfully on other similar projects for similar applications. Provide products which are likely to be available to Owner in the future for items required for maintenance and repair or replacement Work.

5. Furnish interchangeable components of the same manufacturer, for similar components.

6. Provide products that earn the Energy Star® and meet the Energy Star® specifications for energy efficiency.

B. Transportation and Handling

1. Transport and handle material and equipment in accordance with manufacturer's instructions.

2. Notify Engineer and Owner in writing upon acceptance of a shipment.

3. Promptly inspect shipments to assure that material and equipment comply with requirements, quantities are correct, and material and equipment are undamaged.

4. Furnish equipment and personnel to handle material and equipment by methods to prevent soiling, disfigurement, or damage.

5. Uncrate equipment and dispose of packing material properly.

C. Storage and Protection

1. Store and protect material and equipment in accordance with manufacturer's instructions, with seals and labels intact and legible. Store sensitive material and equipment in weather tight, climate controlled enclosures.

2. For exterior storage of fabricated material and equipment, place on sloped supports, above ground.

3. Provide for bonded off-Site storage and protection when Site does not permit on-Site storage or protection.

4. Cover material and equipment subject to deterioration with impervious sheet covering. Furnish ventilation to avoid condensation or potential degradation of material and equipment.

5. Store loose granular materials on solid flat surfaces in a well-drained area. Avoid mixing with foreign matter.

6. Furnish equipment and personnel to store material and equipment by methods to prevent soiling, disfigurement, or damage.

7. Arrange storage of material and equipment to permit access for inspection. Periodically inspect to assure material and equipment are undamaged and are maintained in acceptable conditions.

8. After receipt of material and equipment, assume responsibility for loss and damage including but not limited to breakage, corrosion, weather damage, and distortion.

PART 3 – EXECUTION

3.01 TEMPORARY CONSTRUCTION FACILITIES

A. Barriers

1. Furnish barriers to prevent unauthorized entry to and clear delineation of construction areas, to allow for Owner's use of Site, and to protect existing facilities and adjacent properties from damage from construction operations as recommended by OSHA and as otherwise required for the protection of life and property during construction.

2. Construct barricades and protective facilities in accordance with local and state regulations. Furnish and install signs, lights, reflectors, and such protection facilities as may be required.

3. Furnish barricades required by governing authorities for public rights of way.

4. Provide protection for plant life designated to remain. Replace damaged plant life.

5. Protect non owned vehicular traffic, stored materials, Site and structures from damage.

6. If required, furnish commercial grade, minimum 8 foot high chain link fence around construction Site. Equip with vehicular gates with locks.

B. Protection of Work

1. Protect Work during working and non-working hours.

2. Provide special protection where specified in Specifications or Drawings and in accordance with manufacturer recommendations.

3. Furnish temporary and removable protection for installed equipment and material. Control activity in immediate Work area to minimize damage.

4. Protect exterior areas of Work from damage. Prohibit traffic from landscaped areas.

5. Buildings and Enclosures

a. Furnish protective coverings at walls, projections, jambs, sills, and soffits of openings and protect finished floors, stairs, and other surfaces from traffic, dirt, wear, damage, or movement of heavy objects, by protecting with durable sheet materials.

b. Prohibit traffic or storage upon waterproofed or roofed surfaces. If traffic or activity is necessary, obtain recommendations for protection from waterproofing or roofing material manufacturer

6. Whenever gale or high winds are forecast, take measures to secure loose material, equipment or other items that could be blown and be damaged or cause damage. Do not leave such loose items unsecured at end of a working day. Particular attention shall be taken with scaffolding and items placed or stored on roofs or within a structure prior to being enclosed.

7. Provide for removal of snow and ice which may impede Work, damage the finishes or materials, be detrimental to workers, or impede trucking, delivery, or moving of materials at the Site, or prevent adequate drainage of the Site or adjoining areas.

C. Security

1. Provide protection to stored items, the Work and Owner's operations from unauthorized entry, vandalism, or theft, and against fire, storms and other losses during working and non-working hours.

2. Coordinate with Owner's security program.

D. Safety Facilities

1. Provide first aid and other safety facilities required by Laws and Regulations during working and non-working hours.

E. Access Roads

1. Construct and maintain temporary roads accessing public thoroughfares to serve construction area. Control dust and water.

2. Extend and relocate as Work progress requires. Provide detours necessary for unimpeded traffic flow.

3. Provide for emergency access and maintain throughout the Work Site.

F. Parking

1. Parking is not allowed outside the designated areas.

G. Field Offices – furnish as required.

H. Progress Cleaning and Waste Removal

1. Maintain areas free of waste materials, debris, and rubbish and maintain the Site in a clean and orderly condition.

2. Remove debris and rubbish from spaces and other closed or remote spaces before enclosing the space.

3. Collect and remove waste materials, debris, and rubbish from Site at least weekly and legally dispose off-Site.

3.02 TEMPORARY UTILITIES

A. Arrange for, pay for and maintain suitable utilities as required for duration of Project.

B. Furnish lighting for construction operations. Furnish lighting for exterior staging and storage areas and for security purposes. Maintain lighting and provide routine repairs.

C. Furnish and pay for heat devices and heat and cooling devices as required to maintain specified conditions for construction operations.

D. Ventilate enclosed areas to assist cure of materials, to dissipate humidity, and to prevent accumulation of dust, fumes, vapors, or gases.

E. Furnish and maintain required sanitary facilities and enclosures. Do not use existing facilities.

F. Fire Protection

1. Provide temporary fire protection equipment and services during construction until the permanent system is serviceable per NFPA and local fire code and regulations, and fire marshal's requirements.

2. Use Work procedures that minimize fire hazards to the extent practicable and materials that are fire resistant where possible. Collect and remove combustible debris and waste materials from the Site each day. Store fuels, solvents, and other volatile or flammable materials away from the construction and storage areas in well-marked, safe containers in accordance with Laws and Regulations.

3.03 TEMPORARY CONTROLS

A. Dust Control: Execute Work by methods to minimize raising dust from construction operations. Provide positive means to prevent air-borne dust from dispersing into atmosphere. Utilize the application of sprinkled water to reduce the emission of air-borne soil particulates from the Project Site.

B. Water Control and Dewatering

1. Comply with the requirements for submitting plans for pollution prevention, storm water management, erosion and sedimentation control; compliance with New Hampshire Department of Environmental Services.

2. Methods for Water Control and Dewatering may include but are not limited to perimeter trenches and sump pumping, perimeter groundwater cutoff, well points, ejectors, deep wells and combinations thereof.

3. Grade the Site to drain away from excavations to approved drainage collection facilities. Protect the Site from puddling, ponding and any other surface water.

4. Ensure collected surface drainage water meets permitted criteria for sediment content prior to discharge.

5. The Contractor shall be responsible for the proper design and execution of methods for controlling surface water and groundwater. The Contractor shall be responsible for any damage to properties, buildings or structures, utilities, pavements, and new Work that may result from the dewatering or surface water control operations.

a. The Contractor shall design temporary dewatering systems as required to lower and control water levels to at least 1 foot below the bottom of excavations to allow for construction in the dry and to maintain a stable subgrade; legally dispose of pumped water; construct, maintain, observe and, except where indicated or required to remain in place, remove dewatering equipment and system at the completion of construction.

b. The Contractor shall furnish the services of a professional engineer registered in the State of the Project to prepare and stamp the water control and dewatering system designs and submittals. The Contractor's engineer shall have at least 5 years of relevant experience in the design, installation and monitoring of dewatering systems of similar size and scope to the Project.

6. Dewatering may include lowering the water table, intercepting and collecting seepage which may penetrate the support of excavation, slopes or bottom of the excavations.

7. Normal dewatering is defined as using conventional pumps installed in open excavations, ditches, or sumps to control water and allow for installation of the pipe in a dry trench.

8. Special dewatering is defined as installing sump pumping, well points, deep wells, or eductor and ejector systems, or combinations thereof, to control groundwater and hydrostatic pressures to allow for installation of the Work.

9. Determine if additional subsurface information is required to complete design, the costs of which will be considered incidental to the Work.

10. Dewatering Operations and Procedures

a. Provide electrically operated dewatering equipment, powered with independent generators adequately sized to operate the dewatering system and capable of running on commercial power. Provide standby equipment independent of commercial power and provide for dewatering within 24 hours upon primary pump or power failure. No work shall be performed by the Contractor below the pre-construction groundwater level during dewatering system failure.

b. Construction and backfilling shall proceed in the dry, and flotation of completed portions of the work shall be prohibited.

c. Provide suitable temporary pipes, flumes or channels for water that may flow along or across the Site of the Work.

d. Provide dewatering equipment with noise attenuation systems capable of meeting the governing noise regulation requirements.

e. Dewatering systems must be properly filtered to mitigate the pumping of silt and fine sand from the excavation.

f. Locate dewatering facilities to prevent loss of ground or disturbance to the soils that support adjacent utilities/structures and the construction work to be done by others.

g. For dewatering operations with relatively minor flows, direct pump discharges using filtration bag or system per Erosion and Sediment Control below, or pump into hay bale sedimentation traps lined with filter fabric. Filter water through the hay bales and filter fabric prior to seepage into storm drainage or any natural water course. Discharge of effluent shall conform to all applicable statutory and regulatory requirements.

h. For dewatering operations with larger flows, provide pump discharges into a steel dewatering/sedimentation basin. Use steel baffle plates to slow water velocities, to increase the contact time, and allow adequate settlement of sediment prior to discharge into waterways, storm drainage or discharge point allowed by the construction dewatering permit.

i. Utilize silt sacks in catch basins when excess silt is suspended in the discharge water per Erosion and Sediment Control below.

j. If siltation basin is used, size to effectively filter for the volume and discharge rate of water anticipated without overflow.

k. Provide treatment necessary to prevent discharge of silty and/or contaminated ground water caused by the Contractor's operations, or any contaminated ground water that may pass from excavated surfaces and/or through the excavation support system selected by the Contractor.

l. Dispose of water pumped or drained from the Work in accordance with permit requirements and in a manner to prevent undue interference with other work or damage to adjacent properties, pavements and other surfaces, buildings, structures and utilities.

m. Obtain necessary regulatory approvals for the disposal of dewatering flows, including, among others, approval by the Environmental Protection Agency under the National Pollutant Discharge Elimination System (NPDES) program for construction dewatering activities. Submit the completed and approved construction dewatering permit to the Engineer immediately upon receipt.

n. Remove temporary dewatering and drainage systems when no longer needed. Restore all disturbed areas.

11. Special Dewatering

a. Special Dewatering methods may be necessary if Normal Dewatering methods are inadequate to ensure dry and stable excavation subgrade conditions.

b. Special Dewatering techniques may consist of a combination of sump pumps, one- or two-stage well point systems, deep wells, or eductor and ejector type systems. Design with suitable screens to

prevent pumping of fines and to address specified Work site conditions.

C. Erosion and Sediment Control

1. Comply with the requirements for submitting plans for pollution prevention, storm water management, erosion and sedimentation control; compliance with state and Federal requirements.

2. Submit erosion and sediment control plan to Engineer prior to the start of construction.

3. Plan and execute construction using methods to control surface drainage from cuts and fills, from borrow and waste disposal areas and prevent erosion and sedimentation.

4. Install erosion and sediment controls as may be shown on the Drawings and as required by Laws and Regulations. Install additional erosion and sedimentation control measures beyond those shown on the Drawings as necessary to stabilize the Site. Coordinate temporary erosion controls with permanent erosion controls to the extent practical. Provide and maintain devices to control erosion, siltation, and sedimentation that occur during construction operations. Undertake reasonable precautions and measures to avoid erosion of soil and to prevent silting of drainage ditches, storm sewers, rivers, streams, and lakes.

5. Employ pollution prevention measures, erosion and sedimentation control before, during, and after soils are exposed. Implement measures prior to soil disturbance or soil storage to the extent possible to ensure that such measures are in place before activity occurs and employ additional measures as the Work progresses. Implement and maintain as necessary until the Site is permanently stabilized.

6. Perform inspections of disturbed soil areas, material storage areas exposed to precipitation, and erosion control measures with Engineer a minimum of once every 14 days and also within 24 hours after any storm event greater than 0.5-inches of rainfall. Immediately correct deficiencies in the erosion control measures identified or indicated by failures or erosion by implementing additional measures or different techniques to correct and prevent subsequent erosion at no additional cost to Owner.

7. In the event that silt or debris breaches erosion control, immediately remove and clean silt or debris from drainage ditches and storm sewers and revise erosion control measures as required by the Conservation Commission or the Engineer. Should silt or debris breach erosion controls and reach rivers, streams or lakes, immediately notify local, state or Federal representatives as required and implement required remediation methods at no additional cost to Owner.

8. Limit duration of the exposure of soils on embankments, excavations, and graded areas to a minimum.

9. Provide temporary measures such as berms, dikes and drains to prevent water flow. Install erosion control measures in any ditch, swale or channel before water is allowed to flow in the waterway. Handle water pumped from trenches to minimize discharge of silty water to the maximum extent practicable.

10. Stabilize storm drain outfalls as shown on the Drawings before the discharge points become operational. Install inlet protection immediately upon construction of culverts.

11. Stabilize disturbed areas with temporary and permanent erosion control practices as soon as practicable, but no more than 14 days after construction activity on a particular portion of the Site has temporarily or permanently ceased. Exceptions to this time requirement include: a) where construction activities will resume on the particular portion of the Site within 21 days; and b) where snow cover delays initiation of stabilization measures.

12. Place stockpiled topsoil on the Site away from natural drainages, in piles with side slopes of 50 percent to 70 percent. Install siltation fence around the base of the pile to prevent eroding soil from washing into drainages. Cover topsoil piles which are to remain for a period of 21 days or more with temporary seed and mulch immediately following stockpiling.

13. Conduct pavement sweeping to remove sediment and soil debris accumulation on pavement resulting from construction activity

14. Siltation/Silt Fence

    a. Filter fabric: suitable for erosion control.

    b. Wood posts: oak, 2 inches by 2 inches in section, and at least 4.5 feet in length.

    c. Erosion control fencing: heavy-duty filter fabric towed into the existing soil as shown on the Drawings.

    d. Construct as shown on Drawings or as directed by Engineer. Install parallel to contours where possible, prior to Site clearing and grading activities.

        1) Dig a 6 inch by 6 inch minimum trench where the fence is to be installed. Position the fence in the trench with the fence posts set at 8 feet on center (maximum). Curve ends of fence uphill to prevent flow around ends.

2) Staple sedimentation control fabric and the industrial netting to each post. When joints are necessary, splice filter fabric together only at support posts with 6-inch overlap and securely seal.

3) Bury lower edge of fabric at least 6 inches below ground surface to prevent underflow. Backfill trench and compact soil over filter fabric.

4) Installed height: minimum 2.5 feet and 36 inches maximum.

5) Inspect frequently; repair or replace any damaged sections.

15. Temporary Erosion Control Matting

a. Rolled matting blanket consisting of curled wood excelsior, coconut fiber, straw or paper bound with a weave of twisted craft paper, cotton cord or plastic mesh.

b. Provide staples for fastening matting to the ground. Staples: fabricated in a "U" shape from 11 gage or heavier stiff steel wire, 6 to 12 inches in length and 1 to 2 inches across.

c. Surface Preparation and Installation

1) Conform to grades and cross sections for slopes and ditches shown on the Drawings. Finish to a smooth and even condition with all debris, roots, stones, and lumps raked out and removed. Loosen soil surface to permit bedding of the matting.

2) Unless otherwise directed, apply seed prior to placement. When directed, spread additional seed over matting, particularly at those locations disturbed by building slots. Press matting onto the ground with a light lawn roller or by other similar means.

3) Bury edges of matting around the edges of catch basins and other structures.

16. Seeding

a. Select seed variety and applied rates based upon the date of application per the following table. Equivalent seed mixture based on suitability for use in controlling erosion of the various soil types and slopes may be used as approved by the Engineer.

Dates	Seed	Applied Rate

		(pounds per 1,000 feet^2)
4/1 to 7/1 8/15 to 9/15	Oats	1.8
4/1 to 7/1	Annual Ryegrass	0.9
5/15 to 8/15	Sundangrass	0.9
9/15 to 10/15	Winter Ryegrass	2.6

1) Sow seed at the rates indicated, on the pure live seed basis.

2) Mulch areas where temporary seeding has been applied. Do not mulch seeded areas where matting will be immediately installed. If temporary seeding does not achieve adequate growth by November 1, apply an additional layer of mulch.

3) Mulch temporarily or permanently seeded areas, areas which cannot be seeded within the recommended seeding dates, and any soil stockpile areas, immediately following seeding. Straw or hay mulch, wood fiber mulch, and hydromulch are recommended.

17. Sod: grown from certified seed of adapted varieties to produce high quality sod free of any serious thatch, weeds, insects, diseases and other pest problem, be at least one year old and not older than three years, and cut with a 1/2 inch to 1 inch layer of soil.

    a. Lay sod strips on the prepared soil, perpendicular to the slope or direction of water flow, starting at the lowest elevation. Butt the edges and ends of the sod strips together and tamp or roll. Stagger joints.

    b. Staple sod strips at ends and at 3-foot intervals along the center of the strip.

    c. Irrigate sodded area immediately after installation.

18. Catch Basin Silt Sacks

    a. Style: Silt Sack Regular Flow.

    b. Test Method: ASTM D-4884 165.0 lbs./inch.

    c. Silt sack seams: certified average wide width strength.

    d. Meet the following ASTM D-4884 standards. Properties are Minimum Average Roll Values (MARV).

Property	Test Method	Units	Test Results
Grab Tensile	ASTM D-4632	lbs.	315x300
Grab Elongation	ASTM D-4632	%	15x15
Puncture	ASTM D-4833	lbs.	125
Mullen Burst	ASTM D-3786	psi	650
Trapezoid Tear	ASTM D-4533	lbs	120x150
UV Resistance	ASTM D-4355	%	90
Apparent Opening	ASTM D-4751	US Sieve	40
Flow Rate	ASTM D-4491	gal/min/ft^2	40
Permittivity	ASTM D-4491	sec -1	0.55

1) Utilize silt sacks in catch basins as required when excess silt is suspended in discharge water.

19. Filtration Bag or System for Discharge from Trench Dewatering

a. Meet the following standards. Properties are Minimum Average Roll Values (MARV).

Property	Test Method	Units	Test Results
Flow Rate	ASTM D-4491	gal/min/ft^2	40
Permittivity	ASTM D-4491	sec -1	0.55

b. For discharge from trench dewatering, install filtration bag or system or dewatering siltation basin constructed of a hay bale barrier lined with filter fabric sized to handle the volume of dewatering without overflowing.

20. Compost Filter Socks

a. Furnish and install biodegradable mesh “socks” filled with mature, clean compost per EPA National Pollutant Discharge Elimination System (NPDES) specifications.

1) Install per EPA and manufacturers recommendations.

2) Install parallel to contours where possible. Stake socks as needed to stabilize. Inspect frequently and repair as necessary.

21. Provide detention basins or water filtration systems for dewatering and coordinate locations with Engineer. See Dewatering in Paragraph 3.03.B. above.

22. Other Temporary Measures

    a. Provide and maintain temporary slope drains as required.

    b. Employ other temporary erosion control measures as directed by the Engineer or local Conservation Commission.

23. Maintenance

    a. Inspect erosion control practices immediately after each rainfall and at least daily during prolonged rainfall or snowmelt for damage. Make appropriate repairs or replacement until Final Completion at no additional cost to the Owner.

    b. Remove silt from siltation fence and/or haybale when it has reached one-quarter of the bale and/or fence height, or prior to expected heavy runoff or siltation.

    c. Repair matting if any staples become loosened or raised, or if any matting becomes loose, torn, or undermined, make satisfactory repairs immediately.

    d. Maintain areas mulched or matted until Final Completion, at no additional cost to the Owner.

    e. Maintain sediment basins by removing silt that reaches a depth of over one foot, at no additional cost to the Owner, until Final Completion.

24. Removal of Temporary Erosion Control

    a. Remove temporary materials and devices upon completion of the Work when permanent soil stabilization has been achieved. Re-use materials in good condition if approved by Engineer.

        1) If silt socks are used, remove in paved areas or cut open and disperse media in unpaved areas.

    b. Level and grade to preconstruction conditions and to the extent required to prevent any obstruction of the flow of water or any other interference with the operation of or access to the permanent works.

    c. Remove siltation fences only when adequate grass growth has been established.

    d. Repair areas damaged by silt fences and hay bales to preconstruction conditions to the satisfaction of the local Conservation Commission and the Engineer.

e. Remove unsuitable materials from Site and dispose of in a lawful manner.

D. Noise Control

1. Provide methods, means, and facilities to minimize noise from construction operations.

2. Provide noise attenuation systems capable of meeting the Department of Environmental Protection Division of Air Quality Control regulations governed by the following policy:

a. "A source of sound will be considered to be violating the Department's noise regulation (310 CMR 7.10) if the source:

b. Increases the broadband sound level by more than 10 dB(A) above ambient, or

c. Produces a "pure tone" condition when any octave band center frequency sound pressure level exceeds the two adjacent center frequency sound pressure levels by 3 decibels or more.

d. “These criteria are measured both at the property line and at the nearest inhabited residence. Ambient is defined as the background A-weighted sound level that is exceeded 90% of the time measured during equipment operating hours. The ambient may also be established by other means with the consent of the Department."

3. Construct sound enclosures or utilize other noise reduction techniques if the equipment does not meet the noise level requirements.

E. Pollution Control

1. Provide methods, means, and facilities to prevent contamination of soil, water, and atmosphere from discharge of noxious, toxic substances, and pollutants produced by construction operations.

a. Water Pollution Control

1) Assure that sediment, debris, petroleums, chemicals, or other contaminants will not enter existing drainage facilities and channels. Use construction methods that will prevent entrance of pollutants and wastes into existing streams, rivers, lakes, and flowing and dry watercourses.

2) Obtain legal disposal sites and dispose of pollutants and wastes in a legal manner.

3) Respond immediately to emergencies as directed when water quality of existing streams, rivers, lakes and flowing and dry watercourses is threatened. Take corrective action

to remove or contain pollutants until a permanent solution is determined.

b. Air Pollution Control

1) Equipment and vehicles that exhibit excessive exhausts emissions due to poor engine adjustments or inefficient operation will not be permitted to operate until corrective repairs or adjustments are made.

2) Burning of materials from clearing or grubbing operations, combustible construction materials, and rubbish will not be allowed.

F. Traffic Regulation

1. Control and maintain traffic within the Project area. Submit traffic control plans and coordinate with Owner and local agencies. Submit plan for traffic control to Owner for review 14 days in advance of any Work within public right-of-way, street closure or detour.

2. Provide and maintain traffic control and maintenance devices in accordance with Part 6, Temporary Traffic Control, of the "Manual on Uniform Traffic Control Devices for Streets and Highways", published by the U.S. Department of Transportation, Federal Highway Administration and other applicable codes and standards as specified. Operate devices 24 hours per day as required.

3. Provide for access by emergency vehicles, such as police, fire, and disaster units at all times. Contractor shall be liable for damages resulting from failure to provide such access.

4. During construction hours, traffic flow must be controlled by uniformed traffic police officers. The services of uniformed traffic police officers shall in no way relieve the Contractor of its responsibilities under the Contract.

5. Maintain minimum of one moving lane on roadways at all times.

a. Where detours are permitted, provide necessary barricades, flashers, flashing arrows and signs in accordance with referenced Manuals and Laws and Regulations.

b. Provide gravel borrow and bituminous concrete to maintain temporary passable travel lane ramps, temporary bridging, steel plates, temporary pavement, wood-framed walkways, caution, safety and other necessary signs directing the pedestrian and vehicular traffic towards unblocked and safe areas.

6. Provide safe access/egress to businesses and abutting property owners within the Project area. In areas where the construction activity is in progress, install directional signs in front of businesses indicating "OPEN FOR BUSINESS" or similar for guidance of customers.

    a. Certain construction operations such as utility work and roadway/sidewalk reconstruction may restrict access/egress on some roads and to businesses and abutting property owners. Under these circumstances, schedule operations during off-peak hours or late evenings with Owner approval so that a particular work activity can be completed in the shortest possible time.

    b. Provide 48 hours' notice to businesses and abutting property owners when access/egress will not be available or restrictions will exist.

7. Exercise particular care to establish and maintain such methods and procedures that will not create hazards.

    a. Remove or properly cover traffic control, safety devices and/or signs having messages that are irrelevant to normal traffic conditions at the end of each Work period. Keep signs clean at all times and provide that legends are distinctive and unmarred.

    b. Place excavated material and construction equipment so that vehicular and pedestrian traffic is maintained at all times unless road closure permit is obtained. If the Contractor's operations cause traffic hazards, implement appropriate safety measures immediately.

    c. In areas of high pedestrian and vehicular traffic volume, the remove waste materials and construction equipment from the Work Site on a daily basis. Do not park construction equipment overnight on the Site or the adjacent roads unless permitted by Owner.

    d. Provide night watchmen where special hazards exist.

8. Post signage clearly stating that any vehicle impeding the progress of construction will be towed at the vehicle owner's expense. Towing charges incurred by Owner for Contractor's failure to post such signs will be borne by the Contractor.

3.04 REMOVAL OF TEMPORARY UTILITIES, FACILITIES, AND CONTROLS

A. Remove temporary utilities, equipment, and facilities before Final Application for Payment inspection.

B. Remove temporary underground installations and grade Site as indicated. Clean and repair damage caused by installation or use of temporary utilities, facilities, and controls.

C. Restore existing facilities and areas used during construction to original condition. Restore permanent facilities used during construction to specified condition.

3.05 OVERALL EXECUTION REQUIREMENTS

A. Coordination

1. Conduct preconstruction and pre-installation meetings before commencing certain Work that requires coordination or has special requirements or approvals in accordance with Paragraph 1.03.A above.

2. Coordinate space requirements and installation of Work. Utilize spaces efficiently to maximize accessibility for other installations, maintenance, and repairs.

3. Coordinate Work of the various Specifications with interdependent responsibilities for installing, connecting to, and placing in service, operating equipment.

4. Coordinate related Work at the Site.

5. Coordinate completion and cleanup of Work of separate sections in preparation for Substantial Completion and for portions of Work designated for Owner's partial occupancy.

6. After Owner occupancy of premises, coordinate access to Site for correction of defective Work and/or incomplete Work to minimize disruption of Owner's activities.

7. Coordinate Work such that Work on each street is completed with minimum disruption to residents and businesses.

8. Regular working hours are 6:00 a.m. to 7:00 p.m., Monday through Friday.

B. Record Documents

1. Contractor shall maintain in a safe place at the Site one record copy of all Drawings, Specifications, Addenda, Change Orders, Work Change Directives, Field Orders, and written interpretations and clarifications in good order and annotated to show changes made during construction. These record documents together with all approved Samples and a counterpart of all approved Shop Drawings will be available to Engineer

for reference. and submitted at final completion per Paragraph 1.03.D above.

2. Store Record Documents separate from documents used for construction. Record information concurrent with construction progress.

3. Legibly mark each item to record description of actual equipment and material installed and actual construction on approved submittals, including the following.

   a. Manufacturer's name and equipment and material model and number

   b. Material and equipment substitutions or alternates utilized

   c. Approved changes

   d. Measured depths of foundations

   e. Measured horizontal and vertical locations of Underground Facilities and appurtenances, referenced to permanent surface improvements

   f. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of the Work

   g. Field changes of dimension and detail

   h. Details not on original Contract Documents or Shop Drawings

4. Submit final record documents as specified in Paragraph 1.03.D above in accordance with subparagraph 1.03.C.8. above. Engineer’s review of the final Application for Payment and accompanying documentation and all maintenance and operating instructions, schedules, guarantees, bonds, certificates of inspection, tests and approvals, and other documentation required to be delivered at final completion will be only be to determine generally that the content complies with the requirements of, and in the case of certificates of inspections, tests and approvals, that the results certified indicate compliance with, the Contract Documents.

C. Cutting and Patching

1. Employ skilled and experienced personnel to perform cutting and patching.

2. Submit written request in advance of cutting or alteration which affects:

   a. structural integrity of any element of Project;

   b. integrity of weather exposed or moisture resistant elements;

   c. efficiency, maintenance, or safety element;

d. safety, traffic, or hazard barriers;

e. visual qualities of sight exposed elements; and

f. work of Owner or separate contractor.

3. Execute cutting, fitting, and patching including excavation and fill to complete Work and to:

a. fit materials together, to integrate with other work;

b. uncover Work to install ill-timed Work;

c. remove and replace defective or non-conforming Work;

d. remove Samples of installed Work for testing when requested; and

e. provide openings in element of Work for penetration of mechanical and electrical work.

4. Execute Work by methods to avoid damage to other work and which will provide appropriate surfaces to receive patching and finishing.

5. Provide adequate temporary support for Work to be cut.

6. Restore Work with new materials in accordance with requirements of Contract Documents. Use materials identical with original materials where recognized that satisfactory results can be produced.

7. Provide protection from elements for areas which may be exposed by uncovering work.

8. Refinish surfaces to match adjacent finishes. For continuous surfaces, refinish to nearest intersection or natural break. For an assembly, refinish entire unit. Restore exposed finishes of patched areas; and, where necessary extend finish restoration onto retained adjoining Work in a manner, which will eliminate evidence of patching.

9. Identify any Hazardous Waste, Hazardous Environmental Condition, or hazardous substance exposed during the Work to Owner for decision or remedy.

10. Cut work by methods least likely to damage Work to be retained and work adjoining. Cut Work with sawing and grinding tools, not with hammering, chopping, or burning tools. Cut masonry and concrete materials with masonry saw or core drill. Do not use pneumatic tools without prior approval. Core drill openings through concrete Work. Adhere to mandatory cutback requirements when saw cutting concrete and roadway openings.

11. Do not cut and patch structural Work in a manner resulting in reduction of load-carrying capacity or load/ deflection ratio.

12. Fit Work tight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces. Maintain supports to ensure structural integrity of the Work. Provide devices and methods to protect other portions of Project from damage and seal voids. For interior work at penetrations of fire rated walls, partitions, ceiling, or floor construction, completely seal voids with fire resistant material, to full thickness of the penetrated element.

13. Do not cut and patch operational or safety-related components that reduce capacities to perform in manner intended. Do not cut and patch Work that reduces visual qualities. Remove and replace unsatisfactory cutting patching as directed by Engineer or Owner.

D. Electrolytic Corrosion Prevention

1. Prevent galvanic action, bimetallic corrosion, anodic or cathodic action, and electrolysis at all electrical grounds and for all galvanic scale (electromotive series or table of oxidation potentials). Do not allow contact of dissimilar metals further apart than 0.35 on the galvanic scale (electromotive series or table of oxidation potentials). The electrode potential of common metals is listed below.

	Electrode Potential Volts (Relative to Hydrogen)
Magnesium	+2.37
Aluminum	+1.70
Zinc+	+0.76
Chromium	+0.56
Iron and Steel	+0.44
Cadmium	+0.40
Nickel	+0.25
Tin	+0.14
Lead	+0.13
Copper	-0.34

2. Unless otherwise indicated, provide dielectric insulators between ferrous and nonferrous pipe and equipment.

E. Quality Assurance and Control of Installation

1. Monitor quality control of Subcontractors, Suppliers, manufacturers, material, equipment, services, Site conditions, and workmanship, to produce Work of specified quality. Conduct field quality control and testing specified.

2. Comply fully with manufacturers' installation instructions, including each step in sequence. If manufacturers' instructions conflict with Contract Documents, request clarification from Engineer before proceeding.

3. Comply with specified standards as a minimum quality for the Work except when more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.

4. Perform Work using persons qualified to produce workmanship of specified quality.

5. Install field Samples and mockups at the Site as required in Specifications for review. Acceptable Samples and mockups represent a quality level for the Work. Where field Sample or mockup is specified to be removed, clear area after field Sample or mockup has been accepted by Engineer or after Work is complete when mockup is to serve as a control reference.

6. Protect adjacent construction.

F. Manufacturers' Field Services

1. If required in the Specifications, arrange and pay for material or equipment Suppliers or manufacturers to provide qualified staff personnel (field representative) to perform the following services and services specified. Submit reports of activities, actions taken and test results to Engineer within 10 days of completion in accordance Paragraph 1.03.C above.

   a. Observe Site conditions, conditions of surfaces and installation, quality of workmanship.

   b. Report observations and Site decisions or instructions given to applicators or installers that are supplemental or contrary to manufacturers' written instructions.

   c. Assist with field assembly as required.

   d. Furnish, setup, and operate required test equipment and facilities.

   e. Perform and record results of manufacturer recommended inspections and tests, and tests specified for material and equipment.

   f. Be responsible for protection of material and equipment and safety of all personnel during testing.

   g. Perform any other services normally provided by field representative's company.

   h. Instruct operating personnel in proper use of material and equipment.

G. Independent Testing

1. Employ and pay for specified services of an independent to perform inspection and testing as may be specified.

2. Reports will be submitted by the independent firm to Owner, in duplicate indicating observations and results of tests and indicating compliance or noncompliance with Contract Documents.

3. Inspection, testing, and source quality control may occur on or off the Project Site.

4. Cooperate with independent firm. Furnish samples of materials, design mix, equipment, tools, storage and assistance as requested.

5. Notify Owner and independent firm 24 hours before expected time for operations requiring services.

6. Make arrangements with independent firm and pay for additional Samples and tests required for Contractor's use.

7. Retesting required because of nonconformance to specified requirements will be performed by the same independent firm if instructed by Owner. Payment for retesting will be charged to Contractor by deducting inspection or testing charges from the Contract Price.

8. Testing or inspecting does not relieve Contractor from performing Work in accordance with requirements of the Contract Documents.

3.06 STARTUP, TESTING, AND COMMISSIONING

A. Spare Parts

1. Provide spare parts required for construction, startup, testing and commissioning of the Work prior to achievement of Substantial Completion, including spare parts for flushing and consumable supplies such as bolts, nuts, gaskets, filters, insulating tape, etc., normally consumed in the construction, commissioning and testing.

2. If spare parts are purchased by Owner, Contractor shall have the right to use the spare parts purchased by Owner provided that such spare parts are replaced prior to Substantial Completion at Contractor’s expense. Replacement spare parts, replaced by Contractor, shall be new, unused and identical as the original spare part used.

B. Consumables

1. Provide initial fills of consumables including equipment lubricants, resins, chemicals, desiccants, and fuels. Provide subsequent fills if required

during Warranty Period if acts or omissions of Contractor cause such consumables to require replacement.

2. Coordinate with Owner for consumables required.

C. Checkout and Starting Systems

1. Coordinate schedule for startup and operation of various equipment and systems with Owner.

2. Notify Owner 7 days before startup of each major piece of equipment or system, including a staffing request for Owner's operations and maintenance personnel required to adequately and safely support each specific start-up and operation activity.

3. Verify that each system or piece of equipment item has been assembled, constructed, or completed in accordance with the Contract and capable of functioning as intended.

4. Verify that each piece of equipment or system has been checked for proper lubrication, drive rotation, magnetic center alignment, belt tension, control sequence, or other conditions which may cause damage.

5. Verify that each piece of equipment or system has successfully completed construction testing and cold commissioning, including hydrostatic testing, loop checks, relay checks, calibration, and continuity checks and that all tests, meter readings, and specified electrical characteristics agree with those required by the equipment or system manufacturer.

6. Verify wiring and support components for equipment are complete and tested.

7. Execute start up under supervision of responsible manufacturers' representative or Contractor's personnel in accordance with manufacturers' instructions utilizing Owner's qualified operations and maintenance staff trained by Contractor.

8. When specified in individual Specification Sections, require manufacturer to provide field representative to be present at Site to inspect, check and approve equipment or system installation before start up, and to supervise placing equipment or system in operation.

D. Starting, Adjusting, and Balancing

1. Supply necessary equipment, material, construction power, and consumables (except for those provided by Owner) needed to startup and fully test the Work and replenish the same until Substantial Completion is

achieved. Contractor may utilize Owner's operating spare parts, such use requiring timely replacement at Contractor's expense.

2. Coordinate as required for conduct of independent testing.

3. Perform specified and required adjusting and balancing concurrently to the maximum extent possible on individual equipment and systems and prior to startup and commissioning/performance testing.

E. Startup and Commissioning/Performance Testing

1. Conduct startup and commissioning/performance tests and perform pressure and leakage tests per the Specifications to demonstrate the Work meets the requirements of the Contract Documents, satisfies the Owner's requirements.

2. Prepare and submit a written startup and commissioning/performance testing procedures no later than 60 days prior to start of testing for review and final test procedures no later than 30 days prior to start of testing. Submit a staffing request for Owner's operations and maintenance personnel.

3. Calibrate test equipment and instrumentation on Site or provide acceptable certificate of calibration conducted within 30 days of testing.

4. Complete functional testing prior to initiating the startup and commissioning/performance testing as specified.

5. Complete specified startup and commissioning/performance tests prior to Substantial Completion. Owner and Engineer will witness Performance Testing. Notify Owner and Engineer in writing at least 7 days prior to starting any startup and commissioning/performance testing. Coordinate for witnessing of tests by required regulatory representatives.

6. Submit written test reports per subparagraph 1.03.C.7.b and Paragraph 1.03.D above.

F. Demonstration and Training

1. Provide formal demonstration and training of Owner's personnel as specified in individual Specification sections.

3.07 ATTACHMENTS

A. Contact List

B. Transmittal form

END OF SECTION

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PROJECT CONTACT LIST

OWNER

NAME	OFFICE	CELL
Donald L. Song, P.E.	603-427-1530	207-233-8426

ENGINEER

NAME	OFFICE	CELL
Erik Osborn, P.E.	207-558-3714	207-831-5160

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TRANSMITTAL FORM

Owner:		Transmittal No.:	
Project:		Date:	
Contract No.:			
Contract Title:			
Specification Section No.:			

Assign a consecutive, unique number to each submittal and use same on resubmittals. Example: 25 =original submittal; 25A = 1st resubmittal; 25B (and beyond) = additional resubmittals

Submittal (Item) No.	Resubmittal (A B C etc.)	Date	Title/Description	Vendor/Manufacturer	Copies

☐ The material and equipment, and requirements for construction/installation contained in Submittal No.(s) _____ have been reviewed and we certify that they are correct and in strict conformance with the requirements specified (no exceptions or deviations)

☐ The material and equipment and requirements for construction/installation contained in Submittal No.(s) _____ have been reviewed and we certify that they are correct and in strict conformance with the requirements specified except for the following deviations (list below or attach listing):

_____

_____

CONTRACTOR'S NAME_____

ADDRESS_____

BY: _____ DATE: _____

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0 10 20 30 40 50 60 70 80 Feet

1 inch = 40 feet

Figure 1
Lafayette Pump Station Construction Project
Map prepared by Portsmouth Department of Public Works
12/02/2016

SECTION 01 11 06

PROJECT FORMS

The following forms are included in this Section and shall be used for the Project as specified in the General Requirements. Completed and execution versions of these forms used during the Project shall be incorporated into the Agreement and made a part thereof.

Application for Payment Form (C-00 62 76)
Request for Interpretation/Information Form (C-00 63 15)
Field Order Form (C-00 63 36)
Work Change Directive Form (C-00 63 49)
Change Request Form (C- 00 63 60)
Notice of Substantial Completion Form (C-00 65 15)
Notice of Completion Form (C-00 65 18)

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EJCDC
ENGINEERS JOINT CONTRACT DOCUMENTS COMMITTEE

FORM C-00 62 76

Contractor's Application for Payment No.

	Application Period:	Application Date:
To (Owner):	From (Contractor):	Via (Engineer):
Project:	Contract:	
Owner's Contract No.:	Contractor's Project No.:	Engineer's Project No.:

Application For Payment

Change Order Summary

Approved Change Orders

Number	Additions	Deductions
TOTALS		
NET CHANGE BY CHANGE ORDERS		

1. ORIGINAL CONTRACT PRICE		**$**
2. Net change by Change Orders		**$**
3. Current Contract Price (Line 1 ± 2)		**$**
4. TOTAL COMPLETED AND STORED TO DATE (Column F on Progress Estimate)		**$**
5. RETAINAGE:		
a.	**X** _____ **Work Completed**	**$**
b.	**X** _____ **Stored Material**	**$**
c. Total Retainage (Line 5a + Line 5b)		**$**
6. AMOUNT ELIGIBLE TO DATE (Line 4 - Line 5c)		**$**
7. LESS PREVIOUS PAYMENTS (Line 6 from prior Application)		**$**
8. AMOUNT DUE THIS APPLICATION		**$**
9. BALANCE TO FINISH, PLUS RETAINAGE (Column G on Progress Estimate + Line 5 above)		**$**

Contractor's Certification

The undersigned Contractor certifies that to the best of its knowledge: (1) all previous progress payments received from Owner on account of Work done under the Contract have been applied on account to discharge Contractor's legitimate obligations incurred in connection with Work covered by prior Applications for Payment; (2) title of all Work, materials and equipment incorporated in said Work or otherwise listed in or covered by this Application for Payment will pass to Owner at time of payment free and clear of all Liens, security interests and encumbrances (except such as are covered by a Bond acceptable to Owner indemnifying Owner against any such Liens, security interest or encumbrances); and (3) all Work covered by this Application for Payment is in accordance with the Contract Documents and is not defective.

By:	Date:

Payment of: $ _____
(Line 8 or other - attach explanation of the other amount)

is recommended by: _____ _____
(Engineer) (Date)

Payment of: $ _____
(Line 8 or other - attach explanation of the other amount)

is approved by: _____ _____
(Owner) (Date)

Approved by: _____ _____
Funding Agency (if applicable) (Date)

Approved by: _____ _____

Progress Estimate - Lump Sum Work **FORM C-00 62 76**

Contractor's Application

For (Contract):	Application Number:
Application Period:	Application Date:

			Work Completed		E	F		G
A		B	C	D				
Specification Section No.	Description	Scheduled Value ($)	From Previous Application (C+D)	This Period	Materials Presently Stored (not in C or D)	Total Completed and Stored to Date (C + D + E)	% (F / B)	Balance to Finish (B - F)
	Totals							

Progress Estimate - Unit Price Work

FORM C-00 62 76

Contractor's Application

For (Contract):	Application Number:
Application Period:	Application Date:

A				B	B(2)	C	D	E	F		
Item		Bid Item Quantity	Unit Price	Bid Item Value ($)	Estimated Quantity Installed This Month	Estimated Quantity Installed To Date (Include This Month)	Value of Work Installed to Date	Materials Presently Stored (not in C)	Total Completed and Stored to Date (D + E)	% (F / B)	Balance to Finish (B - F)
Bid Item No.	Description										
	moblize										
	Totals										

Stored Material Summary **FORM C-00 62 76** **Contractor's Application**

For (Contract):								Application Number:			
Application Period:								Application Date:			
A		B	C		D		E		F		G
Bid Item No.	Supplier Invoice No.	Submittal No. (with Specification Section No.)	Storage Location	Description of Materials or Equipment Stored	Stored Previously		Amount Stored this Month ($)	Subtotal Amount Completed and Stored to Date (D + E)	Incorporated in Work		Materials Remaining in Storage ($) (D + E - F)
					Date Placed into Storage (Month/Year)	Amount ($)			Date (Month/ Year)	Amount ($)	
				Totals							

REQUEST FOR INTERPRETATION/INFORMATION (Form C-00 63 15)

RFI #: _____ ☐ **Attachment**

To: _____ From: _____

Attn: _____ Issue Date: _____

Project: _____ Required Reply Date: _____

DISTRIBUTION:

Contractor	Owner	Engineer
☐ _____	☐ _____	☐ _____
☐ _____	☐ _____	☐ _____
☐ _____	☐ _____	☐ _____

REFERENCES:

- Specifications: _____ Section: _____ Page/Paragraph: _____
- Drawings: _____ Issue Date: _____ Detail/Sections: _____
- Work Area: _____ Grid/Level: _____

RFI DESCRIPTION:

From: _____ Tel No: _____ Fax: No: _____

Initial: _____ E-mail: _____

RFI REPLY: (response may be transmitted in separate document)

Possible Cost Effect Yes: ☐ No: ☐ **Possible Schedule Effect** Yes: ☐ No: ☐

From: _____ Reply Date: _____ xc: _____

Initial: _____ _____

Based on: CASE Form B-1999

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Field Order (C-00 63 36)

No. _____

Date of Issuance: _____ Effective Date: _____

Project:	Owner:	Owner's Contract No.:
Contract:		Date of Contract:
Contractor:		Engineer's Project No.:

Attention:
You are hereby directed to promptly execute this Field Order issued in accordance with General Conditions Paragraph 9.04.A, for minor changes in the Work without changes in Contract Price or Contract Times. If you consider that a change in Contract Price or Contract Times is required, please notify the Engineer immediately and before proceeding with this Work.

Reference: _____ _____
(Specification Section(s)) (Drawing(s) / Detail(s))

Description:

Attachments:

	Engineer:
Receipt Acknowledged by Contractor:	Date:

Copy to Owner

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Work Change Directive (Form C-00 63 49)

No. _____

Date of Issuance: _____ Effective Date: _____

Project:	Owner:	Owner's Contract No.:
Contract:		Date of Contract:
Contractor:		Engineer's Project No.:

Contractor is directed to proceed promptly with the following change(s):

Item No.	Description

Attachments (list documents supporting change):

Purpose for Work Change Directive:

Authorization for Work described herein to proceed on the basis of Cost of the Work due to:

- ☐ Nonagreement on pricing of proposed change.
- ☐ Necessity to expedite Work described herein prior to agreeing to changes on Contract Price and Contract Time.

Estimated change in Contract Price and Contract Times:

Contract Price $_____ (increase/decrease) Contract Time _____ (increase/decrease) days

Recommended for Approval by Engineer:	Date
Authorized for Owner by:	Date
Received for Contractor by:	Date
Received by Funding Agency (if applicable):	Date:

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CHANGE REQUEST (FORM C-00 63 60)
(Design Changes/Deviations/Substitutions)

CR NO.
DATE

Project:

Request Initiated by:
- ☐ Contractor
- ☐ Owner
- ☐ Engineer

Impact to Contract Price expected ☐
Impact to Contract Time expected ☐
Change Orders will be processed separately

Request submitted as (format):

Description of Change (☐ documentation attached)

Reason for Change

Response: ☐ This constitutes a Written Amendment to the Agreement.

Review of the proposed change/deviation/substitution by Engineer is for general compatibility with the design concept of the Project. This review does not extend to means, methods, sequences, or procedures of construction or to issues of safety incident thereto. This review shall not relieve the Contractor from responsibility for full compliance with the requirements specified and to determine and verify the information contained therein.

Recommended By Engineer for Acceptance (subject to above comments if any) ☐ recommended for processing and approval under a separate Change Order NAME: *Signature* *Date*	☐ Approved by Owner (no schedule or cost impact) ☐ Acknowledged by Owner – to be processed and approved under a separate Change Order NAME: *Signature* *Date*
Approved by Contractor ☐ Change Order to be requested NAME: *Signature* *Date*	

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Notice of Substantial Completion (C-00 65 15)

Project:	Owner:	Owner's Contract No.:
Contract:		Date of Contract:
Contractor:		

This NOTICE of Substantial Completion applies to:

☐ The following Systems, Equipment or specified portions : ☐ : All Work under the Contract Documents

:

Date of Substantial Completion for above

The following documents are attached to and made part of this Notice.

Submitted by Contractor

Date

This page intentionally left blank

Notice of Completion (Form C-00 65 18)

Project:	Owner:	Owner's Contract No.:
Contract:		Date of Contract:
Contractor:		

This NOTICE of Completion applies to:

☐ All Work under the Contract Documents: ☐ The following specified portions:

Date of final Completion

The Work to which this Notice applies is ready for inspection by authorized representatives of Engineer and Owner. Contractor has completed all corrections, delivered all required documentation, and the Project, or portion designated above, is complete. The Date of Completion of the Project or portion thereof designated above is hereby declared by the Contractor.
.

The following documents are attached to and made part of this Certificate:

Final Punchlist

Final Application for Payment

Only the **making and acceptance of final payment** will constitute:

1. A waiver of all claims by Owner against Contractor, except claims arising from any unsettled liens, from Defective Construction appearing after final inspection; from failure to comply with the Contract Documents or the terms of any special guarantees specified therein, or from Contractor's continuing obligations under the Contract Documents; and
2. A waiver of all claims by Contractor against Owner other than those previously timely made in writing and still unsettled.

Submitted by Contractor Date

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SECTION 01 20 25

MEASUREMENT AND PAYMENT

PART 1 - GENERAL

1.01 DESCRIPTION

A. This Section describes the measurement and payment for the Work to be completed under each item in the Bid Form which may also be referred to as "pay item".

B. Payment procedures are in accordance with the Agreement, General and Special Conditions, and the General Requirements.

C. Measurement: as determined, verified, or approved by Engineer or Owner in except as otherwise specified.

D. The Work described in each pay item shall be as described in the Specifications and shown on the Drawings and not included in other pay items.

1. Pay item descriptions are general and may not specifically describe all associated Work or elements thereof, do not constitute Specifications, and do not supersede the content of the Specifications and Drawings.

2. Review the Specifications and Drawings for Work associated with each pay item. Claims for being unfamiliar with the content of the Specifications and Drawings will not be considered.

E. The following Work is not specifically described or designated as a pay item, is considered incidental to all pay items, and shall not be measured separately for payment.

1. Division 01 General Requirements EXCEPT those items included in Mobilization/Demobilization and included as a separate pay item.

2. Materials, equipment, and services necessary to verify existing field conditions and the location, size, type, material, and orientation of existing pipes and utilities shown on the Drawings including test pits.

3. Restoration of all areas disturbed by the Contractor within the limits of Work, including planting.

F. Payment will not be made for restoration of areas disturbed by the Contractor outside the limits of Work.

G. Payment will only be made for those utility services, including water and fire services, specifically identified for replacement on the Drawings. Relocation or replacement for the Contractor's convenience or due to breakage by the Contractor

of any other utility services shown on the Drawings, or at locations which could reasonably be assumed, shall be at no cost to Owner.

H. Design, installation and removal of excavation support systems, temporary and permanent utility/structure support systems associated with a pay item shall be considered incidental to that pay item.

I. Additional dewatering and erosion control (including installation, operation, maintenance, removal and off Site disposal of erosion control devices) associated with a pay item shall be considered incidental to that pay item.

1.02 MEASUREMENT AND PAYMENT BASIS

ITEM 1: ADMINISTRATION (Mobilization/Demobilization)	
Measurement	Not Applicable
Payment	Percent of lump sum (LS) price as described below.
Schedule of Payment	Payment shall be 50% in the first pay application and the remainder will be released upon Substantial Completion. Installation of project signs shall be completed prior to receipt of initial payment at the first pay application.
Includes all materials, equipment , services, necessary for delivery to and removal of equipment from the Project Site, temporary utilities, facilities and controls, obtaining necessary permits including associated fees, insurance and bond costs, signage, development of pre-construction schedules and plans required by the General Conditions, Supplementary Conditions and General Requirements; necessary pre-construction investigations, verifying existing field conditions, coordination, and Site clean-up, restoration and closeout	

ITEM 2: Pump Station Upgrades (Base Bid)	
Measurement	Progress of Work
Payment	Percent of lump sum (LS) price based on Schedule of Values
Schedule of Payment	Monthly based on progress of work
All materials, equipment, services, and construction inherent to the Work. Upgrade of the existing pump station including sitework, architectural, structural, process piping and equipment, electrical, controls, plumbing and HVAC. This item also includes all costs associated with Bypass Pumping. Includes all work not included in other bid items.	

ITEM 3: Repair Type "A" Shallow Concrete Spall Repair	
Measurement	As measured in place by the Engineer.
Payment	Unit price per square foot of spall repair.
Schedule of Payment	Monthly based on total square feet of concrete repair completed.
Material, equipment, services, installation, construction and testing inherent to the Work. Repair of spalling in existing concrete including repair of exposed rebar as shown and described on Drawing S-101 and as specified in Section 03 01 05 and any other related sections. Any required repairs to new concrete shall be incidental to Item 2 Base Bid.	

ITEM 4: Repair Type "B" Polyurethane Crack Injection	
Measurement	As measured in place by the Engineer.
Payment	Unit price per linear foot of crack injection.
Schedule of Payment	Monthly based on total linear feet of crack injection completed.
Material, equipment, services, installation, construction and testing inherent to repair of cracks in existing concrete as shown and described on Drawing S-101 and as specified in Section 03 63 00 and any other related sections. Any required repairs to new concrete shall be incidental to Item 2 Base Bid.	

ITEM 5 –Owner's Allowance for Electrical Service	
Measurement	Submit bills from Eversource
Payment	Allowance - Actual costs incurred
Schedule of Payment	Monthly - based on actual costs incurred
Owner's allowance for all materials, equipment, services, installation, and construction provided by Eversource for replacing the existing electrical service. Includes providing new riser pole, transformer, primary cables to transformer including terminations, and utility meter. All other electrical and related work provided by the Contractor including raceways, transformer pad, riser pole conduits, transformer secondary cables, and meter cabinet shall be incidental to Item 2 Base Bid. Contractor shall not receive payment for any unused portion of the contingency allowance for electrical service.	

ITEM 6 –Owner's Allowance for Instrumentation System Integrator	
Measurement	Submit bills from Integrator
Payment	Allowance - Actual costs incurred
Schedule of Payment	Monthly - based on actual costs incurred
Under this item, the Contractor will be reimbursed for charges for equipment and services supplied by EII as specified in Section 40 81 00 and the sections referenced therein, complete as indicated in the Contract Documents. The allowance for this item as established in the Bid is an estimated figure to facilitate comparison of bids. The actual amount to be paid for work under this item shall be the amount actually invoiced by EII for the work performed plus 5% markup as described in the General Conditions. If the total amount for such charges is greater or less than the amount stated in the Bid, a debit or credit of the difference in the amount shall be made to the Owner.	

ITEM 7: Owner's Allowance for Force Main Pigging	
Measurement	Submit bills from Ted Berry Company.
Payment	Allowance– Actual costs incurred
Schedule of Payment	Monthly – based on actual costs incurred.
Owner's allowance for all materials, equipment, services, and temporary facilities provided by the firm hired to pig the force main from the Lafayette Rd Pump Station to its termination point. . The actual amount to be paid for work under this item shall be the amount actually invoiced by Ted Berry for the work performed plus 5% markup as described in the General Conditions. Installation of the force main bypass manhole as shown on the Drawings shall be incidental to Item 2 Base Bid. Bypass pumping for the duration of the pigging operation shall be incidental to Item 9 Bypass Pumping. Contractor shall not receive payment for any unused portion of the contingency allowance for pigging of the force main.	

ITEM 8: Owner's Allowance for Testing	
Measurement	Submit bills from testing firms
Payment	Allowance– Actual costs incurred
Schedule of Payment	Monthly – based on actual costs incurred.
All materials, equipment, services, and construction inherent to the Work. Includes testing costs, such as compaction tests, pavement testing, concrete testing, etc., that are specified as Owner's responsibility shall be paid for by the Contractor using the allowance allotted in this item. All testing costs specified as the Contractor's responsibility shall remain so and in no way shall the included allowance be used for such costs. All testing costs shall be billed directly to Contractor, and a final Change Order will be issued balancing the actual testing costs to the Owner, and stated allowance.	

ITEM A-1: Specialty H2S Coating	
Measurement	Per previously established quantity
Payment	Unit price per square foot
Schedule of Payment	Monthly based on total square feet of coating completed.
Material, equipment, services, installation, construction and testing inherent to providing specialty H2S lining of existing wetwell as shown and described on Drawing S-104 and as specified in Section 0 96 50 and any other related sections.	

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION

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SECTION 01 51 40

TEMPORARY SEWAGE BYPASS

PART 1 – GENERAL

1.01 SUMMARY

A. Provide, operate, and maintain a functional bypass pumping system capable of bypassing the entire sanitary flow to the pump station from the influent manhole to the force main without leakage or spillage of sewage upon the ground or streets or back up of sewage into any building or onto any property for the duration of the Project.

B. Design Requirements:

1. Provide a bypass pumping plan designed by a Professional Engineer registered in the state in which the Project is located.

2. Provide temporary bypass pumping adequate to handle dry weather and wet weather flows and to protect against surcharging of the existing system upstream of the Work area.

3. Bypass pumping system shall operate continuously for the entire time between when the existing pumps are brought-off line and when new pumps are started up, tested, and brought into continuous service and both wet wells are returned to continuous service. It is anticipated that this time period will be several months at a minimum. Design bypass pumping system to be robust and permanent enough for this duration.

1.02 PRICE AND PAYMENT PROCEDURES

A. Measurement and payment requirements: per Division 01 General Requirements.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Coordination, Sequencing, and Scheduling: in accordance with Division 01 General Requirements.

1.04 SUBMITTALS

A. Submit in accordance with Division 01 General Requirements.

1. Bypass pumping plan for each bypass location, stamped by a Professional Engineer registered in the state in which the Project is located, prior to implementation and prior to the start of construction

2. Minimum contents of sewage bypass pumping plan:

a. Standard Operating Procedure: Describe the normal sequence of events to be followed while pumping and setting up and breaking down pumping equipment. Plan must address strategies and safeguards to ensure that public safety and environmental health is maintained at all times, the possibility of property damage and wetlands impacts, and overall level of inconvenience is minimized.

b. Layout drawing showing locations of equipment on Site and how access to the Site is maintained

c. Equipment lists

d. Pump curves and motor and engine data demonstrating equipment is sufficiently sized to meet all specified and anticipated operating conditions

e. Notification form

f. Emergency Response Plan: Describe the intended means of handling the following situations, including response and clean-up measures, and emergency backup power or backup fuel storage. List equipment to be used and where it will be stored.

- Break or failure of bypass line (pipe)
- Failure of bypass pump
- Overflow
- Back up into dwelling or onto private property
- Failure of bypass pumping system to accommodate flow

3. Shop Drawings for equipment and materials including, but not limited to:

- Pumps
- Engines and/or Motors
- Sound Enclosures
- Pipe or hose
- Joints/couplings
- Plugs and/or bladders

4. Statement of Qualifications demonstrating experience of the firm in accordance with Article 1.04 and listing a minimum of 20 successful bypass pumping projects conducted in the last ten years. Provide contact information for no fewer than 5 of these projects which:

- Have been completed in the last 5 years,
- Involved similar equipment to that proposed for this Project, and
- Had duty capacities of not less than 3 mgd.

1.05 QUALITY ASSURANCE

A. Provide in accordance with Division 01 General Requirements.

B. Qualifications: per Division 01 General Requirements and as follows.

1. Bypass pumping system shall be provided, operated, and maintained by a firm which has been regularly engaged in providing bypass pumping for a minimum of 10 years.

1.06 SITE CONDITIONS

A. Existing Conditions: per Division 01 General Requirements.

B. Refer to the Drawings for location and depth of the existing pump station influent manhole and proposed force main bypass connection.

C. The fluid to be pumped is raw sanitary wastewater which contains typical solids, rags, and debris. Flows are subject to typical diurnal variations and also increase significantly during wet weather and high groundwater. Provide that the bypass pumping system is capable of handling all of these conditions.

D. Use the following design flows as the basis of design for each bypass pumping plan:

1. Typical Flow: 0.75 mgd at approximately 60 feet TDH

2. Peak Flow: 3.3 mgd at approximately 110 feet TDH

PART 2 – PRODUCTS

2.01 BYPASS PUMPING SYSTEM

A. Godwin Pumps (a Xylem brand)

B. Griffin Dewatering

C. Rain for Rent

D. Or equal

2.02 PUMPS, PIPES & FITTINGS

A. Provide portable, non-clog, centrifugal wastewater pumps suitable for use with raw, unscreened sewage and capable of conveying the volume of flow anticipated with a sufficient margin of safety.

B. Provide two duty pumps and one redundant pump of equal capacity. One duty pump shall be electrically-driven and shall handle typical flows. The second duty pump

and standby pump shall be engine-driven to handle peak flows even without electrical service.

C. All engine-driven pumps must be critically silenced.

D. Pump Connections: quick connect couplings to facilitate change out of pumps

E. Pipe: carbon steel, fused high-density polyethylene pipe, or equal.

F. Joints: Victaulic or approved equal.

G. Fittings: quick-connect type.

H. Flow Meter: Magnetic flow meter

I. Lay-flat hose: extra heavy duty, highly abrasion resistant, fitted with gasketed couplings, and rated for 150 percent of working pressure.

J. Provide sound attenuation enclosure for engines and pumps in accordance with state and local noise requirements.

K. Control: automatic level control for pumps. Redundant pump shall start automatically if one duty pump fails.

L. Autodialers: provide autodialers with capacity to call up to 3 different phone numbers upon low fuel, power failure, zero flow and pump failure.

PART 3 – EXECUTION

3.01 GENERAL

A. Maintain flows under all flow conditions. Adequately handle flows, even instantaneous peak flows, without damage or overflow, providing for potential large instantaneous flow contributors connected to the sewer under repair.

B. Allow for passage of traffic and protect bypass piping at driveway and street crossings.

3.02 SHUTDOWN

A. Shutdown is not permitted. Maintain flow of wastewater at all times with no interruption of service.

3.03 TEMPORARY SERVICES

A. Provide fuel and power, including temporary services, as required to run bypass pumps at no additional cost to Owner.

3.04 PIPING

A. Provide that piping system has adequate water tightness. Perform a leakage test with clean water at Engineer's direction, at no additional cost to Owner.

B. Lay temporary piping along the general lines of streets or roadways in a manner that causes the minimum amount of disruption and is least likely to be damaged. Use temporary bituminous pavement, cold patch, or other approved material to form a ramp on each side of the pipe or depress the pipe at driveways to allow for property owners to drive over the temporary pipe as directed by the Engineer.

3.05 OPERATION AND MAINTENANCE

A. Contractor is responsible for all operations and maintenance of bypass pumping system at all times.

B. Continuously monitor bypassing operations regardless of duration or timing of bypassing. Check bypass pumping at the beginning and end of each work day at a minimum. Check fuel levels, pump operation, piping system and couplings. Fill fuel tanks and replace worn, damaged, or improperly functioning equipment as necessary. Check autodialer once each day for proper operation. Bypass pumping system must be manned continuously if any pump is offline or autodialer is not operational.

END OF SECTION

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SECTION 01 73 30

REMOVAL AND DISPOSAL OF ASBESTOS CONTAINING MATERIAL

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes

1. Minimum requirements for the disturbance, removal, containment, and disposal of asbestos containing material (ACM) generated as a result of the Work by a duly licensed asbestos abatement contractor in accordance with this Section, Laws and Regulations, and applicable reference standards listed in Article 1.03.

2. Work includes, but is not limited to, equipment and material, storage, transportation, signs, preparation, and temporary facilities required to properly remove and dispose of ACM on Site.

1.02 PRICE AND PAYMENT PROCEDURES

A. Measurement and payment requirements: per Division 01 General Requirements.

1.03 REFERENCES

A. U.S. EPA Regulation 40 CFR Part 61 National Emission Standards for Hazardous Air Pollutants (NESHAP) Paragraph 61.145, Standard for Demolition and Renovation, and Part 763, Asbestos

B. U.S. Department of Labor; Occupational Safety and Health Act of 1970 (Particular attention is drawn to the Asbestos Regulations of 29 CFR, Part 1926.1001 General Industry Standard for Asbestos, 29 CFR 1926.1101 Construction Standard for Asbestos Part 1910.134 Respirator Regulations, and Part 1910.1200 Hazard Communication Program)

C. U.S. Department of Transportation regulations, 49 CFR Parts 171-181; Hazardous Materials Regulations

D. New Hampshire Code of Administrative Rules, ENV-A 1800, Asbestos Management and Control

E. New Hampshire Code of Administrative Rules, ENV-Sw 900, Management of Certain Wastes

F. TITLE X, PUBLIC HEALTH, CHAPTER 141-E, RSA 141-E, Asbestos Management and Control

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination, Sequencing, and Scheduling: per Division 01 General Requirements.

1.05 SUBMITTALS

A. Submit in accordance with Division 01 General Requirements.

1. Qualification Statement of licensed asbestos abatement contractor

2. Provide that 2 copies of the following are submitted by the asbestos abatement contractor at the Pre-Construction Conference.

a. Notifications, permits, applications, licenses, and like documents required by applicable Laws and Regulations

b. Copies of medical records as required by OSHA or a signed statement by examining medical doctor that such examinations have taken place, and when, for each worker involved in ACM abatement

c. Record of successful respiratory fit test performed by a Competent Person as defined by OSHA, within the previous 6 months, for each worker involved in ACM abatement

d. Copies of current NH DES certifications for asbestos abatement contractor, each supervisor, and each worker involved in ACM abatement

e. Separate certificate of insurance from asbestos abatement contractor naming Contractor, Owner and Engineer as additional insureds

f. Proposed respiratory program for workers throughout all phases of the abatement Work, including make, model, and NIOSH approval numbers of respirators to be used

g. Written description of procedures, methods, or equipment proposed to be utilized by asbestos abatement contractor that differ from the Specification, including manufacturers' specifications for any equipment not specified for use in the Specification

h. Proposed electrical safeguards to be implemented, including but not limited to location of transformers, GFCI outlets, lighting, etc., necessary to properly perform the abatement Work in wet environments in accordance with all applicable standards and codes, including a description of an electrical hazards safety plan for common practices in the abatement Work area

i. List of equipment to be used on Site, by make and model, including generator (if applicable), air filtering equipment, HEPA vacuums, water atomizing devices, etc.

j. Chain of command of responsibility at the Site, including supervisors, foremen, and competent person, and contact information

k. Proposed emergency plan and route of egress from abatement Work areas in the event of fire or injury, including the name and telephone number of nearest medical assistance center

l. Asbestos abatement contractor's testing laboratory for analysis of personal samples and clearance air samples, most recent NIOSH PAT proficiency testing results, and certification in the location of the Project

m. Safety Data Sheets for encapsulants, adhesives, sealers, and any other potentially hazardous materials brought to the site by the contractor

n. Name and address of waste transporter and disposal site

3. Provide that the following are submitted by the asbestos abatement contractor prior to submittal the final Application for Payment.

a. Waste disposal receipts acknowledging legal disposal of waste material from the Project, indicating delivery date, quantity, and appropriate signature of disposal site's authorized representative

b. Copy of the daily asbestos work area entry-exit log book

c. Personal air monitoring and final clearance air sampling results as required by OSHA, EPA, NH DES or this Section

1.06 QUALITY ASSURANCE

A. Provide in accordance with Division 01 General Requirements.

B. Obtain the services of a duly licensed asbestos abatement contractor to identify and remove ACM prior to demolition of building structures and components that may be disturbed per statutory requirements.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Provide in accordance with Division 01 General Requirements.

B. Protection

1. Provide for protection of workers performing Work in vicinity of ACM and the public and the environment from exposure.

C. Obtain the services of a duly licensed or certified waste transporter and disposal site in accordance with Laws and Regulations.

1.08 SITE CONDITIONS

A. Existing Conditions: per Division 01 General Requirements.

1. Refer to Hazardous Materials Survey Report, Lafayette Road Wastewater Pump Station (April 2016, Woodard and Curran).

2. Common materials that may contain asbestos include thermal insulation on boilers, ducts and pipes, vinyl floor tiles, ceiling tiles, various mastics (i.e. glues), and asbestos cement products, including asbestos cement pipes. Some of these materials are "friable" or will be rendered friable during abatement, meaning the material can easily be crumbled under hand pressure and release asbestos fibers (e.g., insulation) and some are "non-friable", meaning the material cannot easily be crumbled and cannot easily release asbestos fibers (e.g., vinyl floor tiles and asbestos cement pipes that are in good condition and have not deteriorated).

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.01 ABATEMENT WORK

A. Provide that abatement of ACM is performed by a duly licensed asbestos abatement contractor in accordance with Laws and Regulations.

B. Remove all ACM and presumed ACM prior to demolition or renovation activities, wetting the materials prior to removal to prevent asbestos dust, fully containing the Work area (e.g., with plastic sheeting) and drawing air out of the containment through a specially made air filtration unit with HEPA filter capable of capturing asbestos fibers, sealing the wetted asbestos-containing waste material (ACWM) in leak-tight containers with asbestos labeling, and properly disposing of the waste in a permitted landfill or disposal site.

END OF SECTION

SECTION 01 73 32

OTHER HAZARDOUS MATERIAL ABATEMENT

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes

1. Minimum requirements for removal, containment, and legal disposal or recycling of hazardous and regulated materials including fluorescent lamps and associated ballasts, thermostats and mercury-containing devices, smoke detectors, batteries, generator gasoline storage containers, natural gas heaters, transformer vault, electrical switchgears, signage and other miscellaneous items, PCBs, lead containing paint, and associated Hazardous Waste generated as a result of the Work, in accordance with this Section, Laws and Regulations and applicable reference standards listed in Article 1.03.

B. Perform removal and disposal of asbestos containing material in accordance with Section 01 73 30 Removal and Disposal of Asbestos Containing Material.

1.02 PRICE AND PAYMENT PROCEDURES

A. Measurement and payment requirements: per Division 01 General Requirements.

1.03 REFERENCES

A. Reference Standards

1. Department of Environmental Protection (DEP) for state where Project is located

2. Department of Health or similar agency in State where Project is located

3. ENVIRONMENTAL PROTECTION AGENCY (EPA)

   a. 40 CFR Subchapter I – Solid Wastes

   b. 40 CFR Subchapter R – Toxic Substances Control Act (TSCA) (also 15 USC § 2601 et seq.)

4. MINE SAFETY AND HEALTH ADMINISTRATION (MSHA)

5. NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH (NIOSH)

6. OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION (OSHA)

a. OSHA 29 CFR 1926, Safety and Health Regulations for Construction

7. RESOURCE CONSERVATION AND RECOVERY ACT (RCRA)

8. U.S. DEPARTMENT OF TRANSPORTATION (U.S. DOT)

a. 49 CFR Subtitle B, Chapter I, Subchapter A, Hazardous Materials and Oil Transportation

B. Local and county Board of Health and Fire Department rules, regulations, notifications and permits

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination, Sequencing, and Scheduling: per Division 01 General Requirements.

B. In the event of an oil or chemical spill, immediately notify the Owner and the National Response Center at 1-800-424-8802 or www.nrc.uscg.mil using on-line reporting tool.

1.05 SUBMITTALS

A. Submit in accordance with Division 01 General Requirements.

B. Permits, applications, licenses, and notifications required by Laws and Regulations

C. Waste Disposal Plan for disposal of Hazardous Waste which describes the Hazardous Waste stream and disposal means (e.g. landfill or recycle) and the names and address of the proposed Hazardous Waste hauler and proposed disposal, reclamation and treatment facilities

D. Fluorescent Light Fixtures

1. List of Subcontractors to be utilized for incidentals, Hazardous Waste hauling and disposal issues, including Subcontractor's name(s), addresses and phone numbers and applicable licenses

E. PCB Abatement

1. Training certificates for personnel handling PCB containing materials

2. PCB Spill Prevention Control and Countermeasure Plan

3. PCB Abatement Work Plan

F. Lead Paint Abatement

1. Lead Paint Work Plan and Lead Compliance Program per 29 CFR 1926.62, including proposed worker training, respiratory protection program and medical monitoring for employees throughout all phases of the Work, including make, model and NIOSH approval numbers of respirators to be used; worker orientation plan; written description of proposed procedures, methods, or equipment to be utilized.

   a. Protocol for testing paint to determine the presence of lead

   b. Results of lead testing

   c. Name and address of the testing laboratory, certification(s) of AIHA accreditation for metal analysis, listing of relevant experience in air and bulk lead analysis, and presentation of a documented quality assurance and quality control program

   d. Air sampling results

   e. Personnel monitoring results

   f. Copies of written medical opinions for each employee who may be occupationally exposed to lead, as required by 29 CFR 1926.62 (j) (3) (v).

G. Chain of Command of responsibility at Work Site including supervisors and competent person, their names, resumes and phone numbers.

H. Manifests, receipts, and written acknowledgement from the Hazardous Waste disposal, reclamation and treatment facilities with representative's signature, printed name and title, acknowledging:

1. Name, contact, phone number and certification copies of recycling company and facility including written procedures to be used for ballast and light tube recycling.

2. Landfill site information, including EPA ID number, contact name and telephone number

3. Original copies of Waste Disposal Manifests with waste quantities listed and recycling bill of lading for Hazardous Waste transported and confirmation of reclamation if applicable

4. Certificate of Recycling and Disposal after incineration of Hazardous Waste, materials, and recycling of uncontaminated metal components

5. Disposal and recycling of lead waste material from the Site

I. Closeout Submittals: per Division 01 General Requirements.

1.06 QUALITY ASSURANCE

A. Provide in accordance with Division 01 General Requirements.

B. Qualifications: per Division 01 General Requirements and as follows.

1. Minimum personnel training and certification per EPA, RCRA, OSHA and state DEP/DOH requirements.

a. Removal and disposal of the light tubes and PCB equipment/ballasts only.

1) Workers: 24 hour OSHA trained pursuant or HAZWOPER trained

2) Supervisors: 40 hour OSHA trained

b. PCB Abatement: 40-hour OSHA HAZWOPER certification and/or 8-hour OSHA refresher training certification

2. Lead testing lab: AIHA accredited for analysis of metals.

1.07 SITE CONDITIONS

A. Existing Conditions: per Division 01 General Requirements.

1. Refer to Hazardous Materials Survey Report, Lafayette Road Wastewater Pump Station (April 2016, Woodard and Curran).

2. Common materials that may contain hazardous or regulated materials include lead paint, PCBs, fluorescent lamps and associated ballasts, thermostats and mercury-containing devices, smoke detectors, batteries, generator gasoline storage containers, natural gas heaters, transformer vault, electrical switchgears, and signage.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.01 GENERAL

A. Protect personnel and the building environment against exposure to hazardous and regulated materials removed.

B. Engineer may stop hazardous and regulated material removal and abatement Work for noncompliance with the Specification and violation of applicable Laws and Regulations especially if there is potential impact to human health, the environment, and proper completion of the Project.

C. Prior to assignment to any abatement Work, provide each employee with information regarding the potential hazards of PCBs, lead paint and other hazardous and regulated materials, and safety and health precautions.

D. Implement a Spill Prevention Control and Countermeasure Plan pursuant to 40 CFR 761.

E. Remove potentially hazardous and regulated materials or stored items prior to renovation activities and either recycle or legally dispose of in accordance with RCRA, DEP Hazardous Waste Regulations, and other applicable Laws and Regulations.

1. Provide that mercury containing devices that are removed from the building are treated by retort and distillation processes to recover and recycle the elemental mercury at an EPA permitted facility.

F. Maintain required acknowledgements, certifications, logs, and documentation for the following on Site during demolition, removal and abatement activities at a location approved by the Engineer.

- Certifications of required worker training
- Medical examinations required by OSHA 29 CFR 1926
- Documentation of fit-testing specifically for respirators used on the Project
- Material Safety Data Sheets of supplies/chemicals
- Approved abatement work plans and programs
- List of emergency telephone numbers
- Waste Disposal Log

G. Personal Protective Equipment (PPE)

1. Provide each employee performing abatement Work information on the use and requirements of PPE. Proper PPE may vary depending on the activity, but may include disposable gloves, disposable rubber boots, steel-toe boots, Tyvek suits, respirators, hard hats, hearing protection, and/or eye protection.

2. Provide respirator training and fit testing for personnel conducting abatement activities that require the use of a respirator. Only issue respirators to personnel who have participated in a respirator training program.

3. Select respirators from those approved by the MSHA, NIOSH, or State Department of Health.

4. Individually fit-test respirators under the direction of an Industrial Hygienist on a yearly basis. Permanently mark fit-tested respirators to identify the individual fitted, and limit use to that individual. Maintain fit-test records for each employee using a respirator.

5. High Efficiency Particulate Air (HEPA) respirator filters: approved by NIOSH and conform to the OSHA requirements in 29 CFR 1910.134.

6. Provide and make available a sufficient quantity of respirator filters so that filter changes can be made as necessary during the work day. Remove and discard filters during any abatement/ decontamination process at a frequency at least as often as recommended by the manufacturer's specifications. Do not allow filters to be reused.

7. Do not use filters with negative pressure air purifying respirators any longer than one 8-hour work day.

8. Provide a storage area where respirators will be kept in a clean environment.

3.02 FLUORESCENT LIGHT TUBE REMOVAL

A. Remove fluorescent light fixtures prior to any other renovation Work.

B. Carefully remove fluorescent light tubes of each size and type from each fixture, properly package in egg crate cardboard cartons and dispose of in accordance with DEP Regulations. Fully enclose in the boxes to prevent breakage.

C. Quantify and store boxed light tubes in a designated Hazardous Waste storage/holding area. Confirm the total linear footage (quantity) of the tubes and inform Engineer.

D. Fluorescent (mercury) light tubes: collect for recycling (reclaimed) mercury vapor gas by a state approved recycling facility.

3.03 BALLAST REMOVAL AND DISPOSAL

A. Utilize process of ballast recycling approved as an Alternative Disposal Method pursuant to 40 CFR 761.60 (e).

B. Utilize only trained personnel to handle PCB materials per Article 1.06.

C. Remove ballasts from light fixtures with care. Remove and store ballasts in 55 gallon drums so as not to cause ballasts to leak as a direct result of removal and packing.

D. Properly package and legally dispose of <u>non-PCB containing</u> ballasts in a landfill that will accept the Hazardous Waste or recycle and reclaim at a facility that is approved to handle the Hazardous Waste.

E. Properly package and legally dispose of PCB containing ballasts in a landfill that will accept the Hazardous Waste and provide documentation. Comply with applicable requirements specified in Article 3.05.

3.04 LIGHT FIXTURE REMOVAL AND DISPOSAL

A. Shut down and lock out lighting circuits. Cut wiring and cap from the nearest junction box for each light. Confirm electrical power is disconnected and locked out to the light fixtures, and then carefully remove from the ceilings and walls.

B. Carefully remove, decontaminate and legally dispose of fluorescent lights and remove incandescent lights. Light fixtures may be recycled as light metal after removing light tubes and ballasts.

3.05 PCB ABATEMENT

A. Preparation

1. Designate the areas for PCB abatement as “PCB Work Area”.

2. Provide authorized workers and visitors with suitable PPE whenever they enter the PCB Work Area.

3. Use physical barriers where necessary, to limit access to the Work area for the duration of the demolition/PCB abatement Work.

4. Post PCB caution signs, warning signs and barrier tapes at all approaches to the PCB Work Area. Locate signs at such distance that personnel may read the sign and take the necessary protective steps required before entering the PCB Work Area. Post emergency exits only on the PCB Work Area side and post with PCB caution signs on the non-PCB Work Area side.

5. Cover ground surfaces exterior to the PCB Work Area with a layer of 6 mil polyethylene sheeting, attached to the building face and laid down on the surface below the exterior PCB Work Area, at least 10 feet wide or to the furthest point of gravity fall for dislodged debris by methods used, whichever is further.

6. Isolate HVAC equipment intakes by temporarily shutting down units and installing plastic sheeting over the opening in the vicinity of any abatement activities involving soil removal, material grinding, or the use of power tools to remove PCB material.

7. Enclose the following locations within polyethylene sheeting. Cover locations in polyethylene sheeting or water impervious membrane (or equivalent) underfoot, overhead, and around walls not adjacent to the remediation surface. Seal sheeting at the seams using duct tape or other

suitable adhesive. Utilize wet wiping and water misting as a dust suppressant as appropriate.

a. Areas susceptible to wind or other conditions that could cause migration of contaminated materials outside the immediate PCB Work Area (e.g., scaffolding or a hydraulic lift platform)

b. Areas where caulking removal activities are conducted.

c. Along building walls to contain any debris or building materials removed from the exterior walls during abatement Work

8. Provide that medical approval, respirator fit-test reports, worker acknowledgments, and training certificates are on Site prior to admittance of any personnel to the PCB Work Area.

B. PCB Abatement

1. Prevent unprotected, untrained workers or trades from performing any related Work within the same vicinity as the PCB abatement Work. Prevent unauthorized workers and visitors from entering the Work area.

2. PPE must be utilized by personnel during abatement activities. Provide sufficient quantities of PPE to assure that complete disposable outfits are available for each individual performing abatement Work each day.

3. Manage and containerize any visible PCB debris located outside the PCB Work Area immediately at no additional cost to the Owner.

4. Perform removal and disposal of PCB Bulk Product Waste, such as caulking manufactured with PCBs, at locations identified in the Hazardous Materials Assessment, as shown on the Drawings, and as may be identified by Contractor.

5. Utilize tools for the removal of caulking or other PCB materials in a manner that does not generate dust. Uncontained water blasting and open air mechanical cutting or grinding of PCB source materials is prohibited.

6. Utilize power or pressure washers for PCB removal or clean-up procedures only with proper containment/controls.

7. Use scrapers, solvents, mastic removal chemicals, or other required methods and procedures to ensure complete removal PCB materials.

8. Remove accessible caulk, such as in window frames that could be disturbed before cutting building components.

9. Perform removal and disposal of the windows (including frames, sashes, panes, glazing, and hardware) and the door frames collectively with the

caulking removal. Manage the removed caulking, windows, and door frame as a collective Hazardous Waste stream.

10. After gross caulking removal, clean adjacent masonry surface scheduled to remain in place of any residual caulking to the maximum extent practical by scraping with hand tools or scrubbing with an abrasive brush, as appropriate.

11. Place removed material into 6 mil plastic disposal bags or other suitable container upon detachment from the substrate.

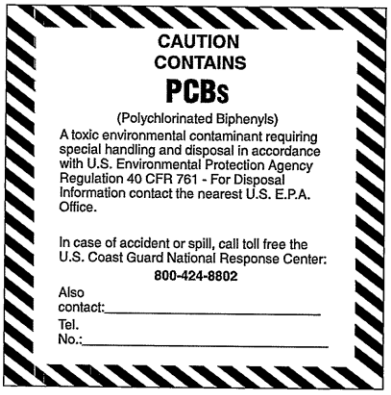
12. In the event of a PCB spill, contact the Owner and National Response Center and clean up the spill pursuant to 40 CFR 761 Subpart G.

C. Containers and Labels for PCB Containing Material

1. Stage secure, lined, and covered waste containers (e.g. roll-off, cubic yard box, or 55-gallon U.S. DOT-approved steel container) for the collection of PCB wastes generated during the abatement Work in accordance with 40 CFR 761.65.

2. Properly label and mark containers with PCB materials regulated as Hazardous Waste (i.e., PCBs greater than or equal to 50 ppm in accordance with 40 CFR 761.40.)

3. Provide the appropriate "Large PCB Marking" or "Small PCB Marking" (ML or MS per 40 CFR 761) as shown below, of sufficient size to be clearly legible, for display on waste containers (bags, boxes, roll-offs or drums) which will be used to contain or transport PCB contaminated material, in accordance with 40 CFR 761. In addition, U.S. DOT 49 CFR Parts 171 and 172 requires the name and UN number of the material to be on the bags or drums, and, if shipped in bulk (rolloffs, Gaylord boxes, etc.), the bulk container must also be labeled: "Polychlorinated biphenyl, solid mixture UN 3432".



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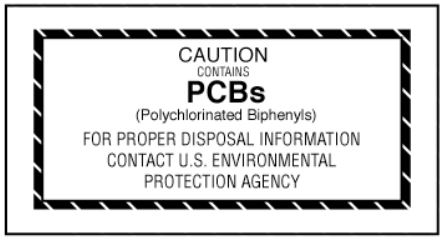

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D. Transportation and Disposal of PCB Containing Material

1. Remove Hazardous Waste generated as part of the PCB abatement from the Site within 7 calendar days after completion of PCB abatement Work.

2. Manage PCB waste generated as PCB waste greater than or equal to 50 ppm which is regulated under the Toxic Substances Control Act (TSCA) and classified as a Hazardous Waste subject to transportation under a Uniform Hazardous Waste Manifest.

3. Provide that PCB waste is managed for disposal at a facility permitted to accept hazardous PCB waste greater than or equal to 50 ppm, such as a chemical waste or a RCRA Hazardous Waste (Subtitle C) landfill or equivalent facility. Provide a certified PCB inspector and a legally permitted Hazardous Waste hauler.

4. Provide written notice to Hazardous Waste disposal facility 15 days prior to the first shipment of the Hazardous Waste stream that the Hazardous Waste contains PCBs greater than 50 ppm, in accordance with 40 CFR 761.62. Obtain acknowledgement from the Hazardous Waste disposal facility with representative's signature, printed name and title and submit to Owner and Engineer.

5. Provide 24-hour advance notice to Engineer prior to removing any Hazardous Waste from the Site. Remove Hazardous Waste from the Site only during normal working hours, only when Contractor and Engineer are present, and when Engineer authorizes the release of the Hazardous Waste.

6. Upon arrival at the Project Site, the Hazardous Waste hauler must possess and present to the Engineer a valid Hazardous Waste hauler's permit. The Engineer may verify the authenticity of the hauler's permit with the proper authority.

7. Perform inspection with Hazardous Waste hauler and Certified PCB Inspector of all material in the transport container prior to taking possession and signing the Hazardous Waste Manifests.

8. Do not permit any off-Site transfers of Hazardous Waste or allow the Hazardous Waste to be transported or combined with any other off-Site Hazardous Waste unless specifically approved by the Owner. Ensure Hazardous Waste hauler travels directly to the Hazardous Waste disposal Site as identified on the manifest with no unauthorized stops.

E. Decontamination and Cleaning After PCB Abatement

1. When PCB abatement is complete and verified by Engineer, perform decontamination by vacuuming (with a HEPA filter), wet wiping/mopping

and a repeated vacuuming (with a HEPA filter) of the entire PCB Work Area to provide that surfaces in and around the PCB Work Area are free of dust generated during the abatement Work.

2. Decontaminate tools and equipment before removal from the PCB Work Area.

3. Thoroughly decontaminate other areas of the building outside of the PCB Work Area if dust or debris has migrated to other areas to ensure visible dust generated by the PCB abatement is eliminated.

4. Remove dust barriers and other protective sheeting. Place in disposable construction bags and dispose of as PCB waste greater than or equal to 50 ppm with the caulking and building material Hazardous Waste stream.

5. Visually inspect the PCB Work Area for any remaining dust or debris and vacuum (with HEPA filter) and wet wipe until clean.

6. Provide a certified PCB inspector to perform a final inspection upon completion of decontamination and removing temporary dust barriers. Clean or reclean areas identified by the certified PCB inspector as requiring further cleaning at no additional expense to the Owner.

3.06 LEAD CONTAINING PAINT REMOVAL/ABATEMENT

A. Preparation

1. Test representative building components prior to demolition of building structures and test selective waste streams prior to disposal.

2. Assume that any painted surface not tested contains lead paint.

3. Designate the areas for lead paint abatement as “Lead Paint Work Area”.

4. Use physical barriers where necessary, to limit access to the Work area for the duration of the demolition/lead paint abatement Work.

5. Post lead paint caution signs, warning signs and barrier tapes at all approaches to the Lead Paint Work Area. Locate signs at such distance that personnel may read the sign and take the necessary protective steps required before entering the Lead Paint Work Area. Post emergency exits only on the Lead Paint Work Area side, post with lead paint caution signs on the non-Lead Paint Work Area side.

6. Erect isolation barriers as necessary to control exposure to lead-containing dust.

7. Provide authorized workers with suitable PPE whenever they enter the Lead Paint Work Area.

B. Minimum Requirements for Demolition Performed on Painted Components

1. Implement feasible engineering controls as described in the Lead Paint Work Plan and Lead Compliance Program to minimize the possibility of contamination of areas adjacent to the Lead Paint Work Area.

2. Inform workers of the components to be impacted during demolition that are identified as containing lead.

3. Clean up and properly containerize loose and flaking paint present on both interior and exterior surfaces prior to both demolition and or asbestos abatement activity.

4. Use demolition methods to eliminate dispersion of lead paint chips and debris to immediate area surrounding the Lead Paint Work Area. Clean up any lead paint chips and debris that should migrate to the surrounding area/ground during demolition.

5. Perform lead paint abatement if demolition activities (i.e. torch cutting, mechanical sanding or stripping or abrasive methods of paint removal) will directly impact any surface on which lead based paint is present.

6. Do not perform demolition activities that increase the workers' exposure above the Action Level of 30 µg/m3. Comply with the OSHA lead standard 29 CFR 1926.62. See Air Sampling and Personnel Monitoring.

7. Characterize debris containing lead generated from demolition activities to determine disposal requirements (construction debris or Hazardous Waste) by performing the toxicity characteristic leachate procedure (TCLP) or using other methods consistent with Laws and Regulations which accurately characterize the waste.

C. Lead Paint Abatement

1. Comply with the OSHA lead standard at 29 CFR 1926.62.

2. Prevent demolition or renovation activities that increase the workers' exposure above the Action Level of 30 µg/m^3

3. Inform workers of the components to be impacted during renovation or demolition that have been identified as containing lead.

4. Worker protection shall comply with the OSHA Lead Standard 29 CPR 1926.62 at a minimum.

5. Prevent unprotected, untrained workers or trades from performing any related Work within the same vicinity as Work involving components identified with lead until clean-up procedures are completed.

6. Provide hand washing facilities and assure that all workers thoroughly wash their hands and face upon exiting Lead Paint Work Areas.

7. Initiate and continue sufficient engineering and Work practice controls, as described in the Lead Paint Work Plan and Lead Compliance Program, to reduce and maintain worker exposures to lead at or below the Action Level.

8. Maintain Lead Paint Work Area free of accumulated debris and paint chips of demolition involving lead.

9. Ensure workers pay careful attention to cleanse the hands and face when decontaminating (provide hygiene facilities, including shower, as required based on initial assessment and continued monitoring);

10. Thoroughly wet the areas to be demolished and mist the air to reduce the potential for creating airborne lead and dust;

11. Ensure that equipment used by the Workers is either left inside the Lead Paint Work Area or thoroughly decontaminated before being removed from the Lead Paint Work Area. Ensure extra Work clothing (in addition to the disposable suits supplied by the Contractor) are left in the clean area until the completion of Work in the Lead Paint Work Area.

12. Clean the clean area of visible debris and disposable materials daily.

13. Do not permit workers or supervisory personnel to eat, drink, smoke, chew gum, or chew tobacco in the Lead Paint Work Area under any circumstance, otherwise demolition operations shall be stopped by Engineer.

14. Only allow workers or supervisory personnel to remove their protective respirators, if applicable, while in the Lead Paint Work Area in the case of life threatening emergency. In this situation, respirators are to be removed for as short a duration as possible.

D. Air Sampling and Personnel Monitoring

1. Perform personnel air sampling during demolition/lead paint abatement work to determine worker exposure limits. Post results of such sampling, provide to individual workers and submit to Engineer.

2. Provide sampling to check personnel exposure levels. Take representative sampling for the duration of the Work shift or for 8 hours, whichever is less. Personnel samples need not be taken for repeated working conditions if working conditions remain unchanged, but must be taken every time there is a change in the abatement/removal operation, either in terms of the location or the type of Work.

3. Use sampling to determine 8-hour Time-Weighted-Averages (TWA).

4. Conduct personnel sampling as outlined in OSHA Standard 29 CFR 1926.62.

5. Transmit air sampling results to the Engineer and individual workers available at the Site in written form no more than 48 hours after the completion of a sampling cycle. List each sample's result, sampling time and date, personnel monitored, task performed while monitored, flow rate, sample duration, sample yield, cassette size, and analyst's name and company, and include an interpretation of the results. Report air sample analysis results in micrograms/cubic meter (µg/m3).

6. Establish air monitoring frequency in accordance with the requirements set forth in 29 CFR 1926.62.

E. Comply with Laws and Regulations applicable to lead waste and recyclable storage.

1. Location of Hazardous Waste and recycling containers on Site: subject to Owner and Engineer's approval.

2. Manage waste from demolition and lead paint abatement that is regulated under the TSCA and classified as a Hazardous Waste subject to transportation under a Uniform Hazardous Waste Manifest.

F. Legally dispose of Hazardous Waste determined to be coated with lead-based paint, performing testing and other requirements imposed by the disposal facility. Comply with the requirements of RCRA and applicable Laws and Regulations.

3.07 CLEAN UP

A. Maintain the various Hazardous Waste Work Sites in a neat and orderly manner at all times, so as not to interrupt or infringe upon the Work of other trades.

B. Comply with all requirements for release of various Hazardous Waste Work Sites.

3.08 CLOSEOUT ACTIVITIES

A. Provide in accordance with Division 01 General Requirements.

END OF SECTION

SECTION 01 91 15

STARTUP AND COMMISSIONING

PART 1 – GENERAL

1.01 SUMMARY

A. Section includes startup and commissioning of wastewater pump station systems.

B. A system is defined as an arrangement of items of equipment, components, piping, wiring, materials, or incidentals so related or connected as to form a functional and operational unit.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.01 SYSTEM STARTUP & DEMONSTRATION REQUIREMENTS

A. Pre-Startup Requirements

1. Prior to startup, undertake the following procedures, in the order listed.

a. Ensure required written statements and/or guarantees from manufacturers of individual Specification sections comply with Contract Documents. Use a checklist to identify such requirements, by Specification section and submit a copy of completed checklist to the Engineer with manufacturers' written statements and/or guarantees.

b. Ensure Work is complete before startup of any unit or system. Certify to Owner that specifically services or respective equipment manufacturers' representative required by individual Specifications have been performed in accordance with Contract Documents.

c. Ensure systems are tested hydraulically, mechanically, and electrically. Ensure systems requiring calibration, commissioning, and balancing are fully certified as complete in performance in accordance with Contract Documents. Ensure required tagging, identification, and/or stenciling is complete.

d. Schedule startup a minimum of 30 days prior, with written notice issued, but not limited to: Owner, Engineer, Subcontractors, and applicable regulatory agencies.

e. Provide labor, supervision, utilities, chemicals, equipment, tools, materials, vehicles and other items necessary to startup, operate, and demonstrate the system.

f. Provide gauges, meters, recorder and monitors as required by the Engineer to supplement or augment the instrumentation system provided under this Contract to properly demonstrate that equipment fully satisfies the requirements of the Contract Documents. Select specific devices employed for the purpose of measuring the performance of the facility's equipment and systems to provide a level of certainty consistent with the variables to be monitored. Provide that instruments are recently calibrated, and be prepared to demonstrate, through recalibration, the certainty of instruments employed for testing purposes. Perform calibration procedures per applicable standards of ASTM, ISA and IEEE. The adequacy of gauges, meters, recorders and monitors are subject to review of the Engineer.

g. Provide sign off forms for each item of mechanical, electrical and instrumentation equipment provided or installed and include provisions for recording relevant performance data for original testing, and not less than 3 retests. Provide separate sections on the form to record values for pre-operation checkout, initials of representatives of equipment manufacturers, Contractor and Engineer.

h. Maintain a master file of equipment sign off forms and make available for inspection by the Engineer. Upon completion of equipment testing, submit the original and two copies of the sign off forms for each equipment item.

B. System Startup and Demonstration

1. Startup, operate and demonstrate specified performance of each item of equipment and each system at full operation without interruption of equipment or system or need of adjustment or repair to the satisfaction of the Engineer.

3.02 EQUIPMENT START-UP & PERFORMANCE TEST PROTOCOL

A. Conduct start-up in the following order.

1. Equipment Pre-Start-up Check
2. Equipment Start-up and Performance Testing
3. Manufacturers' Equipment Testing

B. Equipment Pre-Start-Up

1. Check out each item of equipment in the presence of the Engineer to demonstrate proper installation, functioning and ready for equipment start-up and performance testing.
2. Minimum requirements include, but are not limited to, the following.

a. Coordinate with SCADA Integrator for connections, terminations and controls as required.

b. Ensure equipment is properly installed, painted, leveled, wired and/or insulated.

c. Ensure piping is properly installed and valving is properly set.

d. Ensure piping is cleaned and pressure tested, as required.

e. Ensure equipment is properly lubricated.

f. Ensure safety related accessories are properly installed.

g. Bump or momentarily jog equipment to establish operation and proper rotation.

3. Arrange for equipment manufacturers to be present, or verify that these procedures may be done without the manufacturer's representatives being present.

4. In accordance with AWWA and local requirement, flush, disinfect and examine water supply facilities for the presence of bacteria prior to returning the facility to service.

C. Equipment Start-up

1. Prior to testing any equipment, obtain written certification from the manufacturer that the equipment is properly installed, calibrated and ready for safe and efficient operation as intended by the Engineer and manufacturer.

2. Thoroughly clean and flush equipment and associated piping, channels, basins, wetwells, etc. prior to start-up and testing of any item of equipment.

3. Start-up and operate each item of equipment, with assistance from the manufacturer's factory trained service engineer and in the presence of the Engineer, to demonstrate equipment performs according to the requirements of the Specifications to ensure equipment is ready for performance testing.

D. Performance Tests

1. General

a. Coordinate with Owner's electrical and SCADA contractors for performance testing.

b. Make full tests at the Site on each item of equipment after it has been properly installed, started and certified ready for operation to demonstrate that each item of equipment will operate properly by itself and in conjunction with other facility equipment in accordance with the Specifications.

c. Furnish necessary labor, tools, equipment, power, chemicals and clean water, to perform field tests to determine that the supplied equipment, including controls and alarms, meet hydraulic, electric

mechanical and performance requirements in accordance with the Specifications.

d. Repeat incomplete and/or unsuccessful tests to the satisfaction of the Engineer.

2. Pumps: as specified in SECTION 43 21 40 Submersible Wastewater Pumps

3. Process Equipment, Instrumentation, and Controls

a. Calibrate and/or verify calibration and proper operation and function of all process and analytical instruments, and documents results, for the following.

1) Flow measurement
2) Indicating controllers
3) Indicators
4) Miscellaneous equipment

4. Electrical

a. Verify proper operation and function of electrical distribution and standby power systems.

5. SCADA

a. Verify proper operation and function of all SCADA equipment.

E. Manufacturer's Training

1. Comply with requirements in Specifications for manufacturer's training.

2. No training can be conducted until the Owner has received approved manufacturer's operation & maintenance manuals.

3. Owner will not accept any item of equipment prior to receiving approved manufacturer training for the equipment. This applies only to equipment requiring manufacturer's training in accordance with the Specifications.

4. Engineer shall approve the completeness of training and verify completion by completing a "Verification of Manufacturer's Equipment Training" form.

5. Conduct training in addition to and exclusive of start-up and performance testing. Unless otherwise specified, provide a minimum of 8 hours of operation and maintenance training on each system by Manufacturer's certified representative.

END OF SECTION

SECTION 02 41 19

SELECTIVE DEMOLITION

PART 1 – GENERAL

1.01 DESCRIPTION OF WORK

A. The term "Demolition" shall include modification, removal, relocation, and/or disposal of associated items as shown on the Drawings or as specified herein. In all surrounding areas which are not being renovated under this contract, the Contractor shall verify that supporting systems have not been adversely affected by Demolition activities. In locations where systems are affected, the Contractor shall provide all work to maintain proper operations of the existing systems at no additional cost to the Owner. Provide demolition work required to allow complete installation and construction of the project components.

B. Demolition includes modification, removal, relocation, and disposal of items as shown on Drawings or as specified. This includes, but is not limited to, the following.

1. Demolition of structures as indicated on the Drawings, including but not limited to the superstructure, fixtures, utilities, foundation walls, grade beams, reinforcement and any additional items associated with the building/structure or contained within the building/structure.

2. Removal and replacement of utilities to accommodate new construction.

3. Removal and replacement of pavement, curbing, vegetation and landscaping to accommodate new construction.

4. Coring of holes of diameter required and at locations required to accommodate utilities and piping as necessary for new construction.

5. Demolition of equipment including all associated appurtenances. Appurtenances include but are not limited to concrete pads, concrete base supports, support structures, electrical switchgear, conduit, wiring, instrumentation, anchors and piping.

6. Repair and restoration of all substrate surfaces including floors, walls, concrete, masonry, wood, plastic, wall panels, facades, etc. Repair and restoration shall include providing a smooth finish surface to match the existing surface. Removal of all anchor bolts, painting, re-surfacing, etc. shall also be required.

7. For all open floor, wall and ceiling penetrations through buildings, floors or process tankage, fill holes with non-shrink grout unless otherwise noted.

8. Provide tank, channel, building, and vessel cleaning per ASTM D4258.

9. Provide water tight caps or blind flanges for all abandoned piping and conduit.

10. Provide repair and/or replacement in kind of any existing insulation damaged or removed during construction.

11. All other demolition Work required to allow complete installation of the Project.

1.02 PRICE AND PAYMENT PROCEDURES

A. Measurement and payment requirements: per Division 01 General Requirements.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Coordination, Sequencing, and Scheduling: per Division 01 General Requirements.

1.04 SUBMITTALS

A. Submit in accordance with Division 01 General Requirements.

1. Submit proposed methods and disposal Plans for demolition to Owner and Engineer for review prior to start of Work as specified. Include all required temporary facilities including controls for pedestrian and vehicle traffic, means of limiting access, storage and stockpile locations.

2. Submit schedule indicating proposed sequence of demolition to Owner and Engineer for review prior to start of Work. Include coordination for shutoff, capping, and continuation of utility services, together with details for dust and noise control protection.

B. Closeout and Maintenance Material Submittals: per Division 01 General Requirements.

1.05 QUALITY ASSURANCE

A. Provide in accordance with Division 01 General Requirements.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Provide in accordance with Division 01 General Requirements.

1.07 SITE CONDITIONS

A. Existing Conditions: per Division 01 General Requirements. Other associated existing conditions shall include but are not limited to the following:

B. The Owner will be continuously utilizing areas where selective demolition will be occurring. Conduct selective demolition work in a manner such that will minimize the need for disruption of the Owner's normal operations.

C. Obtain and pay the associated cost for all required permits for demolition Work.

D. The Owner shall assume no responsibility for actual condition of structures, items, and appurtenances called out or specified to be demolished. Conditions existing at time of inspection for bidding purposes shall be maintained by the Owner in so far as practicable. However, variations within structures or variations in items to be demolished may occur by the Owner's removal and salvage operations prior to the start of demolition work.

E. Coordinate with the Owner before disposal of any demolished items. Owner reserves right to retain and salvage all demolished items or portions thereof.

F. The Contractor shall be responsible for demolition of all items as indicated in the contract documents. Provide transportation of all demolished items to locations as designated by the Owner at the project site. Field verify the location of stored demolished items with the Engineer and Owner prior to transport and stockpiling. Allow the Owner to remove components from the stockpile of demolished items. Items the Owner does not retain shall become property of the Contractor and shall be removed and disposed of in a proper and lawful manner.

G. The use of explosives shall not be permitted for demolition purposes.

H. Provide temporary barricades and other forms of protection to ensure safe passage of personnel around area(s) of demolition. Conduct operations to prevent injury to adjacent buildings, structures, other facilities, and persons.

I. Promptly repair all damages caused to adjacent facilities by demolition operations at no additional cost to the Owner.

J. Provide water sprinkling, temporary enclosures, and other suitable methods to limit dust and dirt rising and scattering in the air to the lowest practical level. Comply with all governing regulations, permits, laws, ordinances, etc. pertaining to environmental protection.

K. Upon completion of demolition of below-grade portions of buildings; notify the Owner and Engineer. Filling/backfilling operations shall not commence until a complete record of the plan and vertical limits of demolition has been documented by the Owner and Engineer.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.01 PREPARATION

A. Provide interior and exterior shoring, bracing, or support to prevent movement, settlement, or collapse of structure or element to the demolished and adjacent facilities or Work to remain.

B. Stop demolition operations and notify Engineer immediately if safety of structure appears to be endangered. Take precautions to support structure until determination is made for continuing operations.

C. Locate, identify, stub-off, and disconnect utility services that are not indicated to remain in accordance with the Drawings and that specified. All items indicated for demolition shall be removed completely, back to the source. All associated items and appurtenances including but not limited to conduit, boxes, wiring troughs, wiring, cables, hangers, etc. shall be completely removed back to the source. Provide water tight solid caps on all abandoned conduit and piping.

D. Plan demolition operations and storage and removal of debris to ensure no interference with driveways, walks, and other adjacent occupied or used facilities. Do not close or obstruct driveways, walks or other occupied or used facilities without permission from the Owner. Provide traffic control and alternate routes around closed or obstructed traffic ways.

3.02 DEMOLITION

A. Perform selective demolition Work in a systematic manner. Use such methods as required to complete Work indicated on Drawings or as specified in accordance with demolition schedule and applicable Regulations.

B. Limit dust and dirt rising and scattering in air to lowest practical levels. Comply with governing Regulations, permits, Laws, and ordinances pertaining to environmental protection.

C. Completely fill below grade areas and voids resulting from demolition Work. Provide fill materials as shown on the Drawing or as specified in Section 31 00 00 EARTHWORK.

D. Saw-cut asphalt and concrete paved surfaces before removal. Joint cut should be neat and straight.

E. Where exposed conduit exits concrete surfaces; cut the conduit flush to the concrete surfaces and seal the openings gas and water tight to eliminate the potential for migration of hazardous gasses and moisture. Remove all wiring and appurtenances from conduit penetrations completely back to source prior to sealing.

3.03 SUBSTRATE & SURFACE REPAIR

A. Following demolition, repair surfaces and substrates to remain. The repair shall match the surrounding area in material, quality, color, paint/coating type and quantity.

B. For repair of poured concrete walls, floors or suspended slabs (including but not limited to concrete below equipment pads), provide a smooth and finished surface. Saw cut smooth edges around perimeter and chip below finish surface approximately 1/2 inch unless otherwise indicated on the Drawings. Provide concrete repair systems as specified in Division 03 and as indicated on the Drawings.

C. Anchor bolts, threaded rods, and other systems embedded in concrete that require demolition shall be cut flush with the substrate or wall. Provide a corrosion resistant epoxy coating over the embedded item surface, as specified in Section 09 90 00 PAINTING & COATING.

D. Provide aluminum diamond plate covers for equipment penetrations and openings that remain in any floor(s) following demolition. Diamond plate covers shall be a minimum of 1/4 inch thickness with beveled edge and retaining lips to maintain position in the floor.

3.04 HAZARDOUS MATERIALS

A. Assess and remove and dispose of all components containing lead, asbestos, PCBs, mercury, and other hazardous materials in accordance with Sections 01 73 30 REMOVAL AND DISPOSAL OF ASBESTOS CONTAINING MATERIALS and Section 017332 OTHER HAZARDOUS MATERIAL ABATEMENT.

B. In the event that unanticipated hazardous materials are discovered or suspected, Contractor shall carry out suitable measures to minimize hazards and immediately report conditions to Engineer.

3.05 SALAVAGED MATERIALS

A. Salvage materials as shown on the Drawings indicated in the Specification, or directed by Owner or Engineer.

B. Carefully remove indicated items, clean, store, and turn over to Owner in area designated by Engineer or Owner.

C. Any unanticipated items of significant historic or commercial value discovered in the demolition Work shall remain the property of Owner. Contractor will have the option to take possession of all other demolition materials or to dispose of them suitably. No materials assigned to Contractor may remain on Site without written authorization from Engineer or Owner.

3.06 TANK, VESSEL & CHANNEL CLEANING

A. Remove all water, sludge, wastewater and debris from tanks, vessels and channels and provide pressure washing of all surfaces prior to commencing demolition within the tank, vessel or channel. Properly dispose of all materials removed from tanks in a suitable and lawful manner. Following demolition work within a tank, vessel or channel, removal all water, sludge, debris, and other foreign objects and provide a broom clean and shop vacuumed clean surface.

3.07 DISPOSAL OF DEMOLISHED MATERIALS

A. Remove from Project Site, debris, rubbish, and other materials resulting from demolition operations as it accumulates. Do not remove from Project Site without prior permission by Owner or Engineer. Store all demolished materials that Owner wishes to retain at location designated by Owner or Engineer.

B. Burning of demolished materials will not be permitted.

C. Dispose of demolition debris in a lawful manner.

D. Upon completion of the Work, all materials, equipment, waste, and debris of every sort shall be removed and premises shall be left, clean, neat, and orderly.

3.08 WATER UTILITIES

A. Contractor shall complete all Work in accordance with City requirements and standards. Provide coordination of work involving both the potable water utilities and the irrigation water utilities as specified and as indicated on the Drawings.

3.09 SANITARY SEWER

A. Contractor shall complete all Work in accordance with City requirements and standards. Provide coordination of work involving the sanitary sewer utilities as specified and as indicted on the Drawings.

3.10 GAS/ELECTRICAL/OTHER

A. Contractor shall complete all Electrical and Gas Work in accordance with the requirements of Eversource.

3.11 FIELD QUALITY CONTROL

A. Provide in accordance with Division 01 General Requirements.

3.12 STARTUP & COMMISSIONING

A. Provide in accordance with Division 01 General Requirements.

3.13 CLOSEOUT ACTIVITIES

A. Provide in accordance with Division 01 General Requirements.

END OF SECTION

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SECTION 03 01 05

CONCRETE REPAIR

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes

1. Repair new concrete when permitted by the Engineer and fill form tie holes per Section 03 30 20. Payment for repair of new concrete shall be incidental to the base bid item.

2. Repair deteriorated existing concrete areas as defined on the Drawings, in accordance with this Section and applicable reference standards listed in Article 1.03. Payment for this work shall be in accordance with unit price bid item.

B. Related Requirements

1. Section 03 30 20 CONCRETE PLACING, CURING AND FINISHING

1.02 PRICE AND PAYMENT PROCEDURES

A. Measurement and payment requirements: per Division 01.

1.03 REFERENCES

A. Reference Standards

1. AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

a. AASHTO T 277 Standard Method of Test for Electrical Indication of Concrete’s Ability to Resist Chloride Ion Penetration

2. ASTM INTERNATIONAL (ASTM)

a. ASTM C109/C109M Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or (50-mm) Cube Specimens)

b. ASTM C1202 Standard Test Method for Electrical Indication of Concrete's Ability to Resist Chloride Ion Penetration

c. ASTM C78/C78M Standard Test Method for Flexural Strength of Concrete (Using Simple Beam with Third-Point Loading)

d. ASTM C496/C496M Standard Test Method for Splitting Tensile Strength of Cylindrical Concrete Specimens

e. ASTM C882/C882M Bond Strength of Epoxy-Resin Systems Used with Concrete by Slant Shear

f. ASTM C884 Thermal Compatibility between Concrete and Epoxy-Resin Overlay

g. ASTM G109 Determining the Effects of Chemical Admixtures on the Corrosion of Embedded Steel Reinforcement in Concrete Exposed to Chloride Environments

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination, Sequencing, and Scheduling: per Division 01 General Requirements.

1.05 SUBMITTALS

A. Submit in accordance with Division 01 General Requirements.

B. Product Data

1. Trowel-grade polymer modified portland cement repair mortar

2. Non-sag polymer modified portland cement repair mortar

3. Reinforcing steel primer

C. Notarized certificate stating that repair material meets the specified requirements and the manufacturer's current printed product literature.

D. Closeout and Maintenance Material Submittals: per Division 01 General Requirements.

1.06 QUALITY ASSURANCE

A. Provide in accordance with Division 01 General Requirements.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Provide in accordance with Division 01 General Requirements.

1. Deliver products in original, unopened containers with the manufacturer's name, labels, product identification, and batch numbers.

2. Store in accordance with manufacturer recommendations.

1.08 SITE CONDITIONS

A. Existing Conditions: per Division 01 General Requirements.

1. Take precautions to avoid damage to surface due to mixing and handling of the specified repair material near the area of Work.

PART 2 – PRODUCTS

2.01 MORTAR

A. Performance/Design Criteria

1. Mixed Properties

a. Application time: approximately 15 minutes

b. Finishing time: 20-60 minutes

c. Color: concrete gray

2. Cured Properties

a. Compressive strength (ASTM C109)

1) 1 day: 3,000 psi minimum

2) 28 day: 7,000 psi minimum

b. Splitting Tensile Strength (ASTM C496)

1) 28 day: 750 psi minimum

c. Flexural Strength (Modulus of Rupture, ASTM C78)

1) 28 day: 2,000 psi minimum

d. Bond Strength (ASTM C882/C882M, modified)

1) 28 day: 2,200 psi minimum

e. Thermal Compatibility (ASTM C884, modified)

1) Passes test

f. Permeability (ASTM C1202, AASHTO T 277)

1) 28 day: approximately 500 coulombs

g. Cracked Beam Corrosion Tests (ASTM G 109, modified)

1) Reduced corrosion rates: 63 percent versus control specimens

B. Acceptable level of quality: equivalent to products manufactured by Sika Corporation meeting the specified performance requirements.

1. Trowel grade mortar: SikaTop 122 Plus

1. Non-sag mortar: SikaTop 123 Plus

2. Steel reinforcement primer: Sika Armatec 110 EpoCem

2.02 SOURCE QUALITY CONTROL

A. Provide in accordance with Division 01 General Requirements.

PART 3 – EXECUTION

3.01 GENERAL

A. Do not apply material in inclement weather or if inclement weather is imminent.

B. Condition product as recommended by the manufacturer.

3.02 SURFACE PREPARATION

A. Mechanically prepare areas to be repaired so they are clean, sound and free of contaminants. Remove loose and deteriorated concrete by mechanical means. Remove dirt, oil, grease, and bond-inhibiting materials from the surface.

B. Except where tie holes are filled, saw cut perimeter 1/8 inch minimum when a neat mortar is to be applied, and 1-inch minimum when an extended mortar is to be applied.

C. Prepare concrete substrate to obtain a minimum surface profile of 1/16 inch in depth with a new aggregate fractured surface using steel shot blasting, abrasive blasting, or water jetting (hydrodemolition). Do not use of scabblers, bush hammers, or pneumatic hammers. Provide that the area to be repaired is not less than 1/8 inch in depth.

D. Prepare substrate to saturated surface dry condition with no standing water.

E. Steel Reinforcement Primer

1. Where reinforcement with active corrosion is encountered, sandblast to remove contaminants and rust, pressure wash, and apply primer.

2. Determine section loss and splice new reinforcement where there is more than 15 percent to 25 percent loss, as directed by the Engineer. If half or

more of the diameter of the bar is exposed, chip out 1/2 inch minimum behind the bar.

F. Treat cracks in the substrate in the area of repair as directed by the Engineer.

3.03 MIXING AND APPLICATION

A. The following describes the specific procedures applicable for the Sika products specified in Part 2. Mix and apply in strict accordance with, and adhere to limitations and cautions of manufacturer's instructions.

1. Horizontal surfaces: SikaTop 122 Plus (trowel-grade) or equal

2. Vertical and overhead surfaces: SikaTop 123 Plus (non-sag) or equal

B. Trowel-Grade Polymer Mortar

1. Pour entire Component A into mixing container. Add entire Component B while mixing. For extended mix, introduce 3/8 inch coarse aggregate at desired quantity. Mix to uniform consistency, maximum 3 minutes.

a. Addition rate not to exceed 42 pounds per bag.

b. Aggregate: non-reactive, clean, well-graded, saturated surface dry, with low absorption/high density

2. Scrub mortar into substrate, filling pores and voids. Force material against edge of repair, working toward center. After filling repair, consolidate, then screed. Allow mortar or concrete to set to desired stiffness and finish with wood or sponge float for a smooth surface.

a. Minimum application thickness: 1/8 inch for a neat mortar; 1 inch if extended

b. Maximum application thickness in a single lift: 1-inch for a neat mortar; 3 inches if extended

c. Where multiple lifts are required, score top surface of the preceding lift to produce a roughened surface. Allow preceding lift to reach final set prior to applying the next lift.

C. Non-Sag Polymer Mortar

1. Pour entire Component A into mixing container. Add entire Component B while mixing. Mix maximum 3 minutes to uniform consistency.

2. Scrub mortar into substrate, filling pores and voids. Force material against edge of repair, working toward center. After filling repair, consolidate,

then screed. Allow mortar or concrete to set to desired stiffness and finish with wood or sponge float for a smooth surface.

a. Minimum application thickness: 1/8 inch

b. Maximum application thickness in a single lift: 1-1/2 inches

c. Where multiple lifts are required, score top surface of the preceding lift to produce a roughened surface. Allow preceding lift 30 minutes minimum to reach final set prior to applying the next lift.

D. Curing

1. Moist cure with wet burlap and polyethylene using a fine mist of water or water based compatible curing compound. Do not use curing compounds for curing between successive lifts. Do not use solvent-based curing compounds. Commence moist curing immediately after finishing. Protect newly applied material from direct sunlight, wind, rain, and frost.

3.04 FIELD QUALITY CONTROL

A. Provide in accordance with Division 01 General Requirements.

B. Manufacturer Field Services

1. Furnish the services of a qualified manufacturer's field representative prior to commencement of application to provide instruction, demonstrate proper application and inspection procedures, and to inspect the finish of the prepared surfaces prior to application.

3.05 CLEANING

A. Leave finished Work and Work area in a neat, clean condition without evidence of spillovers on adjacent areas.

3.06 CLOSEOUT ACTIVITIES

A. Provide in accordance with Division 01 General Requirements.

END OF SECTION

SECTION 03 11 00

CONCRETE FORMING

PART 1 – GENERAL

1.01 SUMMARY

A. The Work of this section comprises all materials, tools, equipment and labor required for the design, preparation and cleaning, construction, and removal of all concrete formwork, and the installation of all concrete embedments furnished under other sections, necessary for the proper completion of the Work in accordance with this Section and applicable reference standards listed in Article 1.03.

B. Related Requirements

1. Division 03, Section 03 30 20 CONCRETE PLACING, CURING AND FINISHING

2. Division 03, Section 04 20 00 UNIT MASONRY

1.02 PRICE AND PAYMENT PROCEDURES

A. Measurement and Payment requirements: per Division 01 General Requirements.

1.03 REFERENCES

A. Reference Standards

1. AMERICAN CONCRETE INSTITUTE INTERNATIONAL (ACI)

a. ACI 117 Specifications for Tolerances for Concrete Construction and Materials and Commentary

b. ACI 301 Specifications for Structural Concrete

c. ACI 347 Guide to Formwork for Concrete

2. ASTM INTERNATIONAL (ASTM)

a. ASTM C31 Standard Practice for Making and Curing Concrete Test Specimens in the Field

b. ASTM C39 Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

3. U.S. ARMY CORPS OF ENGINEERS (USACE)

a. COE CRD-C 572 Corps of Engineers Specifications for Polyvinylchloride Waterstops

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination, Sequencing, and Scheduling: per Division 01 General Requirements.

1.05 SUBMITTALS

A. Submit in accordance with Division 01 General Requirements.

B. Product Data

1. Form Ties

2. Form Release Agent

3. Waterstops, including details at all corners and intersections, which shall be factory formed

C. Manufacturer's Instructions

1. Form Ties

2. Waterstops

D. Closeout and Maintenance Material Submittals: per Division 01 General Requirements.

1.06 QUALITY ASSURANCE

A. Provide in accordance with Division 01 General Requirements.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Provide in accordance with Division 01 General Requirements.

1.08 SITE CONDITIONS

A. Existing Conditions: per Division 01 General Requirements.

PART 2 – PRODUCTS

2.01 MATERIALS

A. General

1. Formwork shall conform dimensionally to the concrete Work as shown on the Drawings. To minimize the number of panel joints, formwork panels shall be of the largest practicable sizes.

2. Undamaged smooth form facing materials such as plywood, hardboard, metal, and plastic, that will produce a smooth form finish, shall be used. Formwork shall not result in fins or offsets exceeding 1/8 inch. If used, aluminum forms with un-oxidized surfaces shall be pretreated with a paste made of calcium hydroxide and water, followed by water rinsing, repeated until hydrogen bubbles do not form.

B. Form Release Agent

1. Form release agent shall be non-grain raising, non-staining, and shall not leave a residue on the concrete nor adversely affect bonding of materials to be applied.

C. Form Ties

1. General Requirements

a. Form ties shall be adjustable length, sized to withstand construction loads, and upon removal shall prevent concrete spalling. Ties shall have break back indentation.

b. Plastic Cones: Form tie assembly with cone-shaped depressions at the concrete surfaces with break back ties. The protion of the tie remaining embedded in the concrete upon removal shall be equal to the depth of the cone specified.

c. Neoprene Washers: Flat washer sized to fit tightly on tie wire and positioned at the center of the tie wire.

d. Tie Systems that include plug style waterstops inserted into tie holes after removal of forms are not permitted.

2. Concrete tanks, Secondary Containment Structures, and Basement Walls

a. Plastic Cones: 1” diameter x 1-1/2 inches deep (Special Order)

b. Neoprene Washers: Required on all form ties

3. All other work:

a. Plastic Cones: 1” diameter x 1” deep (Standard)

b. Neoprene Washers: Not required, unless noted otherwise on drawings.

D. Hydrophilic Waterstops

1. Hydrophilic waterstops, where noted on the Drawings, shall be non-bentonite, expansive rubber strip: CJ-1020-2K by Sika Hydrotite, Swellseal Joint as manufactured by DeNeef Construction Chemicals, Inc., ConSeal CS-231 by Concrete Sealants, Inc., or approved equal.

2.02 SOURCE QUALITY CONTROL

A. Provide in accordance with Division 01 General Requirements.

PART 3 – EXECUTION

3.01 TECHNICAL REQUIREMENTS

A. The Contractor shall design, erect, shore, brace, and maintain formwork in accordance with ACI 301 to support all loads, including construction loads, until the concrete structure can support such loads.

3.02 CONSTRUCTION

A. Tolerances

1. Tolerances shall be in accordance with ACI 117.

B. Form Alignment

1. At locations where continuous surfaces are formed in successive units, forms shall be tightly fitted over the hardened concrete surface to obtain accurate surface alignment and to prevent leakage of mortar and the formation of fins, ridges, and other defects.

C. Chamfered Edges

1. All exposed concrete corners shall be formed with beveled strips to provide 3/4 inch chamfers, unless otherwise shown, specified, or directed by the Engineer.

2. Where concrete walls, columns, and beams abut masonry walls, the chamfer shall be omitted.

3. Where masonry walls are flush with the face of supporting concrete curbs, the chamfer shall be omitted.

4. Chamfering by grinding is prohibited.

D. Openings

1. Form openings in concrete where required for other Work. Upon failing to form such openings, provide them in a manner approved by the Engineer at no additional cost to the Owner.

2. Provide hydrophilic waterstop at the perimeter of such openings required to be watertight.

3. Except as otherwise specified, all such openings shall be filled with concrete after the Work to be installed therein is complete.

E. Cleanouts and Access Panels

1. Temporary openings shall be provided to facilitate cleaning and inspection prior to concrete placement, including at the bottom of wall forms. Cleanout openings are not permitted in exposed concrete, concrete exposed to view upon completion of the Work, whether or not it is painted, without the approval of the Engineer.

2. All refuse, sawdust, shavings, etc. shall be removed, and the forms broom cleaned before concrete placement.

F. Form Release Agent

1. Forms shall be coated with the approved form release agent before placement of reinforcing steel. Do not apply form release agent at locations of monolithic construction joints, which are construction joints with all the reinforcement continuous through the joint. Excess agent applied to the forms, and on the reinforcing steel and other surfaces requiring a concrete bond, shall be removed.

2. Forms for unexposed surfaces may be thoroughly wetted in lieu of the approved form release agent immediately before concrete is placed. However, form release agent shall be used in freezing weather.

G. Hydrophilic Waterstop

1. Hydrophilic waterstop shall be continuous, and installed in strict accordance with the manufacturer's instructions, in double rows with a space between, at each joint. Any extended contact with standing water, such as puddles, is not permitted.

3.03 INSTALLATION OF EMBEDDED ITEMS

A. General

1. Coordinate the setting of anchor bolts, thimbles, inserts, wall pipe, sleeves, and other embedded items. Before placing concrete, ensure that all items are accurately located and firmly secured against displacement.

2. All items shall be thoroughly cleaned and free of loose rust, mill scale, dirt, grease, etc. Wood used for removable keys shall be thoroughly dampened before concrete is placed against it.

B. Electrical Conduit

1. Electrical conduit may be embedded in concrete provided the following conditions are met:

   a. Outside diameter of conduit shall not exceed 1/3 of concrete thickness.

   b. Conduit shall not be placed closer than 3 diameters on center.

   c. Conduit shall not significantly impair the strength of the construction.

   d. Conduit shall not be embedded in structural concrete slabs less than 4 inches thick.

   e. Only 2 conduits may cross at any point. The sum of the outside diameter of the crossing conduits shall not exceed 1/3 of the concrete thickness.

   f. A 1-1/2 inch minimum concrete cover shall be provided for conduits in structural slabs.

   g. Conduit shall not be located between bottom of reinforcing steel and bottom of slab.

   h. Conduit is not permitted in beams, girders, and columns without the approval of the Engineer.

   i. Aluminum conduit shall not be embedded in concrete.

   j. Conduit shall be installed so that cutting, bending, or displacement of reinforcement from its proper location is not necessary.

2. Contractor shall notify Engineer of any embedded conduits not installed according the conditions specified herein a minimum of 24 hours prior to concrete placement. Noncompliant conduit placements shall be repositioned or removed to the satisfaction of the engineer and owner's representative.

3.04 REMOVAL

A. Form Removal

1. Form removal per ACI 347, as modified herein.

2. Forms shall be removed while ensuring the complete safety and serviceability of the structure. Forms or shoring for slabs, beams, and other suspended members shall not be removed until members are of sufficient strength to safely support their own weight and the weight thereon.

3. Newly unsupported portions of the structure shall not be subjected to heavy construction or material loading. Additional shores or re-shores shall be provided as required to adequately support the members during the construction period.

4. The Contractor shall be responsible for the proper removal of forms, shores, and bracing.

5. Spalling of concrete surfaces shall be prevented.

6. When forms are removed before the specified curing period (as specified in Section 03 30 20 CONCRETE PLACING, CURING AND FINISHING) is complete, measures shall be taken to continue curing and to continue providing thermal protection for the concrete.

7. Forms may be removed when the cumulative time during which the temperature of the air surrounding the concrete is above 50°F are as follows:

   a. Walls, columns, sides of beams and girders, and similar parts of the Work not supporting the weight of the concrete: 24 hours

   b. When design superimposed load is less than the self-weight

      1) Beam and Girder Soffits

         a) Clear span less than 10 feet: 7 days

         b) Clear span 10 feet to 20 feet: 14 days

         c) Clear span more than 20 feet: 21 days

      2) Slabs

         a) Clear span less than 10 feet: 4 days

         b) Clear span 10 feet to 20 feet: 7 days

c) Clear span more than 20 feet: 10 days

c. When design superimposed load is more than the self-weight

1) Beam and Girder Soffits

a) Clear span less than 10 feet: 4 days

b) Clear span 10 feet to 20 feet: 7 days

c) Clear span more than 20 feet: 14 days

2) Slabs

a) Clear span less than 10 feet: 3 days

b) Clear span 10 feet to 20 feet: 4 days

c) Clear span more than 20 feet: 7 days

d. Alternatively to the stripping times specified, additional concrete cylinders shall be made using representative concrete, witnessed and approved by the Engineer, and tested at no additional cost to the Owner. Such specimens shall be field cured in accordance with ASTM C31 under conditions that are not more favorable than the most unfavorable conditions for the portions of the concrete that the test specimens represent. The supporting forms and shores may be removed when the concrete strength as tested per ASTM C39 is a minimum of 70 percent of the specified design strength, as determined by the field-cured cylinders according to ACI 301.

B. Tie Holes

1. Filling of form tie holes and concrete finishing are specified in Section 03 30 20 CONCRETE PLACING, CURING AND FINISHING.

3.05 CLEANING AND REPAIR OF FORMS

A. Parts of forms reserved for reuse shall be inspected, cleaned, and repaired. Any parts dented, deformed, or otherwise rendered unfit for reuse shall be discarded.

3.06 FIELD QUALITY CONTROL

A. Provide in accordance with Division 01 General Requirements.

3.07 CLOSEOUT ACTIVITIES

A. Provide in accordance with Division 01 General Requirements.

END OF SECTION

SECTION 03 16 00

CONCRETE SPECIALTIES

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes

1. Provide all materials, tools, equipment, and labor necessary for the construction of concrete specialties as specified, as shown on the Drawings, and as necessary for the proper completion of the Work in accordance with this section and applicable reference standards listed in Article 1.03.

2. Epoxy adhesive for installing drilled and epoxy rebar is specified herein.

3. Post-installed expansion anchors and adhesive anchoring systems are specified in Section 05 50 00 METAL FABRICATIONS.

B. Related Requirements

1. Division 03, Section 03 30 00 CAST-IN-PLACE CONCRETE

2. Division 03, Section 03 30 20 CONCRETE PLACING, CURING AND FINISHING

3. Division 05, Section 05 50 00 METAL FABRICATIONS

1.02 PRICE AND PAYMENT PROCEDURES

A. Measurement and payment requirements: per Division 01 General Requirements.

1.03 REFERENCES

A. Reference Standards

1. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

a. ASTM A615 Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement

b. ASTM A1064 Standard Specification Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete

c. ASTM C1107 Standard Specification for Packed Dry, Hydraulic-Cement Grout (Non-shrink)

d. ASTM D4832 Preparation and Testing of Controlled Low Strength Material (CLSM) Test Cylinders

2. ICC EVALUATION SERVICE (ICC-ES)

a. ICC-ES AC308 Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete Elements

3. AMERICAN CONCRETE INSTITUTE (ACI)

a. ACI 355.2 Qualification of Post-Installed Mechanical Anchors in Concrete

b. ACI 355.4 Qualification of Post-Installed Adhesive Anchors in Concrete

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination, Sequencing, and Scheduling: per Division 01 General Requirements.

1.05 SUBMITTALS

A. Submit in accordance with Division 01 General Requirements.

B. Product Data

1. Non-Shrink Grout

2. Epoxy Adhesive (for drill and epoxy rebar)

a. ICC-ES report for manufacturer's specific product

b. Epoxy ultimate bond strength

c. Manufacture's chart for embedment to develop yield strength and tensile strength of ASTM A615, grade 60, rebar sizes #3 thru #11.

d. Storage requirements

e. Gel and cure times as a function of temperature

f. Installation temperature requirements for cartridges and base material

g. Drilling method (diamond drill bit shall be prohibited)

h. Drill bit diameter and depth of hole for rebar sizes

i. Hole cleaning procedure and required condition of hole

j. Requirements for discarding initial discharge to ensure proper mixing

k. Hole filling procedure

3. Time period when anchor cannot be contacted or otherwise disturbed

C. Design Data and Test Reports

1. Concrete for concrete fill and duct banks.

a. Submittals as required in Section 03 30 00 CAST-IN-PLACE CONCRETE.

2. Controlled Low Strength Material

a. Submittals as required in Section 03 30 00 CAST-IN-PLACE CONCRETE.

b. Both 28-day and 90-day compressive strength test results.

D. Shop Drawings

1. Reinforcement

E. Closeout and Maintenance Material Submittals: per Division 01 General Requirements.

1.06 QUALITY ASSURANCE

A. Provide in accordance with Division 01 General Requirements.

B. Qualifications: per Division 01 General Requirements for anchor installation and as follows.

1. Anchors shall be installed by qualified personnel trained to install adhesive anchors.

2. Adhesive anchors shall be installed in strict accordance with the Manufacturer's Printed Installation Instructions (MPII).

3. Each installer shall have the MPII in their possession at all times.

C. Epoxy Adhesive Installation Contractor Requirements

1. In structures assigned to Seismic Design Category C, D, E, or F as noted on the Drawings: qualified for earthquake loading (use in cracked concrete) in accordance with ACI 355.4.

2. Anchors installed horizontally or upwardly inclined: qualified in accordance with ACI 355.4 requirements for sensitivity to installation direction.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Provide in accordance with Division 01 General Requirements.

1.08 SITE CONDITIONS

A. Existing Conditions: per Division 01 General Requirements.

PART 2 – PRODUCTS

2.01 GROUT

A. Grout shall be non-metallic, cementitious non-shrink grout meeting ASTM C1107, grade C. Grout shall be Five Star Grout by U.S. Grout Company, Crystex or Premier by L&M Construction Chemicals, Inc., Sure-Grip High Performance Grout, by Dayton Superior, or approved equal.

2.02 CONCRETE FILLS

A. Concrete shall be as specified in Section 03 30 00 CAST-IN-PLACE CONCRETE, except it shall have a 28-day design compressive strength of 4,000 pounds per square inch, and a maximum water-to-cementitious ratio of 0.45.

B. Concrete fills of minimum thickness less than 2-1/4 inches, and those screeded into place by process equipment, shall have a 1/2 inch maximum size aggregate.

2.03 DUCTBANKS

A. All underground electrical duct banks shall be concrete encased. Concrete shall be as specified in Section 03 30 00 CAST-IN-PLACE CONCRETE, except it shall have a 3/8 inch maximum aggregate size and a minimum 28-day compressive strength of 3,000 pounds per square inch.

B. Duct banks shall be reinforced as detailed where crossing under roads, driveways, parking areas, all areas subject to vehicular traffic, and whereas shown or specified in the Contract Documents. Reinforcement shall extend a minimum of 4 feet beyond the specified areas.

C. Coordinate red shake-on red pigmented dye, acid stains, or integral coloring as required.

2.04 CONTROLLED LOW STRENGTH MATERIAL

A. A rigid-setting mixture of portland cement, sand, and water shall not require vibration during placement, flow without noticeable segregation, self-consolidate, and be excavatable with hand tools.

B. Sand gradation (U.S. Standard Sieve/Percent Passing)

1. 3/8-inch/100

2. No. 4/95-100

3. No. 16/45-80

4. No. 50/10-30

5. No. 100/2-10

6. No. 200/0-3

C. Cement, water, and chemical admixtures shall meet the requirements of Section 03 30 00 CAST-IN-PLACE CONCRETE.

D. The 28-day and 90-day compressive strengths, measured in accordance with ASTM D4832, shall be between 30-80 psi and less than 100 psi, respectively.

2.05 EPOXY ADHESIVE

A. Epoxy adhesive for installation of post-installed reinforcing bars denoted as “Drill and Epoxy” or “Drill & Epoxy” on drawings.

B. Evaluation Requirements: ICC-ES evaluation report stating product is compliant with 2015 International Buildng Code and approved for use to resist static, wind and earthquake (Seismic Design Categories A through F) tension and shear loads in cracked and uncracked normal-weight concrete having a compressive strength of 2,500 psi to 8,500 psi. Evaluation reports with a listed renewal date month/year which is prior to the month/year the product is submitted for engineer’s review will be rejected.

C. Epoxy adhesive for anchoring reinforcement to concrete shall be a 2-component solid epoxy based system supplied in manufacturer's standard side-by-side cartridge and dispensed through manufacturer's standard static-mixing nozzle. Epoxy adhesive shall be:

1. Simpson Strong Tie: SET-XP or ET-HP

   a. SET-XP Compliance Report (ESR-2508)

   b. ET-HP Compliance Report (ESR-3372)

2. Hilit: HIT-RE 500-SD

   a. Compliance Report (ESR-2322)

3. Approved equal based

   a. Compliance Report to be submitted

D. Epoxy adhesive shall pass the creep test requirements of ICC-ES AC58.

E. The embedment depth shall be per the manufacturer's requirements and the ultimate strength exceeds the tensile strength of the bar, and the ultimate strength divided by

a minimum factor of safety of 3.75 is at least 40 percent of the yield strength of the bar.

2.06 SOURCE QUALITY CONTROL

A. Provide in accordance with Division 01 General Requirements.

PART 3 – EXECUTION

3.01 EQUIPMENT PADS

A. New concrete surfaces upon which equipment pads are to be built shall receive a scratched finish in accordance with Section 03 30 20 CONCRETE PLACING, CURING AND FINISHING.

B. All laitance shall be removed and the surface shall be saturated with water for a minimum of 6 hours. Excess water shall then be removed and the epoxy bonding compound applied as specified in Section 03 30 20 CONCRETE PLACING, CURING AND FINISHING.

C. All equipment pads shall be sized to suit the approved equipment, and reinforcement shall be as shown on the Drawings.

D. The top surface shall be level within 1/8-inch. All exposed faces shall be formed with smooth forms and shall be smooth and free of sands streaks, bug holes, and honeycomb. All exposed surfaces shall have a smooth, even surface with all exterior corners chamfered. Exposed faces of pads shall receive a sack-rubbed finish as specified in Section 03 30 20 CONCRETE PLACING, CURING AND FINISHING.

E. All anchor bolts, dowels, sleeves, and other fittings required for the equipment shall be built in.

3.02 GROUTING

A. Grouting is required for structural, mechanical, and electrical items, and shall be in accordance with the manufacturer's recommendations.

B. Concrete surfaces to receive grout shall be cleaned of all contamination and debris. Surface roughening shall be required if laitance or poor concrete is evident.

C. Grout placement shall be rapid and continuous such that grout completely fills the space to be grouted, absent of air pockets.

D. Grout may be placed by gravity or pumped. When practical, grout shall be placed from one side and made to flow to the open side to prevent the formation of air pockets.

3.03 CONCRETE FILLS

A. New unformed concrete surfaces upon which concrete fills are to be placed shall receive a rough broom scratched, rough screed, or rough wood float finish in accordance with Section 03 30 20 CONCRETE PLACING, CURING AND FINISHING. However, where concrete fills are to be screeded into place by process equipment, the concrete surface shall receive a scratched finish in accordance with Section 03 30 20 CONCRETE PLACING, CURING AND FINISHING.

B. All laitance shall be removed and the surface shall be saturated with water for a minimum of 6 hours. Excess water shall then be removed and the epoxy-bonding compound applied as specified in Section 03 30 20 CONCRETE PLACING, CURING AND FINISHING. However, where concrete fills are to be screeded into place by process equipment, it shall be permitted to scrub in a stiff cement slurry immediately prior to placing concrete fill, in lieu of epoxy bonding compound.

3.04 EXISTING CONCRETE

A. Where equipment pads are to be constructed, grouting is to be performed, and concrete fills are to be placed against existing concrete, the following surface preparation shall be required.

1. The existing concrete surface shall be cleaned of all contamination and debris, and roughened by steel shot blasting, abrasive sand blasting, or water jetting. Use of scabblers, scarifiers, bush hammers, and pneumatic hammers is not permitted.

2. The existing concrete surface shall be water-saturated for a minimum of 6 hours, after which the excess water shall be removed immediately prior to placement of new concrete or grout.

3. In areas where equipment pads are to be constructed and concrete fills are to be placed, apply epoxy-bonding compound (as specified in Section 03 30 20 CONCRETE PLACING, CURING AND FINISHING) to prepared concrete surface prior to concrete placement.

3.05 DUCTBANKS

A. There shall be a minimum of 4 inches of concrete between the outside of a duct and surrounding soil. There shall be not less than 3 inches of concrete between adjacent ducts.

B. All ductbank concrete placements shall be continuous between manholes and handholes, and between manholes, handholes, and structures.

C. Where ducts pass through a foundation wall, the concrete encasement shall extend through the wall and be flush with inside face per the details on the Drawings. Watertight construction joints shall be provided.

3.06 EPOXY ADHESIVE

A. Installation: Per manufacturer's installation instructions and as listed in the product ICC-ES Evaluation Report.

B. Drilled and epoxied rebar shall be installed in concrete having a minimum age of 21 days at time of installation.

C. All cartridges shall have the expiration date clearly visible. Material past its expiration date shall not be used, and shall be immediately removed from the Site.

D. Diamond drill bits are not permitted. Hammer drills shall be used. Hole diameter size per manufacturer's installation instructions.

E. The initial material extruded from each cartridge shall be discarded in accordance with the manufacturer's instructions to ensure that all material is properly mixed.

F. Depth stop shall be used to ensure correct drilling depth. Drilled holes shall be blown out with air, thoroughly wire brushed with a repeated back and forth movement, blown out, thoroughly wire brushed, and blown out again. Adhesive shall be injected, starting from the bottom of the hole and slowly withdrawn as filling progresses to prevent air pockets.

G. Rebar shall remain completely undisturbed between the manufacturer's specified gel time and the full cure time. Zero load shall be applied during this time.

3.07 FIELD QUALITY CONTROL

A. Provide in accordance with Division 01 General Requirements.

B. Manufacturer's Field Services

1. Epoxy Adhesive

a. Except where specified to be performed by personnel certified by an applicable program such as the ACI/CRSI Adhesive Anchor Installer Certification program or equivalent, as approved by the Engineer, the Contractor shall furnish the services of a competent manufacturer's field representative who shall be present at the Work Site prior to beginning installation in order to instruct the Contractor and the Engineer on proper installation and inspection procedures. Such instruction shall include a full and complete demonstration.

b. Installation of anchors horizontally or upwardly inclined to resist sustained tension loads shall be continuously inspected by the Engineer's special inspector approved for that purpose. The special inspector shall furnish a report to the Engineer that the Work covered by the report has been performed and that the materials and

installation procedures conform to the Contract Documents and the Manufacturer's Printed Installation Instructions (MPII).

c. Proof loading: performed where required per ACI 355.4.

3.08 CLOSEOUT ACTIVITIES

A. Provide in accordance with Division 01 General Requirements.

END OF SECTION

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SECTION 03 20 00

CONCRETE REINFORCING

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes

1. Provide all materials, tools, equipment, and labor necessary for the fabrication and installation of all reinforcement (except installation only of reinforcement for masonry construction which is included in Section 04 20 00 UNIT MASONRY) as shown on the Drawings, as specified, and as necessary for the proper completion of the Work in accordance with this Section and applicable reference standards listed in Article 1.03.

B. Related Requirements

1. Division 04, 04 20 00 UNIT MASONRY

1.02 PRICE AND PAYMENT PROCEDURES

A. Measurement and payment requirements: per Division 01 General Requirements.

1.03 REFERENCES

A. Reference Standards

1. AMERICAN CONCRETE INSTITUTE (ACI)

   a. ACI 117 Specifications for Tolerances for Concrete Construction and Materials and Commentary

   b. ACI SP-66 ACI Detailing Manual

2. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

   a. ASTM A615 Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement

3. AMERICAN WELDING SOCIETY (AWS)

   a. AWS D1.4 Structural Welding Code – Reinforcing Steel

4. CONCRETE REINFORCING STEEL INSTITUTE (CRSI)

   a. CRSI 10MSP Manual of Standard Practice

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination, Sequencing, and Scheduling: per Division 01 General Requirements.

1.05 SUBMITTALS

A. Submit in accordance with Division 01 General Requirements.

B. Product Data

1. Certified mill reports, including chemical and physical analyses

2. Dowel bar splicers and dowel inserts

C. Shop Drawings

1. Reinforcement Drawings: Comply with ACI SP-66, and include the following information:

a. Sizes, dimensions, and locations for reinforcement and supports

b. Bending diagrams and schedules

c. Splices

d. Cover and clearances

e. Class designation and details of bar supports

f. Pertinent reinforced concrete details with dimensions and elevations

g. Items furnished by other trades or under other sections of the Specification that are to be cast in concrete where interference with reinforcement may occur.

h. Reinforcement shall be shown on wall elevations with required sections, on beam elevations with required sections, on plan views of slabs with required sections. Provide plan details where walls intersect.

D. Closeout and Maintenance Material Submittals: per Division 01 General Requirements.

1.06 QUALITY ASSURANCE

A. Provide in accordance with Division 01 General Requirements.

B. Fabricate reinforcement in accordance with ACI 117.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Provide in accordance with Division 01 General Requirements.

B. Deliver reinforcement in bundles with tags indicating size, length, and identification mark.

C. Store materials off the ground to prevent soiling and to facilitate subsequent inspection and handling.

1.08 SITE CONDITIONS

A. Existing Conditions: .per Division 01 General Requirements.

PART 2 – PRODUCTS

2.01 STEEL REINFORCEMENT

A. General: Steel reinforcement shall include all bars, anchorages, stirrups, dowels, ties, tie-wire, chairs and other steel supports, and spacers as noted on the Drawings, specified, and as required for the proper completion of the Work.

B. Materials

1. Reinforcement bars shall be formed from new billet steel conforming to ASTM A615, Grade 60 except as otherwise specified.

C. Tie Wire

1. 16-gauge minimum

2. FS QQ-W-461 annealed black, except for architectural concrete

D. Bar Supports

1. Chairs, bolsters, spacers and other supports to properly position reinforcement shall conform to the bar support recommendations of CRSI 10MSP, and shall be of adequate strength and design to prevent displacement of reinforcement and discoloration of concrete.

2. Supports shall be Class 1 - plastic protected

3. Supports for bottom reinforcement of slabs on soil shall be chairs with integral plates, or precast concrete blocks not less than 4-inches square with a compressive strength equal to that of the surrounding concrete. Precast blocks may only be used to support reinforcement not more than 3-inches from the bottom of the slab.

E. Fabrication

1. Steel reinforcement shall be fabricated to the sizes, shapes and dimensions shown on the Drawings, details and schedules. All bending shall be in accordance with CRSI 10MSP. All steel shall be bent cold and shall not be bent or straightened in a manner that will injure the metal. Bars with kinks or bends not so detailed shall not be used.

2. Bends for stirrups and ties shall be made around a pin having a diameter not less than 4 times the diameter of the bar. Bends for other bars shall be made around a pin having a diameter not less than 6 times the diameter of the bar, except for bars larger than 1-inch, the pin shall be not less than 8 times the diameter of the bar.

F. Dowel Bar Splicers and Dowel Inserts (DBS/DI)

1. Dowel bar splicers shall be a 2-component threaded rebar splice system. The internally threaded component shall be forged from Grade 60 deformed rebar material free of external machining or welding. It shall contain an integral flange with nailing holes and be threaded with Unified National Coarse (UNC) or UN (unified) threads to a depth equal to the nominal diameter of the threads plus 1/4 inch. The externally threaded splice component shall be fabricated from Grade 60 deformed rebar material and supplied with rolled threads corresponding with the internally threaded component. The root diameter of the threads shall provide a minimum cross sectional area equal to the cross sectional area of the nominal bar size. Manufacturer testing shall indicate ultimate tension failure occurring in the nominal bar diameter, not at the mechanical splice.

2.02 SOURCE QUALITY CONTROL

A. Provide in accordance with Division 01 General Requirements.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Reinforcement

1. Tolerances shall conform to ACI 117.

2. Placement

a. Reinforcement shall be accurately positioned both horizontally and vertically, and shall be properly secured and sufficiently rigid to prevent displacement during concrete placement.

b. Reinforcement shall be securely tied at intersections with tie wire or clips in a manner that will keep all metal away from exposed concrete surfaces.

3. Splices

a. Reinforcement splices shall be as shown on the Drawings. Where not shown, splices shall be located away from areas of maximum stress, and shall be approved by the Engineer.

b. Welding shall only be permitted by written approval of the Engineer, and shall be in accordance with AWS D1.4.

4. All reinforcement within an area of a continuous concrete placement shall be installed, supported, and secured before beginning the concrete placement.

5. Reinforcement Adjustment

a. Adjust to within allowable tolerances to avoid interference with other reinforcement, conduits, or embedded items.

b. Reinforcement shall not be moved beyond allowable tolerances without the Engineer's approval.

c. Reinforcement shall not be heated, bent or cut without approval Engineer's approval.

B. All reinforcement shall be entirely free from flaking rust, loose mill scale, grease, dirt, etc. that might reduce its bond with the concrete.

C. Concrete cover for reinforcement shall conform to the dimensions shown on the Drawings.

D. Notify the Engineer at least 24 hours before placing concrete. All reinforcement within the area of 1 day's concrete placement shall be tied in place and observed by the Engineer or Owner’s representative, prior to commencing concrete placement.

3.02 FIELD QUALITY CONTROL

A. Provide in accordance with Division 01 General Requirements.

3.03 CLOSEOUT ACTIVITIES

A. Provide in accordance with Division 01 General Requirements.

END OF SECTION

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SECTION 03 30 00

CAST-IN-PLACE CONCRETE

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes

1. Provide cast-in-place concrete in accordance with this Section and applicable reference standards listed in Article 1.03.

B. ACI 301 is hereby made a part of this Specification, except as otherwise modified by the Contract Documents.

C. Related Requirements

1. Division 03, Section 03 16 00 CONCRETE SPECIALITIES

2. Division 03, Section 03 30 20 CONCRETE PLACING, CURING AND FINISHING

1.02 PRICE AND PAYMENT PROCEDURES

A. Measurement and payment requirements: per Division 01 General Requirements.

1.03 REFERENCES

A. Reference Standards

1. AMERICAN CONCRETE INSTITUTE INTERNATIONAL (ACI)

a. ACI 117 Specifications for Tolerances for Concrete Construction and Materials and Commentary

b. ACI 301 Specifications for Structural Concrete

2. ASTM INTERNATIONAL (ASTM)

a. ASTM C31 Standard Practice for Making and Curing Concrete Test Specimens in the Field

b. ASTM C33 Standard Specification for Concrete Aggregates

c. ASTM C40 Standard Test Method for Organic Impurities in Fine Aggregates for Concrete

d. ASTM C88 Standard Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate

e. ASTM C94 Standard Specification for Ready-Mixed Concrete

f. ASTM C131 Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine

g. ASTM C143 Standard Test Method for Slump of Hydraulic-Cement Concrete

h. ASTM C150 Standard Specification for Portland Cement

i. ASTM C173 Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method

j. ASTM C231 Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method

k. ASTM C260 Standard Specification for Air-Entraining Admixtures for Concrete

l. ASTM C494 Standard Specification for Chemical Admixtures for Concrete

m. ASTM C535 Standard Test Method for Resistance to Degradation of Large-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine

n. ASTM C595 Standard Specification for Blended Hydraulic Cements

o. ASTM C618 Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete

p. ASTM C989 Standard Specification for Slag Cement for Use in Concrete and Mortars

q. ASTM C1116 Standard Specification for Fiber-Reinforced Concrete

r. ASTM C1157 Standard Specification for Hydraulic Cement

s. ASTM C1260 Standard Test Method for Potential Alkali Reactivity of Aggregates (Mortar-Bar Method)

t. ASTM C1293 Standard Test Method for Determination of Length Change of Concrete Due to Alkali-Silica Reaction

u. ASTM C1567 Standard Test Method for Potential Alkali-Silica Reactivity of Combinations of Cementitious Materials and Aggregate (Accelerated Mortar-Bar Method)

v. ASTM C1602 Standard Specification for Mixing Water Used in Production of Hydraulic Cement Concrete

w. ASTM E329 Standard Specification for Agencies Engaged in the Testing and/or Inspection of Materials Used in Construction

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination, Sequencing, and Scheduling: per Division 01 General Requirements.

1.05 SUBMITTALS

A. Submit in accordance with the Division 01 General Requirements.

1. Test Reports

   a. Provide reports by testing agencies meeting ASTM E329.

2. Design Data for Each Concrete Mixture

   a. Submit at minimum 14 days before initial placement of concrete.

   b. Proportions for all ingredients, 28-day design compressive strength, water to cementitious materials ratio, admixture dosages, slump, and air content.

   c. Test data supporting proportions based upon laboratory trial batches or field test records per ACI 301 Section 4, Concrete Mixtures.

      1) Field test data used to determine the standard deviation used for establishing the required average design strength shall be from within the previous 12 months, per ACI 301.

      2) Field test data documenting that the proposed concrete proportions will produce an average compressive strength equal to or greater than the required average compressive strength shall be from within the 12 months.

      3) Laboratory trial batch data shall be from within the previous 24 months.

3. Cement: Certified mill reports, not older than 90 days.

4. Supplementary cementitious materials: Source and test reports for actual material to be used in the Work, not older than 90 days.

   a. Fly ash

   b. Ground granulated blast-furnace slag

5. Aggregate

   a. Data not older than 90 days, except test data for soundness, abrasion, and alkali reactivity - not older than 1 year.

b. Fine and coarse aggregate data, except as noted

1) Sources

2) Specific gravity

3) Sieve analyses per ASTM C33 (including fineness modulus of fine aggregate)

4) Organic impurities for fine aggregate per ASTM C40

5) Potential alkali reactivity (not required if a cement containing less than 0.60 percent alkalis is used, per ASTM C33) per ASTM C1260, ASTM C1293, or ASTM C1567

6) Soundness per ASTM C88

7) Abrasion for coarse aggregate per ASTM C131 and ASTM C535

6. Product Data and Instructions

a. Admixtures

7. Certificates

a. Plant certification: Concrete plant certified by the National Ready Mixed Concrete Association.

8. Sample Batch Ticket

a. Sample blank batch ticket from concrete batch plant

B. Closeout and Maintenance Material Submittals: per Division 01 General Requirements.

1.06 QUALITY ASSURANCE

A. Provide in accordance with Division 01 General Requirements.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Provide in accordance with Division 01 General Requirements.

PART 2 – PRODUCTS

2.01 SOURCE

A. Provide concrete supplied from a single commercial ready-mix plant, mixed and delivered in accordance with the requirements of ASTM C94.

2.02 CONCRETE MATERIALS

A. Concrete mixture design

1. Per ACI 301, Section 4, Concrete Mixtures.

2. 28-day design compressive strength: 4,500 pounds per square inch, except as otherwise specified.

3. Water to cementitious materials ratio: Not to exceed 0.42 except as otherwise specified.

4. Provide designs of required strength, water to cementitious materials ratio, slump, and workability for placing conditions and specified finishes without segregation.

5. Slump

a. Per ASTM C143.

b. Specified Slump Range:

1) 3-inches to 5-inches

c. Specified Slump Range (mixes with mid-range water reducer)

1) 2-inches to 4-inches, before admixture is added

2) Maximum 6-inches, after admixture is added

d. Specified Slump range (mixes with high-range water reducer)

1) 2-inches to 4-inches, before admixture is added

2) Maximum 8-inches, after admixture is added

B. Cement: per ASTM C150, Type II or ASTM C595 IP(MS), IS(<70)(MS). Do not use ASTM C595 cements that contain ASTM C1157 cement.

C. Supplementary cementitious materials

1. Fly ash (optional)

a. ASTM C618, Class F

b. Maximum loss of ignition: 3.0 percent

c. Not less than 15 percent or more than 25 percent of weight of cement plus fly ash

2. Ground-granulated blast furnace (GGBF) slag (optional)

a. ASTM C989

b. Activity classification: Grade 100 or 120

c. Not less than 25 percent or more than 50 percent of weight of cementitious material

3. Fly ash plus GGBF slag

a. Maximum 50 percent of total cementitious materials

b. Fly ash portion maximum 25 percent of total cementitious materials

c. Minimum portland cement: 337 pounds per cubic yard of concrete

D. Aggregate

1. Meet ASTM C33, as amended herein. Evidence of a satisfactory service record in lieu of testing for alkali reactivity is not permitted.

2. Do not use crushed hydraulic cement concrete for aggregate.

3. Aggregate reactivity testing: per ASTM C1260. Do not use aggregate having a 14 day expansion greater than 0.10 percent (considered potentially reactive), except if tested per ASTM C1567, the 14 day expansion is not greater than 0.10 percent, or if tested per ASTM C1293, the 2-year expansion is not greater than 0.04 percent, or if cement containing less than 0.60 percent alkalis is used per ASTM C33.

4. Fine aggregates: Sand or screenings of gravel or crushed stone, well graded from fine to coarse; clean and free from soft particles, clay, loam and organic matter, with the volume removed by sedimentation not more than 3 percent.

a. Organic impurities testing: per ASTM C40. Color of the supernatant liquid above the test Sample, not darker than organic plate No. 3.

b. Grading

U.S. Standard Sieve	Percent Passing
Size 3/8 inch	100
No. 4	95 - 100
No. 8	80 - 100
No. 16	50 - 85
No. 30	25 - 60
No. 50	5 -30
No. 100	0-10

c. Not more than 45 percent retained between any 2 consecutive sieves listed above. Fineness modulus, not less than 2.3 nor more than 3.1.

5. Coarse Aggregates: Crushed stone or washed gravel of clean, hard, durable, uncoated particles, free from dust, dirt, or other deleterious substances, and free from thin, flat, or elongated particles.

a. Nominal maximum aggregate size for slabs poured on ground, at least 15 inches thick, except where clear spacing between reinforcing bars is less than 2 inches: 1-1/2 inches.

b. Nominal maximum aggregate size at all other locations, except as specified otherwise or approved: 3/4 inch.

c. Nominal maximum aggregate sizes per grading in Table 2 of ASTM C33: No. 467 (1-1/2 inches), No. 57 (1 inch), No. 67 (3/4 inch), No. 7 (1/2 inch), and No. 8 (3/8 inch).

E. Admixtures

1. Air-entraining admixture

a. Per ASTM C260 and chloride free

b. Provide air entrainment, except as noted below, per manufacturer's directions and this Specification to produce the following total entrained air content determined per the procedure in ASTM C173 or ASTM C231.

Nominal Maximum Size Coarse Aggregate (inches)	Air Content By Volume (percent plus or minus 1.5)
3/8	7.5
1/2	7.0
3/4	6.0
1	6.0
1-1/2	5.5

c. Maximum air content for interior concrete slabs to be hard-troweled: 3.0 percent.

2. Mid-range water reducing agents: per ASTM C494, Type A, and with consideration of the air entraining effect of the water reducing agent.

3. Water reducing-retarding agents: For use when ambient temperature above 70°F, replace water reducing agent in whole or part with water reducing-

retarding agent meeting ASTM C494, Type D. Use amounts to produce concrete with set time equal to that at 70°F without the retarder.

4. Set accelerator: Non-chloride type conforming to ASTM C494, Type C or E where allowed under Section 03 30 20 CONCRETE PLACING, CURING AND FINISHING.

5. High-range water reducing agent: ASTM C494, Type F or G (added in plant or field).

F. Water

1. Meet ASTM C1602.

2. Fresh and free from oil, acid, salt, alkali, sewage, organic matter, and other deleterious substances.

3. The amount of water carried on the aggregate and the effect of admixtures is included in the water content. Provide that water carried on the aggregate is determined periodically by test and the amount of free water on the aggregate subtracted from water added to the mixture.

4. Residual, wash, or other water in drums: Completely discharged prior to concrete batching (drums backed out).

5. Maximum amount of water required to produce a plastic mixture of the strength and water to cementitious materials ratio specified and the required density, uniformity and workability. Consistency of mixture required for the specific placing conditions and methods.

6. Slump adjustment: Not made at wash down, slump rack, or by any other means prior to arrival at point of delivery at the Site.

7. Water added after arrival at Site: Accurately metered and recorded on the batch ticket.

2.03 SOURCE QUALITY CONTROL

A. Provide in accordance with Division 01 General Requirements.

PART 3 – EXECUTION

3.01 FIELD QUALITY CONTROL

A. Provide in accordance with Division 01 General Requirements.

B. Advise testing laboratory and field observers minimum 24 hours in advance of placing concrete to allow for scheduling observation and testing.

C. Assist testing laboratory and Engineer in obtaining and handling Samples at the Site and other sources of material.

D. Provide space and electrical power at the Site for facilities to be provided by Owner's testing agency for proper initial curing and storage of concrete test cylinders to be lab-cured as required by ASTM C31 for 48 hours after casting. For cylinders to be field-cured: per Section 03 30 20 CONCRETE PLACING, CURING AND FINISHING.

E. Owners' testing agency to store cylinders to be lab-cured at 60°F to 80°F in an environment preventing moisture loss from the specimens such as storage in wooden boxes, and placement in damp sand pits. Shield specimens from direct sunlight and radiant heating devices. Control storage temperature by use of heating and cooling devices as necessary and record temperature with a maximum-minimum thermometer.

3.02 CLOSEOUT ACTIVITIES

A. Provide in accordance with Division 01 General Requirements.

END OF SECTION

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SECTION 03 30 20

CONCRETE PLACING, CURING, AND FINISHING

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes

1. Provide placing, curing and finishing of cast-in-place concrete accordance with this Section and applicable reference standards listed in Article 1.03.

2. Concrete sampling and field testing by an independent technician certified in accordance with the requirements of ACI Concrete Field Testing Technician – Grade 1 certification program, or the requirements of ASTM C1077. Paid for by Owner.

3. Laboratory testing of concrete cylinders by an independent, accredited and certified testing laboratory. Paid for by Owner.

4. Tightness testing of concrete tanks in accordance with ACI 350.1 and concrete tank leak repairs. Contractor is responsible for all costs associated with testing and completing all repairs to successfully pass the testing requirements of ACI 350.1. Contractor's construction schedule shall account for sufficient time to perform testing and leak repairs prior to backfilling concrete tanks.

B. Related Requirements

1. Division 03, Section 03 11 00 CONCRETE FORMING

2. Division 03, Section 03 16 00 CONCRETE SPECIALITIES

3. Division 03, Section 03 30 00 CAST-IN-PLACE CONCRETE

4. Division 03, Section 03 63 00 INJECTION GROUTING

5. Division 07, Section 07 19 00 WATER REPELLENTS

1.02 PRICE AND PAYMENT PROCEDURES

A. Measurement and payment requirements: per Division 01 General Requirements.

1.03 REFERENCES

A. Reference Standards

1. AMERICAN CONCRETE INSTITUTE INTERNATIONAL (ACI)

   a. ACI 117 Specifications for Tolerances for Concrete Construction and Materials and Commentary

   b. ACI 301 Specifications for Structural Concrete

   c. ACI 306.1 Standard Specification for Cold Weather Concreting

   d. ACI 308.1 Standard Specification for Curing Concrete

   e. ACI 350.1 Specification for Tightness Testing of Environmental Engineering Concrete Containment Structures

   f. ACI 306R Cold Weather Concreting

2. ASTM INTERNATIONAL (ASTM)

   a. ASTM C31 Standard Practice for Making and Curing Concrete Test Specimens in the Field

   b. ASTM C39 Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

   c. ASTM C42 Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete

   d. ASTM C143 Standard Test Method for Slump of Hydraulic-Cement Concrete

   e. ASTM C144 Standard Specification for Aggregate for Masonry Mortar

   f. ASTM C171 Standard Specification for Sheet Materials for Curing Concrete

   g. ASTM C172 Standard Practice for Sampling Freshly Mixed Concrete

   h. ASTM C173 Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method

   i. ASTM C231 Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method

   j. ASTM C309 Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete

   k. ASTM C404 Standard Specification for Aggregates for Masonry Grout

   l. ASTM C578 Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation

m. ASTM C881 Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete

n. ASTM C920 Standard Specification for Elastomeric Joint Sealants

o. ASTM C1064 Standard Test Method for Temperature of Freshly Mixed Hydraulic-Cement Concrete

p. ASTM C1077 Standard Practice for Agencies Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Testing Agency Evaluation.

q. ASTM C1315 Standard Specification for Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete

r. ASTM D1751 Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)

s. ASTM D1752 Standard Specification for Preformed Sponge Rubber Cork and Recycled PVC Expansion

t. ASTM E96 Standard Test Methods for Water Vapor Transmission of Materials

u. ASTM D2240 Standard Test Method for Rubber Property - Durometer Hardness

v. ASTM E1155 Standard Test Method for Determining Floor Flatness and Floor Levelness Numbers

w. ASTM E1745 Standard Specification for Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs

B. Definitions

1. Construction joint refers to a monolithic construction joint in which the surface between successive placements is prepared to enhance bond and shear transfer and reinforcement is continuous.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination, Sequencing, and Scheduling: per Division 01 General Requirements.

1.05 SUBMITTALS

A. Submit in accordance with Division 01 General Requirements.

B. Product Data and Manufacturer’s Instructions

1. Delivery Tickets

a. Provide duplicate delivery tickets at time of delivery for each truckload of concrete delivered

b. Serial number of ticket

c. Date and Project location

d. Name and location of ready mixed concrete plant

e. Truck number, time loaded, cubic yardage delivered

f. Dispatcher's name

g. Mixture design, cement type, and admixtures with brand names

h. Types and quantities of cement, fly ash and/or slag (if included in approved mix design) and admixtures. Quantities of water and fine and coarse aggregate including moisture content, and nominal maximum aggregate size

i. Water added subsequent to plant batching, if any. (Only applicable if total water per mixture design is not added at plant. Addition of water such that the water content of the approved mixture design is exceeded will be strictly prohibited.)

j. Concrete temperature upon delivery

k. Unloading time and location

2. Curing Paper

3. Epoxy Bonding Compound

4. Cure and Seal Compound

5. Curing Compound

6. Preformed Joint Filler

C. Source and Field Quality Control Submittals

1. Methods to be used to protect concrete placed during cold weather. The Engineer's review shall not constitute approval as the Contractor shall be responsible for the protection of concrete placed during cold weather.

2. Methods to be used to protect concrete placed during hot weather. The Engineer's review shall not constitute approval as the Contractor shall be responsible for the protection of concrete placed during hot weather.

D. Closeout and Maintenance Material Submittals: per Division 01 General Requirements.

1.06 QUALITY ASSURANCE

A. Provide in accordance with Division 01 General Requirements.

B. Concrete sampling and testing per Article 3.10.

C. Tightness Test Concrete Tanks per Article 3.11.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Provide in accordance with Division 01 General Requirements.

B. Protection

1. Provisions shall be made for maintaining new concrete in a continuously moist condition for at least seven days after placement

2. Fresh concrete shall be protected from freezing, premature drying, flowing water, and mechanical injury

3. Concrete shall not be placed while rain, sleet, or snow is falling unless acceptable protection is provided. Precipitation shall not be allowed to enter into the concrete mix or damage concrete surfaces

1.08 SITE CONDITIONS

A. Existing Conditions: per Division 01 General Requirements.

PART 2 – PRODUCTS

2.01 PREFORMED JOINT FILLER

A. Preformed joint filler: Conform to ASTM D4819, closed cell polyethylene foam isolation joint material, 1/2” thick unless noted otherwise on drawings. Joint filler shall be X-Tech by C2 Products, Inc., or approved equal.

2.02 CURE AND SEAL COMPOUND

A. Water Based Cure and Seal Compound: Conform to ASTM C309, Type 1, and ASTM C1315, Type 1 with minimum 25 percent solids, non-yellowing, non-staining, and UV light resistant.

1. MasterKure CC 1315WB, by Master Builders; Vocomp-25, by W.R. Meadows; Dress & Seal WB 25, by L&M Construction Chemicals, Inc.; or approved equal shall be provided.

2. Approved Use: Water based products are preferred and approved for application to surfaces with a surface temperature above 50F for interior or exterior surfaces.

3. Limitations: Not permitted for Cold weather application to surfaces temperatures less than 50F. Not permitted for surfaces to receive additional concrete fills, chemical hardeners, sealers, waterproofing, and architectural finishes such as concrete stain, paints and coatings, tile, carpet, and floor covering adhesives. Not permitted for surfaces to receive a sack-rubbed finish.

B. Solvent Based Cure and Seal Compound: Conform to ASTM C309, Type 1, and ASTM C1315, Type 1 with minimum 25 percent solids, non-yellowing and non-staining, and UV light resistant.

1. MasterKure CC 250 SB, by Master Builders; CS-309-25, by W.R. Meadows;Dress & Seal 30, by L&M Construction Chemicals, Inc.;

2. Approved Use: Exterior surfaces with surface temperature above 40F.

3. Limitations: Not permitted for surfaces with a surface temperature less than 40F. Not permitted for surfaces to receive additional concrete fills, chemical hardeners, sealers, waterproofing, and architectural finishes such as concrete stain, paints and coatings, tile, carpet, and floor covering adhesives. Not permitted for surfaces to receive a sack-rubbed finish.

2.03 CURING COMPOUND

A. Curing Compound: Conform to ASTM C309, Type 1, Class A.

1. 1300 Clear, by W.R. Meadows; L&M Cure, by L&M Construction Chemicals, Inc.;

2. Approved Use: Building wall footings, building foundation walls, exterior face of basement walls, and concrete sidewalks.

3. Limitations: Not permitted for building interior surfaces; exterior concrete equipment pads; concrete tank structures.

2.04 CURING PAPER

A. Curing Paper: Conform to ASTM C171, for regular or white waterproof paper.

2.05 EPOXY BONDING COMPOUND

A. Epoxy Bonding Compound: Conform to ASTM C881, contain 100 percent solids, and be moisture tolerant. Sikadur 32 Hi-Mod or Sikadur 32 Hi-Mod LPL, by Sika Corporation; Sure-Bond (J-58, or J-58 LPL), by Dayton Superior; or approved equal shall be provided.

2.06 EVAPORATION RETARDANT

A. Evaporation Retardant: water based polymer liquid placed on fresh concrete to control the rate of evaporation and extend workability. E-CON as manufactured by L&M Construction Chemicals, Inc.; SikaFilm by Sika Corporation; MasterKure ER 50 by Master Builders; or approved equal.

2.07 SOURCE QUALITY CONTROL

A. Provide in accordance with Division 01 General Requirements.

PART 3 – EXECUTION

3.01 CONCRETE PLACEMENT AND JOINTING

A. Tolerances: Tolerances shall conform to all requirements of ACI 117 except as modified.

B. Cold Weather Requirements

1. Cold weather concreting provisions shall be followed during cold weather: any and all periods when for more than three consecutive days the average daily outdoor temperature drops below 40°F. (The average daily temperature is the average of the highest and lowest temperature during the period from midnight to midnight.) When temperatures higher than 50°F occur during more than half of any 24-hour duration, the period shall not be regarded as cold weather.

2. When freezing temperatures may occur during periods not defined as cold weather, concrete surfaces shall be protected against freezing for at least the first 24 hours after placing.

3. Concrete shall not be placed on frozen subgrade. Insulate or heat subgrade to ensure temperature above 32°F when concrete is placed.

4. All embedment’s having a cross sectional area of 1.0 square inch or greater, and including #9 reinforcing bars, shall be at a temperature not less than 10°F at time of concrete placement.

5. Thermal protection must be provided immediately after concrete placement. Procedures for covering, insulating, housing, and/or heating concrete shall be prearranged. Except when supplemental heat is provided, the R-value of the insulation shall be per the recommendations of chapter 9 of ACI 306R.

6. Accelerating admixtures shall be approved at the Engineer's discretion, however those containing calcium chloride shall not be permitted

7. When combustion heaters are used, flue gases shall be vented to the exterior of enclosures

8. Concrete shall be placed and maintained at the following minimum concrete placement temperatures (measured at concrete surface)

   a. Sections of less than 12-inch minimum dimension: 55°F

   b. Sections of 12 to 36-inches minimum dimension: 50°F

9. The concrete placement temperature shall not be higher than the minimum concrete placement temperature by more than 20°F.

10. The minimum concrete temperature as mixed shall be: 5°F higher than the minimum concrete placement temperature when the air temperature is above 30°F; 10°F higher when the air temperature is between 0 and 30°F; and 15°F higher when the air temperature is less than 0°F.

11. The temperature shall be monitored at the surface of the concrete, including at corners and edges, which are more vulnerable to freezing. The concrete surface temperature and the corresponding outside air temperature shall be recorded a minimum of twice per each 24 hour period

12. Concrete shall be maintained at the minimum specified temperatures for a protection period of 6 days. When an approved accelerating admixture is used the protection period may be reduced to 4 days.

13. Slabs, regardless of air content, shall not be exposed to freezing temperatures when exposed to rain, snow or other water sources, prior to reaching a compressive strength of 3,500 psi. For hard-troweled slabs (which have a maximum air content of 3.0 percent) see Article 3.07, paragraph D.3 for additional requirements.

14. Concrete shall be cooled gradually at the end of the protection period. The maximum allowable temperature drop at the concrete surface during the first 24 hours after the protection period shall be: 50°F for concrete sections of less than 12-inch minimum dimension; and 40°F for concrete sections of 12 to 36-inch minimum dimension.

C. Hot Weather Requirements

1. The temperature of the concrete when placed shall not exceed 90°F. When the air temperature is 90°F and above, procedures to cool mixture ingredients may be warranted. These include: providing shaded storage for aggregate, frequent sprinkling or fog spraying of coarse aggregate, and using chilled batch water and/or ice. Forms and reinforcement shall be sprinkled with cold water just prior to concrete placement. When possible, placement of slabs should be scheduled after walls and roof structure are in place in order to minimize problems associated with direct sunlight and/or drying winds. Newly placed concrete shall be protected from the direct sunlight.

2. Records shall be maintained of: time and location of concrete placement, air temperature, weather conditions (i.e. calm, windy, clear, and/or cloudy), relative humidity, and concrete temperature as delivered and after placement.

3. When the air temperature is 90°F and above: the time between the addition of water to cement or cement to aggregate (whichever occurs first) and the time of concrete placement shall not exceed 60 minutes, except upon approval of the Engineer when all tests for air content, slump and temperature are acceptable.

D. Placing

1. Concrete shall be handled from the truck to the place of final deposit as rapidly as practicable by methods preventing segregation and/or loss of ingredients.

2. The time between the addition of water to cement, or cement to aggregates (whichever occurs first), and the placement of concrete shall not exceed 90 minutes. When air temperature is 90°F and above, this time shall be reduced to 60 minutes. These times may be exceeded only upon approval of the Engineer, and only if all tests for air content, slump, and temperature are also acceptable.

3. Water shall be removed from all forms and excavations and the Work shall be kept dry during placement. No water shall be thrown on, allowed to flow over, or rise upon the concrete until it is thoroughly set.

4. Prior to placement of slabs on soil, the subgrade shall be moist with no free water and no muddy or soft spots.

5. The concrete shall be directly deposited as close as possible to its final location, and shall be deposited in such manner so as to maintain a homogeneous, plastic, approximately horizontal surface.

6. Where concrete may contact soil while being placed, free fall shall be limited to a maximum of 3 feet. Concrete that has been contaminated by soil and/or other foreign matter shall be rejected. The accumulation of concrete on the forms and/or on reinforcement above the level of placement shall be avoided. The splashing of concrete upon formwork that is set for a subsequent concrete placement shall be prevented due to the resulting marks on the finished concrete.

7. Re-tempering of concrete and concrete placement against partially hardened concrete shall not be permitted. A concrete placement, once started, shall be carried out as a continuous operation until the placement of the entire section between construction joints is complete.

E. Runways: Runways shall be provided for wheeled concrete handling equipment which shall not be wheeled over reinforcement. Runways shall not be supported upon reinforcement that is part of the Work.

F. Chuting

1. Minimum slope shall be 3 horizontal to 1 vertical and maximum slope shall be 2 horizontal to 1 vertical. Between these limits, the slope shall be that which will prevent segregation and ensure continuous flow.

2. A baffle shall be provided at the end of the chute to prevent segregation. If the end of the chute is more than 3 feet above the surface of deposit, a spout shall be used. The spout shall be kept full of concrete with the end kept as near as practical to the surface of deposit.

3. The chute shall be steel or steel lined, and sections shall have the same slope throughout. Aluminum chutes are not permitted.

4. The chute shall be thoroughly flushed with water before and after each use, the water discharged outside the forms.

G. Pumping: The inside diameter of pipes and hoses used to convey the concrete shall be a minimum of three times the maximum size aggregate of the mixture. In order to minimize altering the concrete properties, long vertical sections at the end of the pump line shall be avoided. A horizontal hose run, a hose loop, or a slide gate at the end of the hose may be used to reduce loss of entrained air.

H. Compaction

1. Provide at least one standby vibrator, and at least one for each three in use.

2. Concrete may be deposited in one or multiple layers. Each layer shall be compacted by mechanical internal vibrating equipment supplemented by hand spading, rodding, and tamping as required. The depth of each layer shall not exceed the smaller of 36 inches and the depth that can be properly vibrated with the equipment used. When deposited in multiple layers, the vibrator shall penetrate the previous layer approximately 6 inches. Ensure initial setting of the previous layer does not occur prior to placement of subsequent layer.

3. Vibrators shall be relocated frequently, and over-vibration resulting in segregation shall be prevented. Vibrators shall not be used to move concrete within the forms. Concrete shall be thoroughly consolidated around reinforcement, embedments, and into the corners of the forms.

4. Ensure that vibrator is kept several inches clear of waterstops.

5. Where internal vibration is impractical, the use of form vibrators will be considered, and will be allowed only with the Engineer's written approval. When allowed, the vibrator shall be placed so that motion is horizontal

I. Construction Joints

1. Construction joints shall be located where shown on the Drawings, or, if not shown, locations shall be approved by the Engineer. Where required to be watertight, waterstops as specified in Section 03 11 00 CONRETE FORMING shall be used.

2. Horizontal construction joints: laitance shall be removed immediately after initial set and the surface shall roughened in an acceptable manner that exposes the aggregate uniformly and doesn't leave laitance or loose aggregate. After the concrete has set to a degree that precludes laitance removal by shovels or scrapers, the Contractor shall remove it, and create a roughened surface, by water jetting or other effective method. The use of pneumatic hammers is not permitted.

3. Vertical construction joints: the surface shall be thoroughly cleaned of laitance by water jetting, or by wire brushing followed by air blasting.

4. Before concrete is placed against set concrete, the surface shall be thoroughly wetted with standing water removed. Horizontal construction joints shall be in a saturated surface dry condition: saturated for a minimum of 6 hours, with standing water removed.

5. Where noted on the Drawings, and as approved by the Engineer where an unplanned interruption within a concrete placement has occurred, epoxy-bonding compound shall be used in accordance with the manufacturer's instructions.

6. Reinforcement shall be continuous at construction joints unless otherwise shown on the Drawings. Waterstops shall be provided where called for in the Contract Documents. All necessary precautions to ensure that the waterstop is properly located and aligned and remains so during concrete placement shall be taken. In the event that the waterstop is improperly located, allowing a tolerance of plus or minus 1/2-inch, the Engineer may order the waterstop extended, or replaced, or such other action as deemed necessary, and at no additional cost to the Owner.

J. Concrete Fills

1. New unformed concrete surfaces upon which concrete is placed shall receive a rough (broom, scratched, rough screed, or rough wood float) finish.

K. Existing Concrete

1. Where concrete is placed against existing concrete, the following surface preparation shall be required.

2. The existing concrete surface shall be cleaned of all contamination and debris, and roughened by steel shot blasting, abrasive (sand) blasting, or water jetting (hydrodemolition). Use of scabblers, scarifiers, bush hammers, or pneumatic hammers is not permitted.

3. The existing concrete surface shall be water-saturated for a minimum of six hours, after which the excess water shall be removed immediately prior to placement of new concrete.

4. Apply epoxy-bonding compound to prepared concrete surface prior to concrete placement.

3.02 CURING AND PROTECTION

A. Temperature

1. When the ambient temperature falls below 40°F or rises above 95°F, a record shall be kept of concrete temperatures and of protection given to concrete during placement and curing.

2. The temperature of in-place concrete shall be the surface temperature of the concrete. The surface temperature may be determined by placing temperature sensors in contact with concrete surfaces or between concrete surfaces and covers used for curing, such as insulation blankets or plastic sheeting.

B. Curing

1. Provide curing per ACI 308.1 except as modified.

2. During cold weather, as previously defined, the application of water shall not be required. Curing shall be accomplished by the use of curing paper, curing compounds, cure and seal compounds, or other approved methods. Thermal blankets are not an approved curing method and shall be used in conjunction with curing provisions previously stated.

3. Provisions shall be made for maintaining new concrete in a continuously moist condition for a minimum of 7 days. Curing shall commence as soon as possible after final finishing when it will not mar, erode, or stain the concrete surface.

4. Curing shall be accomplished by the use of curing paper, curing compounds (except as noted below), wet methods (ponding, fog spray, damp sand or burlap, sprinkling, soaker hoses) or other methods.

5. Water used for curing shall be no more than 20°F cooler than the concrete surface temperature.

6. Concrete slabs to receive a coating or bonded finish, including chemical hardeners, that aren't wet cured, shall be covered with curing paper as specified, laid with side joints lapped 4 inches and end joints lapped 6 inches. Paper shall be applied no earlier than 24 hours and no later than 30 hours after finishing the slab and shall be left in place at least seven days. (Wet methods shall be used for the first 24-30 hours.) The slab surface shall be maintained in a wet condition beneath the paper at all times. Joints shall be taped and paper shall be weighted to prevent displacement. Tears during the first 7 days after a slab is completed shall be immediately repaired.

7. Curing paper shall also be used to protect newly poured concrete floors from damage. Where heavy tools and/or equipment may be used, provide additional protection as required. Only light traffic will be permitted until 7 days after concrete placement. Slabs shall be protected from damage for the Contract duration, with any and all damage repaired by the Contractor at no additional cost to the Owner.

8. The use of a curing compound or cure and seal compound on surfaces to receive applied toppings, chemical hardeners, water repellents, coatings, or a rubbed or bonded finish will not be allowed. Where used, curing compound shall be applied immediately following the disappearance of the surface water sheen after the final finishing pass for slabs, and immediately upon removal of forms for formed concrete. Apply two coats per manufacturer’s installation instructions. Apply each coat uniformly with no gaps in coverage. If applied by spray, provide additional spray tank and spray nozzles as required to provide uninterrupted application of product. Cure and seal compounds have high solid content and shall be applied by trays and rollers, if application by spray tanks is not completed in a timely manner and to the satisfaction of the engineer.

9. Soaker hoses shall be used at tops of walls and columns before forms are removed. Wood forms shall be kept continuously wet in hot weather.

3.03 DEFECTIVE CONCRETE

A. The Engineer may direct the Contractor to remove and replace, at no additional cost to the Owner, concrete Work that is not formed as shown and/or specified in the Contract Documents, or that contains a defective surface.

B. Upon the Engineer's approval, minor imperfections may be patched as specified herein.

3.04 REPAIR OF SURFACE DEFECTS AND PATCHING

A. After form removal, all form ties shall be cut off, all fins and irregularities removed, and all defective areas, holes, honeycombs, cavities and irregularities shall be repaired where surface finish defects exceed the finish tolerances of Section 3.05

B. Exposed patchwork shall match adjacent finish and shall include a sack rubbed finish to blend repair into adjacent surfaces, and cured and protected as specified for concrete.

C. Filling Form Tie Holes: Tie holes shall be filled solid with non-shrink grout, specified in Section 03 16 00 CONCRETE SPECIALTIES, in the same manner as specified under patching above.

3.05 FINISH OF FORMED SURFACES

A. General

1. Concrete surfaces "exposed to view" shall be defined as those exposed to view upon completion of the Work, whether or not a painted finish is specified. Surfaces which will be covered by fill, such as exterior faces of walls, shall not be considered exposed to view.

2. Surface tolerance classes indicated herein are specified in ACI 117, and include abrupt surface irregularities that are measured within 1-inch of the irregularity, and gradual surface irregularities measured as the maximum gap between the concrete and the near surface of a 5-foot straight-edge, measured between contact points.

B. Surface Finish – 3.0 (SF3.0)

1. SF-3.0 shall be provided for formed surfaces exposed to view, and for concrete not containing liquids, and/or gases.

2. Patch voids larger than 1/2-inch wide or 1/4-inch deep.

3. Remove projections larger than 1/8-inch.

4. Fill tie holes

5. Surface tolerance Class C, with formed surface irregularities not more than 1/2-inch.

C. Environmental Surface Finish-1.0 (ESF-1.0)

1. ESF-1.0 shall be provided for exterior and interior formed surfaces of concrete tanks containing liquids or gases.

2. Patch voids larger than 1/2- inch wide or 1/4-inch. All interior formed surfaces to receive grout-cleaned rubbed finish, unless noted otherwise on drawings.

3. Remove projections larger than 1/8-inch.

4. Fill tie holes.

5. Surface tolerance Class A, with formed surface irregularities not more than 1/8-inch.

D. Grout-cleaned rubbed finish (Sack-Rubbed)

1. All interior and exterior concrete surfaces that are exposed to view shall receive a grout-cleaned rubbed finish and shall have a smooth and even surface, free of bug holes, when completed, unless specifically noted otherwise on drawings.

2. Wet the surface, and apply a thin coat of medium consistency neat cement slurry to the concrete surface by means of bristle brushes to provide a bonding coat. Before the slurry has dried or changed color, grout comprising one part cement to 1 1/2 parts sand meeting ASTM C144 or ASTM C404, with sufficient water to produce the consistency of thick paint, shall be applied and scrubbed into voids, with excess removed. The cement shall be that used in the concrete mix adjusted with white cement as necessary to match color of exposed concrete. Grout shall be applied with slightly damp pads of coarse burlap approximately 6 inches square used as a float, and shall be well scrubbed into the surface to provide a dense mortar.

3. The mortar shall be allowed to partially harden for 1 to 2 hours depending upon weather conditions. Work in direct hot sunlight shall be avoided. In hot dry conditions the concrete shall be kept damp during this period with a fine fog spray. Grout shall not be allowed to remain on the surface too long as it will become very difficult to remove. Grout shall not be left on the concrete overnight.

4. After the grout has hardened sufficiently, all that can be removed with a trowel shall be.

5. The surface shall then be allowed to dry thoroughly, and be rubbed vigorously with clean, dry burlap to completely remove any dried grout. There should be no visible film of grout remaining after rubbing.

6. The entire rubbing operation shall be completed in a single working day. Sufficient time shall be allowed for this.

7. On the following day, the concrete shall again be wiped clean with dry burlap to remove dust. The use of burlap containing old hardened mortar may be used since it will act as a mild abrasive. After this treatment, no build-up film should remain on the surface, but if it does, a fine abrasive stone shall be used to remove it without breaking through the surface film of the parent concrete. Do not work up a lather.

8. After application of the surface grout, the surface shall be thoroughly washed down with stiff brushes and the concrete maintained in a continuously damp condition for at least three days above 50°F by the periodic application of a fine fog spray, the use of damp fabric covered with polyethylene or other methods.

3.06 FINISHING OF RELATED UNFORMED SURFACES

A. Tops of exposed walls and similar unformed surfaces shall be struck off smooth and hand steel troweled to produce a smooth hard level surface. Line and elevation shall be pre-established by means of preset wood screeds, which shall be removed during the troweling operation.

B. After troweling is completed and after the curing period, the surface shall be dry honed to a smooth non-directional surface texture satisfactory to the Engineer.

3.07 FINISH OF SLABS

A. General

1. The evaporation retardant specified may be used in accordance with manufacturer recommendations to control plastic shrinkage cracking and as an aid in slab finishing operations. Conditions that may warrant its use include: high temperature, low humidity, high winds, and direct sunlight.

2. Loss of bleed water and surface drying shall be allowed to proceed naturally. Means to accelerate drying such as applying dry cement, sand, or other materials shall be prohibited.

B. Floor Flatness and Floor Levelness

1. Elevated floor slabs constructed on formwork and all concrete tank base slabs shall be true to the gradient and elevation shown on the Drawings. Flat Slabs shall be level with a tolerance of 1/8 inch in 10 feet. Sloped slabs shall be true to the gradient shown, within a tolerance of 1/8 inch in 10 feet. Slabs shall be pitched to drains as indicated on the Drawings.

C. Floated Finish

1. Slabs to receive a seamless floor finish or roofing, and all tank bottom slabs, shall receive a floated finish. Floating shall also precede a troweling, where a troweled finish is required as specified below. After consolidating, screeding, and leveling, the slab shall not be worked further until it is ready for floating.

2. Floating shall begin when the water sheen has disappeared, and when the slab has stiffened sufficiently to allow proper operation of a power-driven float. Hand floating with wood, aluminum or magnesium floats shall be used at locations inaccessible to the power-driven float.

3. Surface trueness shall be verified at this stage with a 10-foot straightedge applied in multiple angles. High spots shall be cut down and low spots filled so that the finished surface is true. The slab shall then be immediately refloated to a uniform, smooth, granular texture.

D. Troweled Finish

1. All interior slabs left exposed shall receive a troweled finish.

2. The surface shall be finished with power floats as specified above for floated finish, followed by power trowels, and finally hand trowels. The first power troweling shall produce a smooth surface relatively free of defects but which may contain trowel marks. Subsequent trowel shall be by hand after the surface has sufficiently hardened. The surface shall be thoroughly consolidated by the hand troweling, and final troweling shall be done when a ringing sound is produced as the trowel is moved over the surface. The finished surface shall be free of trowel marks and uniform in texture and appearance.

3. Interior concrete slabs to be hard-troweled shall have a maximum air content of 3.0 percent. After the curing period, they shall be protected from freezing temperatures for a minimum of 8 weeks. Thereafter, and for the duration of the Contract, if such slabs might be subject to freezing temperatures, they shall be fully sheltered from rain, snow and all other water sources.

4. Subsequent trowels shall be by hand after the surface has sufficiently hardened. The surface shall be thoroughly consolidated by the hand troweling, and final troweling shall be done when a ringing sound is produced as the trowel is moved over the surface. The finished surface shall be free of trowel marks and uniform in texture and appearance.

E. A broom finish shall be provided for all exterior slabs, sidewalks, platforms, ramps, exterior stairs and as specified herein or shown on the Drawings. After floating, and

between initial and final set, the surface shall be given a coarse transverse scored texture by drawing a broom across the surface.

F. After consolidating, screeding and leveling, the surface shall be roughened with stiff brushes or raked before final set. At sloped surfaces scratches shall be made parallel to the direction of slope, to facilitate subsequent cleaning.

G. A wood float finish, a broom finish with open pores, or a finish as otherwise required by the waterproofing manufacturer shall be provided for concrete slabs that will receive a wet slurry application of cementitious waterproofing.

3.08 WATER REPELLENT

A. Water repellent: Per Section 07 19 00 WATER REPELLENTS.

3.09 CLEANING CONCRETE

A. Cleaning during progress of the Work shall not be permitted. Cleaning shall not commence until the structure is entirely completed.

B. Rust and other stains and discolorations shall be removed with a non-etching cleaning agent used in accordance with the manufacturer's instructions. Cleaning of all surfaces to receive a painted finish is also required.

C. Rust stains may be removed by applying a bleaching agent such as oxalic acid. Acid etching, sandblasting, or cleaning by other methods may be used as approved by the Engineer.

3.10 FIELD QUALITY CONTROL

A. General:

1. Provide in accordance with Division 01 General Requirements.

2. During the progress of the Work, an independent, accredited and certified testing laboratory shall conduct concrete testing as specified herein, including the preparation and testing of concrete cylinders. All testing shall be paid for by the Owner.

3. Field technicians in charge of sampling concrete; testing for slump, unit weight, air content, and temperature; and making and curing test specimens shall be certified in accordance with the requirements of ACI Concrete Field Testing Technician – Grade 1 certification program, or the requirements of ASTM C1077.

4. Scheduling: Contractor to advise testing laboratory and field technician(s) a minimum 24 hours in advance of placing concrete to allow for scheduling observation and testing.

5. Test Cylinder Storage: Provide space and electrical power at the Site for temperature controlled storage of concrete laboratory test cylinders to be standard cured per Section 03 30 00 CAST-IN-PLACE CONCRETE. Temperature controlled storage containers to be provided by testing agency.

B. Field Testing and Sampling Procedures

1. Concrete samples shall be taken in accordance with ASTM C172 for slump, entrained air, unit weight, and strength tests.

2. Entrained air content and slump requirements are listed in Section 03 30 00 CAST-IN-PLACE CONCRETE.

3. Air Content: Test in accordance with ASTM C173 or ASTM C231. Pumped concrete shall be sampled and tested for air content at the point of placement, as opposed to at the point of delivery. Upon the Engineer's approval: once the slump loss and the loss of entrained air due to pumping is established, correlated acceptance limits at the point of delivery, where sampling and testing may then be performed, shall be made applicable. When the pump line configuration is changed significantly, sampling and testing shall again be performed at the point of placement until new acceptance limits at the point of delivery may be determined.

4. Slump: Measured in accordance with ASTM C143 at the point of delivery.

5. Temperature shall be measured in accordance with ASTM C1064 at the point of delivery

6. Test Cylinders: Concrete cylinders shall be prepared in accordance with ASTM C31 and be 4 inches diameter by 8 inches tall. Refer to Article 3.10, part D for number of cylinders required.

   a. Lab-Cured (Standard Cured) Cylinders: Filed cured in temperature controlled storage per Section 03 30 00 CAST-IN-PLACE CONCRETE. Cylinders shall be transported to the testing lab within 48 hours of forming, but not sooner than 8 hours after final set.

   b. Field Cured Cylinders: Cured in the field under conditions that are not more favorable than the most unfavorable conditions for the portions of the concrete that the cylinders represent.

C. Laboratory Testing of Test Cylinders

1. Cylinders shall be tested for compressive strength in accordance with ASTM C39.

2. Test concrete cylinders per Section 3.10, Part D.

3. The compressive strength shall be the average strength of three cylinder breaks per ASTM C39 and tested at 28-days.

4. Test Results: Submit test results to Engineer and concrete supplier within 24 hours of laboratory testing.

D. Field and Laboratory Testing Frequency

1. Minimum field testing frequency for each day concrete is delivered and placed at the project site shall be as follows.

   a. Take concrete test cylinders at frequency stated herein from truckload determined by technician, contractor, or engineer

   b. 1st truck load: Test air content, slump, and temperature.

   c. 2nd and 3rd truck load: No testing unless noted otherwise.

   d. 4th truck load: Test air content, slump, and temperature

   e. 5th and 6th truck load: No testing unless noted otherwise

   f. 7th truck load: Test air content, slump, and temperature.

   g. Repeat test frequency for additional truckloads of concrete delivered during each day of concrete placement.

   h. Concrete temperature shall be tested for each truckload of concrete during cold weather or hot weather as defined within this specification.

   i. Contractor, Owner's representative, or Engineer shall increase testing frequency as required to verify mix designs, address workability concerns, and to ensure all concrete placed complies with specifications

2. Lab-Cured (Standard Cure) Cylinders

   a. Lab-cured cylinders are required for all concrete on the project, and shall be in addition to field-cured cylinders, where provided.

   b. One set of 5 cylinders shall be prepared for each 100 cubic yards, or fraction thereof, of each different mix placed in each single day; or for each 5,000 square foot of slab or wall surface area placed each day.

   c. Test one cylinder at 7 days, three at 28 days, and reserve one cylinder for 56-days.

   d. Test 56-day cylinder as needed or requested by Contractor or Engineer.

3. Field-Cured Cylinders

   a. Contractor is responsible for taking additional field-cured test cylinders to verify concrete compressive strength prior to tightness testing concrete tanks, backfilling concrete basement walls, or early removal of formwork.

   b. One set of 3 field-cured cylinders shall be prepared for each 100 cubic yards, or fraction thereof, of the concrete placed in each single day.

   c. Test field cured cylinders at 14 days or as requested by Contractor or Engineer.

E. Acceptance Criteria and Additional Testing Requirements

1. Concrete strength shall be evaluated in accordance with ACI 301 Section 1.6.5, "Evaluation of concrete strength tests", and Section 1.6.6, "Acceptance of concrete strength"

2. Construction will be considered potentially deficient if concrete fails to meet any requirements that affect the strength and durability of the structure, including but not necessarily limited to

   a. Low strength concrete per ACI 301, Section 1.6.5, "Evaluation of concrete strength tests", and Section 1.6.6, "Acceptance of concrete strength"

   b. Water-to-cementitious materials ratio higher than that of the specified mix

   c. Reinforcing steel size, quantity, strength, position or arrangement that does not meet the requirements of the Contract Documents

   d. Reinforced concrete that differs from the dimensions or locations shown on the Drawings

   e. Curing that does not meet the requirements of the Contract Documents, including premature formwork removal

   f. Hot or cold weather concreting that doesn't meet the requirements of the Contract Documents

   g. Mechanical damage from accidents or fire

   h. Poor construction practices

F. The Engineer may order load and/or core tests in accordance with ASTM C 42. Such testing shall be paid for by the Owner if the concrete is proven to meet the requirements specified.

3.11 TIGHTNESS TESTING OF CONCRETE TANKS

A. General

1. The Contractor shall individually test the following concrete basins for water tightness before backfilling operations, except where backfilling is necessary in order to construct tank:

   a. List Each Tank to be Tested

2. Testing shall be in accordance with ACI 350.1, Section 2- "Hydrostatic tightness test for open or covered containment structures".

   a. Testing Criteria: Volume loss shall not exceed 0.10 percent net liquid loss per day

B. Testing Sequence and Schedule

1. Contractor shall submit tank basin testing sequence and testing schedule for Engineer's review.

2. Prior to submitting testing sequence and testing schedule, Contractor shall request and obtain test documentation forms prepared by Engineer. Forms will be provided to Contractor within 14-calender days of request.

C. Documentation

1. Contractor shall document test results for each tank test basin using Engineer's documentation forms.

D. Failed Test

1. If any basin fails Part 1: Qualitative Criteria or Part 2: Quantitative Criteria per ACI 350.1, the Contractor shall correct the problem and retest at Contractor's expense.

E. Tank Leak Repairs

1. Contractor shall repair leaks per Section 03 63 00 INJECTION GROUTING.

3.12 CLOSEOUT ACTIVITIES

A. Provide in accordance with Division 01 General Requirements.

B. Submit signed and completed concrete tank tightness testing forms for each tank basin required to be tested.

END OF SECTION

SECTION 03 63 00

INJECTION GROUTING

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes

1. Provide polyurethane injection grouting for repair of cracks in existing tank walls as indicated on Drawings, in accordance with this Section, and applicable reference standards listed in Article 1.03. Payment for this work shall be in accordance with unit price bid item.

2. Provide injection grouting per this specification to seal leaks in new concrete structures as part of tightness testing. Payment for this work shall be incidental to the base bid item.

B. Work Performed by General Contractor

1. Concrete tank tightness testing in accordance to ACI 350.1 will be performed by the General Contractor.

C. Related Requirements

1. Division 03, Section 03 30 20 CONCRETE PLACING, CURING AND FINISHING

1.02 PRICE AND PAYMENT PROCEDURES

A. Measurement and payment requirements: per Division 01 General Requirements.

1.03 REFERENCES

A. Reference Standards

1. AMERICAN CONCRETE INSTITUTE (ACI)

a. ACI 350.1 Specification for Tightness Testing of Environmental Engineering Concrete Containment Structures.

2. ASTM INTERNATIONAL (ASTM)

a. ASTM C 273 Shear Properties of Sandwich Core Materials

b. ASTM D412 Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers—Tension

c. ASTM D638 Standard Test Method for Tensile Properties of Plastics

d. ASTM D2842 Water Absorption of Rigid Cellular Plastics

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination, Sequencing, and Scheduling: per Division 01 General Requirements.

1.05 SUBMITTALS

A. Submit in accordance with Division 01 General Requirements.

B. Manufacturer’s product data and instructions

C. Manufacturer’s certification

D. Closeout and Maintenance Material Submittals: per Division 01 General Requirements.

1.06 QUALITY ASSURANCE

A. Provide in accordance with Division 01 General Requirements.

1.07 CONTRACTOR QUALIFICATIONS

A. Installation contractor must have a minium of five years of experience successfully sealing cracks with submitted product. On-site personnel installing system must have minium five years experience installing the product.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Provide in accordance with Division 01 General Requirements.

B. Packing, Shipping, Handling, and Unloading

1. Deliver material in original, unopened containers with manufacturer's name, labels, product identification, and batch numbers.

1.09 SITE CONDITIONS

A. Per Division 01 General Requirements

PART 2 – PRODUCTS

2.01 GENERAL

A. Acceptable level of quality equivalent to:

1. Mountain Grout – SLV with Accelerator, as manufactured by Green Mountain International, LLC.

2. SikaFix HH LV with SikaFix Accelerator, as manufactured by Sika Corporation.

B. Coordinate compatibility of material with waterproofing materials.

2.02 PERFORMANCE CRITERIA

A. Shear strength: 17 psi (ASTM C273)

B. Tensile strength: 29 psi (ASTM D638)

C. Elongation: plus 44 percent (ASTM D412)

D. Shrinkage: less than 1 percent.

E. Water absorption: less than 1 percent (ASTM D2842)

2.03 SOURCE QUALITY CONTROL

A. Provide in accordance with Division 01 General Requirements.

PART 3 – EXECUTION

3.01 GENERAL

A. Do not apply material during periods of rain or snow or if rain or snow is imminent.

B. Take precautions to avoid damage to surfaces near Work zone due to mixing and handling of grouting material.

C. Fills cracks as indicated on the Drawings and repair all leaks as specified herein.

3.02 INSTALLERS

A. Qualified per Division 01 General Requirements.

3.03 EXAMINATION

A. Site Visit: Prior to installation, visit the site with a manufacturer's representative to inspect and certify that concrete surfaces are in acceptable condition to receive treatment.

B. Verification of Substrates: Verify concrete surfaces are sound and clean, and that form release agents and materials to cure and seal the concrete are compatible with the treatment.

C. Defects: Examine surfaces to be treated for form tie holes and defects such as honeycombing, rock pockets, faulty construction joints, and cracks.

D. Tightness Testing: Leaks shall be examined during concrete tank tightness testing in accordance with ACI 350.1, while the concrete tank is filled with water. All leaks shall be sealed in accordance with ACI 350.1 and to the satisfaction of the Engineer and Owner's representative.

3.04 SURFACE PREPARATION

A. Ensure cracks and adjacent substrate are clean, sound, and free of frost. Remove dust, laitance, grease, curing compounds, waxes, impregnations, foreign particles, efflorescence and other bond inhibiting materials from surface by mechanical means.

B. Ensure sufficient moisture is present to activate grout. If moisture is insufficient for activation, inject crack with a small amount of water prior to injecting grouting material.

3.05 MIXING AND APPLICATION

A. Mixing and application per manufacturer's written instructions and product data sheets.

B. Mixing for injection of cracks:

1. Agitate vigorously by shaking a 5 gallon pail or by mixing thoroughly with drill and paddle, bung mixer for 2 minutes maximum with low speed (400-600 rpm).

2. Do not allow water to enter mix and avoid "whipping" air into material.

C. Placement Procedure

1. Drill 5/8 inch diameter holes alongside of crack at a 45 degree angle. Drill holes to intersect crack midway through substrate at a spacing of 6 inches minimum to 18 inches maximum.

2. Install injection packers in holes and tighten. If crack to be injected is 1/2 inch or greater at surface, pack with open cell polyurethane foam, saturated with mixed grouting material, into the crack. Spray with small amount of water to activate grout and create a surface seal.

3. Pump grouting material at over 250 psi into cracks for 45 seconds and then pause to allow material to flow into all cracks. Watch for material flow and water movement to appear on surface. When movement stops, begin injecting into next packer. Begin injecting at bottom of crack and work vertically when sealing vertical cracks.

4. Reinject to ensure cracks are properly sealed.

3.06 CLEANING

A. Remove excess material and injection ports from all areas that are exposed to view, including the inside of covered and uncovered tanks.

3.07 FIELD QUALITY CONTROL

A. Provide in accordance with Division 01 General Requirements.

B. Manufacturer Field Services

1. Furnish the services of a qualified manufacturer's field representative at the Site to demonstrate proper application and inspection procedures prior to commencement of application.

3.08 CLOSEOUT ACTIVITIES

A. Provide in accordance with Division 01 General Requirements.

END OF SECTION

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SECTION 04 20 00

UNIT MASONRY

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes

1. Provide services, material, and equipment necessary to complete the masonry work shown on the Drawings and as required to complete the Work in accordance with this Section and applicable reference standards listed in Article 1.03.

   a. Furnishing and installing concrete masonry units (CMU), and face brick veneer.

   b. Furnishing and installing masonry joint reinforcement, ties, and anchors.

   c. Furnishing and installing cavity wall dampproofing, which is specified in Section 07 10 00 DAMPPROOFING AND WATERPROOFING.

   d. Furnishing and installing bond beam lintels for openings required for Work specified under other sections.

   e. Building into masonry-embedded items such as anchors, anchor bolts, inserts, flashing, steel and concrete lintels, etc. furnished and located by the Contractor.

   f. Building into masonry door and window frames, louvers, vents, conduits, etc., furnished and set by the Contractor.

   g. Furnishing and installing membrane wall flashing, and other specified items.

   h. Repairing existing interior and exterior masonry, including repointing exterior face brick veneer, as shown on the Drawings and specified herein. Allow for repointing 500 lineal feet of mortar joints.

B. Products Installed But Not Supplied Under This Section

1. Deformed steel reinforcement as specified in Section 03 20 00 CONCRETE REINFORCING.

2. Metal door frames as specified in Section 08 11 00 METAL DOORS AND FRAMES.

C. Related Requirements

1. Division 03, Section 03 11 00 CONCRETE FORMING
2. Division 03, Section 03 20 00 CONCRETE REINFORCING
3. Division 07, Section 07 10 00 DAMPPROOFING AND WATERPROOFING
4. Division 07, Section 07 92 00 JOINT SEALANTS
5. Division 08, Section 08 11 00 METAL DOORS AND FRAMES

1.02 PRICE AND PAYMENT PROCEDURES

A. Measurement and payment requirements: per Division 01 General Requirements.

1.03 REFERENCES

A. Reference Standards

1. AMERICAN CONCRETE INSTITUTE INTERNATIONAL (ACI)
   a. ACI 530.1 Specification for Masonry Structures
2. ASTM INTERNATIONAL (ASTM)
   a. ASTM A82 Standard Specification for Steel Wire, Plain, for Concrete Reinforcement
   b. ASTM A153 Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
   c. ASTM A951 Standard Specification for Steel Wire for Masonry Joint Reinforcement
   d. ASTM C67 Standard Test Methods for Sampling and Testing Brick and Structural Clay Tile
   e. ASTM C90 Loadbearing Concrete Masonry Units
   f. ASTM C126 Standard Specification for Ceramic Glazed Structural Clay Facing Tile, Facing Brick, and Solid Masonry Units
   g. ASTM C140 Standard Test Methods for Sampling and Testing Concrete Masonry Units and Related Units
   h. ASTM C143 Standard Test Method for Slump of Hydraulic-Cement Concrete
   i. ASTM C144 Standard Specification for Aggregate for Masonry Mortar
   j. ASTM C150 Standard Specification for Portland Cement

k. ASTM C207 Standard Specification for Hydrated Lime for Masonry Purposes

l. ASTM C216 Facing Brick (Solid Masonry Units Made from Clay or Shale)

m. ASTM C270 Standard Specification for Mortar for Unit Masonry

n. ASTM C404 Standard Specification for Aggregates for Masonry Grout

o. ASTM C476 Standard Specification for Grout for Masonry

p. ASTM C494 Standard Specification for Chemical Admixtures for Concrete

q. ASTM C1329 Standard Specification for Mortar Cement

r. ASTM C1384 Standard Specification for Admixtures for Masonry Mortars

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination, Sequencing, and Scheduling: per Division 01 General Requirements.

1.05 SUBMITTALS

A. Submit in accordance with the Division 01 General Requirements.

B. A letter from the masonry Contractor indicating that they have reviewed the reinforcement Shop Drawings for the masonry Work

C. Product Data

1. Brochures for all items furnished, including, but not limited to

a. Anchors and fasteners

b. Grout ingredients

c. Masonry Units: CMU, and face brick

d. Metal accessories

e. Reinforcement supports/spacers

f. Mortar ingredients

g. Joint reinforcement and wall ties

D. Design Data

1. Mortar mix designs in accordance with the proportion Specification of ASTM C270 for each mortar mix.

2. Grout mix designs in accordance with the proportion Specification of ASTM C476.

E. Material Certificates

1. Anchors and Fasteners

2. Grout Ingredients

3. Masonry Units: CMU, SGFT, glass block, and face brick

4. Metal Accessories including reinforcement supports and spacers

5. Mortar Ingredients

6. Joint Reinforcement and Wall Ties

F. Hot Weather and Cold Weather Construction Procedures

1. The Engineer's review shall not constitute approval, as the Contractor shall be responsible for all Work performed during hot and cold weather.

G. Closeout and Maintenance Material Submittals: per Division 01 General Requirements.

1.06 QUALITY ASSURANCE

A. Provide in accordance with Division 01 General Requirements.

B. Prior to commencement of Work, a Sample panel shall be constructed.

1. Only materials and procedures approved for the Work shall be used.

2. The Sample panel shall be approved by the Engineer prior to the commencement of the Work. It will be the standard of comparison for masonry work built of the same materials, and shall not be destroyed until the Work is complete and accepted by the Engineer

3. The Sample panel shall be approximately 8 feet long by 4 feet tall, and shall be constructed in the presence of the Engineer or his designated representative. The panel shall include two exterior corners with 2-foot returns. One corner and return shall show the layout of face brick field, soldier course, accent bands, and CMU backup. The second corner and return shall show the CMU field, and exterior corner layout

4. The Sample panel shall be full cavity wall construction, showing proposed color range and texture of brick veneer, bond mortar color, joint ties, back-up CMU, dampproofing, weeps through wall flashing, cavity drainage material, and workmanship.

5. Control joint shall be provided where brick veneer meets CMU veneer for Sample caulking later.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Provide in accordance with Division 01 General Requirements.

B. Cement, lime, and all other cementitious materials shall be delivered to the Site in unbroken packaging that is plainly labeled with brand and manufacturer, and stored in dry, weather tight enclosures. They shall be stored and handled in a manner to prevent contamination by foreign materials, water, and dampness.

C. Masonry units shall be handled with care in order to prevent chipping and other damage. Damaged units shall not be used in exposed Work.

D. Materials stored on newly constructed floors shall be placed such that the load does not exceed 50 pounds per square foot.

E. CMU shall be shipped with each pallet wrapped in polyethylene plastic film. The wrapping shall not be removed until the CMU is to be placed in the wall to prevent moisture absorption.

F. CMU left exposed, or is otherwise allowed to pick up moisture, will be rejected and shall be removed from the Site.

1.08 SITE CONDITIONS

A. Existing Conditions: per Division 01 General Requirements.

PART 2 – PRODUCTS

2.01 GENERAL

A. Gauges

1. Wire gauge standard shall be United States Steel Wire. Sheet gauge standard shall be U.S. Standard.

B. Materials

1. Cement shall be portland cement conforming to ASTM C150, Type I or Type II. Alternatively, for mortar, the cement may be mortar cement as specified.

2. Hydrated Lime shall conform to ASTM C207, Type S, and shall not contain air-entrainment additives.

3. Aggregates for mortar shall conform to ASTM C144.

4. Aggregates for grout shall conform to ASTM C404.

5. Water shall be clean, fresh, and potable.

6. Concrete Masonry Units (CMU)

   a. CMU shall be supplied by a single manufacturer that is capable of providing all types, sizes, shapes, and textures described below.

   b. CMU shall conform to ASTM C90. CMU shall be lightweight with a concrete density of less than 105 pounds per cubic foot, except as specified for veneer block. Surfaces shall be smooth and dense. The minimum CMU net section compressive strength shall be 1900 pounds per square inch (psi) (average of 3 units) and 1700 psi (individual unit) measured in accordance with ASTM C140.

      1) f'm= 1500 psi, where f'm = specified compressive strength of masonry at age 28 days.

   c. Bond beam units, lintel units and all other special shapes shall be furnished as required, and the exposed face shall closely match that of the stretcher units.

   d. Stretcher units of 6 inches and greater nominal thickness shall be 2-core units. Stretcher units of 4 inch nominal thickness shall be 3-core units. Open-ended units shall be permitted in order to facilitate positioning units at vertical reinforcement.

   e. The minimum fire rating for CMU of 8 inches and greater nominal thickness shall be 2 hours. The minimum fire rating for CMU of 6 inches and less nominal thickness shall be 1 hour.

7. Face Brick Veneer

   a. Face brick shall be solid, hard burned, molded brick with a water absorption of not more than 10 percent per ASTM C67. Face brick shall be nominally 2-1/2 inches thick by 3-5/8 inches wide by 7-5/8 inches long and shall conform to ASTM C216, Grade SW, Type FBS.

   b. Brick shall match the color and texture of the existing face brick.

8. Joint Reinforcement and Wall Ties

   a. Masonry joint reinforcement and wall ties shall be factory fabricated from cold-drawn steel wire conforming to ASTM A82, galvanized after fabrication in accordance with ASTM A153.

   b. Joint reinforcement shall conform to ASTM A951 and shall be fabricated of W1.7, 9-gauge, 0.148-inch diameter wire in a ladder-type configuration. Smooth cross wires, at a maximum spacing of 16 inches, shall be welded to deformed longitudinal wires. The

out-to-out dimension of the longitudinal wires shall be approximately 2 inches less than the nominal thickness of the wythe. Prefabricated corners shall be used. Joint reinforcement shall be supplied in flat sections 10 feet to 20 feet in length.

c. For exterior cavity walls, joint reinforcement shall be fabricated as specified above and contain adjustable 2-piece, W2.8, 3/16 inch diameter, eye-and-pintle ties spaced not more than 24 inches on center. The eye section shall be welded to the joint reinforcement and shall extend 1/4 inch beyond the face of the wall insulation. The pintle section shall cover one-half of the veneer mortar bed.

d. For exterior CMU veneer wythe and brick soldier courses, reinforcement shall be 2-rod ladder-type, fabricated as specified above.

9. CMU Anchors

a. Wire components shall be hot dip galvanized per ASTM A153. Sheet metal components and components fabricated from steel plate shall be hot dip galvanized per ASTM A153 Class B.

b. Anchors where CMU bearing or shear walls (i.e. structural walls) intersect each other shall be strap anchors, 1/4 inch by 1-1/2 inch by 24 inches, including a 2-inch long 90-degree bend at each end to form a Z-shape. They shall be #344 Rigid Partition Anchor as manufactured by Hohmann & Barnard, Inc.

c. Anchors where CMU partition walls (i.e. nonstructural walls) intersect each other shall be prefabricated tee joint reinforcement or 16-gauge by 1/2 inch mesh galvanized hardware cloth. Provide hardware cloth 6 inches wide for walls of 8 inch or greater nominal thickness, and 2 layers of hardware cloth, 3 inches wide for walls less than 8-inch nominal thickness. (Isolation joints shall be provided where CMU partition walls intersect structural CMU walls.)

d. Anchors at steel members shall be Model #359FH weld-on ties with #VBT Vee Byna-Ties by Hohmann & Barnard, Inc., or equal.

e. Anchors at heads of CMU partitions shall be PTA 422, all as manufactured by Hohmann & Barnard, Inc., or equal.

f. Dovetail slots to anchor CMU to concrete shall be 18-gage, furnished in 10-ft lengths equal to #305 dovetail slots manufactured by Hohmann & Barnard, Inc., or equal.

1) CMU Dovetail Anchors: For anchoring ends of CMU walls to concrete shall be 1” wide x 12-gage x 8” long #303 SV seismic-notch anchor with 3/16” dia x 9” long VBT-Vee Byna-Tie each manufactured by Hohmann & Barnard, Inc., or equal.

2) Dovetail slots and dovetail anchors shall be manufactured by same manufacturer and shall be compatible.

10. Veneer Anchors

a. Wire components shall be hot dip galvanized per ASTM A153. Sheet metal components shall be hot dip galvanized per ASTM A153 Class B.

b. Dovetail slots to anchor veneer to concrete shall be 18-gage, furnished in 10-ft lengths equal to #305 dovetail slots manufactured by Hohmann & Barnard, Inc., or equal

1) Dovetail Anchors for veneer to cast-in-place concrete shall be 12-gauge dovetails with be 1" wide x 12-gage x length (as required to place 3/16" continuous wire 1-inch from exterior face of veneer) equal to #303 SV seismic-notch anchor manufactured by Hohmann & Barnard, Inc., or equal.

2) Provide continuous 3/16" wire within veneer mortar joint.

3) Dovetail slots and dovetail anchors shall be manufactured by same manufacturer and shall be compatible.

11. Wire mesh. For use under all knockout block bond beams, and for bonding where noted, shall be 16-gauge, 1/2 inch mesh galvanized hardware cloth.

12. Membrane wall flashing shall be a full 5-ounce copper sheet permanently bonded between 2 layers of textured, woven, high tensile strength glass fiber fabric with a ductile asphalt compound.

13. Compressible filler shall be PolySeal compressible polyurethane foam saturated with polybutylene as made by Sandell Manufacturing Co., or equal. In general, material shall be twice as wide as joint to be filled. Depth to be equal to width if not noted.

14. Pre-molded joint filler: 3/8 inch thick closed cell neoprene. Acceptable level of quality: NS by Hohmann & Barnard, Inc.

15. Control joint: Regular rubber. Acceptable level of quality: RS by Hohmann & Barnard, Inc.

16. CMU Lintels

a. CMU lintels shall be provided where shown on the Drawings and above all openings required by other trades.

b. They shall be formed of U-shaped channel bond beam units with solid bottoms.

c. Unless indicated otherwise, they shall be reinforced with a minimum of 2, #5 bars, and filled solid with grout. Reinforcement shall extend a minimum of 40 times the diameter of the bar past the face of openings, except it shall terminate 2 inches from control joints.

d. Exposed Work shall be of the same material and texture as the adjoining masonry.

e. Lintels may be built on the ground or assembled in place. Lintels built on the ground shall be allowed to set at least 6 days before being moved and shall have at least 8 inches of bearing at each end when placed, with the reinforcement extended as noted above.

17. CMU Bond Beams

a. CMU bond beams shall be provided where shown on the Drawings

b. They shall be constructed of knockout web (not low web) bond beam units with open bottoms.

c. Unless indicated otherwise, they shall be reinforced with a minimum of 2, #5 bars, and filled solid with grout. Wire mesh shall be placed in the bed joint to contain the grout.

d. Exposed Work shall be of the same material and texture as the adjoining masonry.

18. Mortar

a. Aggregate shall be measured in a damp, loose condition

b. Except as noted below, mortar for concrete masonry shall conform to ASTM C270, Type S, consisting of the following proportions by volume.

1) 1 part Type S mortar cement, 2-1/4 to 3 parts aggregate, or

2) 1/2 part portland cement, 1 part Type N mortar cement, 2-1/4 to 3 times the sum of the cement volumes, parts aggregate, or

3) 1 part portland cement, 1/4 to 1/2 part hydrated lime, 2-1/4 to 3 times the sum of the cement and lime volumes, parts aggregate

c. Mortar for veneer shall conform to ASTM C270, Type N, and shall consist of the following proportions by volume.

1) 1 part Type N mortar cement 2-1/4 to 3 parts aggregate, or

2) 1 part portland cement, 1/2 to 1-1/4 parts hydrated lime, 2-1/4 to 3 times the sum of the cement and lime volumes, parts aggregate

d. Mortar Pigment: for coloring exterior face brick mortar and CMU veneer mortar shall be chemically pure inorganic oxides in compounds suitably prepared for use in masonry mortar. Colors shall be selected by the Engineer. Two colors shall be used; 1 for the face brick mortar matching the mortar of the existing buildings of the respective Site; and 1 for the CMU veneer mortar.

e. Integral Type Waterproofing: Use in all exterior mortar and shall be metallic stearate type, Hydrocide Powder by Sonneborn Contech; Omicron Mortar Proofing by Master Buildings Inc.; Integral Waterpeller or equal.

19. Grout

a. Conform to ASTM C476 for fine grout, and meet either the specified compressive strength or proportion requirements.

b. If by proportion (by volume)

1 part portland cement, 0 to 1/10 part hydrated lime, 2-1/4 to 3 times the sum of the cement and lime volumes parts fine aggregate (with aggregate measured in a damp, loose condition).

20. Weeps and Cavity Vents

a. Full head joint weeps and cavity vents shall be formed using Hohmann & Barnard QV Quadro Vent, Advanced Building Products Mortar Maze Cell vents, or equal.

21. Cavity Drainage Material

a. Cavity drainage material shall be 2-inch thick free drainage mesh; made from polyethylene strands and shaped to avoid being clogged by mortar droppings. Mortar net as manufactured by Mortar Net USA or equal. Provide at all through wall flashings.

22. Metal Flashing (Drip Edge)

a. Metal flashing shall be 26-gauge stainless steel Type 304 as manufactured by Keystone Flashing Co., Cheney Flashing Co., Hohmann & Barnard, or equal.

b. Two-piece cap flashing shall be 16 ounce copper with 4 inch flat return in-wall and 5 inch cap flashing insert as manufactured by Keystone Flashing Co., Cheney Flashing Co., Ryerson, or equal.

23. Self-Adhered Wall Flashing

a. Self-adhered wall flashing shall be a 40-mil membrane comprising a polyethylene or polyvinyl chloride (PVC) membrane integrally bonded to a rubberized asphalt adhesive.

b. Provide primer and rubberized asphalt mastic for sealing edges

c. Self-adhered wall flashing shall be Perm-A-Barrier Flashing by W. R. Grace and Company, Hyload S/A Flashing by Hyload, or equal.

2.02 SOURCE QUALITY CONTROL

A. Provide in accordance with Division 01 General Requirements.

PART 3 – EXECUTION

3.01 TECHNICAL REQUIREMENTS

A. Masonry materials and construction shall conform to ACI 530.1 except as modified by the Contract Documents.

3.02 INSTALLATION

A. Inspection

1. Examine all areas scheduled for Work to determine whether existing masonry or other conditions will adversely affect execution of the Work including meeting specified tolerances. Report any such conditions to the Engineer.

B. Workmanship

1. Masonry shall be constructed level, square, plumb and true within the following tolerances.

a. Dimensions

1) Cross section and elevation: minus 1/4 inch, plus 1/2 inch

2) Mortar joint thickness (except glass block)

a) Bed joints: minus 1/8 inch, plus 1/8 inch

b) Head and collar joints: minus 1/4 inch, plus 3/8 inch

3) Mortar joint thickness for glass block

a) Bed joints: minus 1/16 inch, plus 1/8 inch

b) Head joints: minus 1/8 inch, plus 1/8 inch

4) Grout space and cavity width, except for walls passing framed construction: minus 1/4 inch, plus 3/8 inch

b. Elements

1) Variation from level

a) Bed joints within 10 feet: minus 1/4 inch, plus 1/4 inch

b) Bed joints maximum: minus 1/2 inch, plus 1/2 inch

c) Top surface of bearing walls, in 10 feet: minus 1/4 inch, plus 1/4 inch

d) Top surface of bearing walls, maximum: minus 1/2 inch, plus 1/2 inch

2) Variation from plumb

a) In 10 feet: minus 1/4 inch, plus 1/4 inch

b) In 20 feet: minus 3/8 inch, plus 3/8 inch

c) Maximum: minus 1/2 inch, plus 1/2 inch

3) True to a line

a) In 10 feet: minus 1/4 inch, plus 1/4 inch

b) In 20 feet: minus 3/8 inch, plus 3/8 inch

c) Maximum: minus 1/2 inch, plus 1/2 inch

4) Alignment of columns and walls (bottom versus top)

a) Bearing walls: minus 1/2 inch, plus 1/2 inch

b) Nonbearing walls: minus 3/4 inch, plus 3/4 inch

c. Location of elements

1) Indicated in plan

a) In 20 feet: minus 1/2 inch, plus 1/2 inch

b) Maximum: minus 3/4 inch, plus 3/4 inch

2) Indicated in elevation

a) In story height: minus 1/4 inch, plus 1/4 inch

b) Maximum: minus 3/4 inch, plus 3/4 inch

2. The tolerance for the placement of reinforcement in walls and other flexural members when the distance from the centerline of reinforcement to the opposite face of masonry "d" is not more than 8 inches shall be plus or minus 1/2 inch. For "d" greater than 8 inches but not more than 24 inches, the tolerance shall be plus or minus 1 inch. For "d" greater than 24 inches, the tolerance shall be plus or minus 1-1/4 inches. Tolerances shall be considered in conjunction with the cover requirements specified.

3. Elevations shall be checked by instrument as often as necessary to maintain the tolerances specified.

4. Anchors, ties, wall plugs, accessories and other items to be built into the Work shall be installed as the masonry work progresses. Cutting and fitting of masonry, including that required to accommodate the Work of others, shall be done with masonry saws or other approved methods which provide cuts that are straight and true.

5. Mortar shall be used within 2 hours of initial mixing. Pigmented mortar shall not be re-tempered. No mortar shall be used after it has begun to set.

6. Grout shall be placed within 1-1/2 hours of introduction of water into the mix, and before initial set. Grout shall not be re-tempered by the addition of water.

7. During erection, walls shall be kept dry by covering the top with a strong, waterproof membrane at the end of each day or shutdown. Partially completed walls shall be covered at all times when Work is not in progress. Cover shall extend a minimum of 2 feet down both sides, and shall be securely held in place.

8. Unfinished Work shall be stepped back for joining with new Work.

9. Hollow concrete masonry units shall be protected against wetting prior to use, and shall be dry when laid. Each unit shall be adjusted to its final position while mortar is still soft and plastic. Any unit disturbed after mortar has stiffened shall be removed and re-laid with fresh mortar. Vertical cells to be filled with grout shall be aligned to provide a continuous unobstructed opening.

C. CMU Construction

1. Interior, single wythe exterior and backup CMU and SGFT shall be laid in full running bond. Mortar joints at CMU shall be 3/8 inch thick; joints at SGFT shall be 1/4 inch thick. Units shall be laid with full mortar coverage on horizontal and vertical face shells. Webs shall also be bedded in all courses where adjacent to cells or cavities filled with grout, and shall be bedded in the starting course on solid foundation walls or floors. Remove mortar protruding more than 1/2 inch into cells or cavities to be filled with grout. Corners shall interlock: alternating courses shall overlap in running bond. Intersecting walls shall not interlock.

2. Joint reinforcement shall be placed so that the longitudinal wires are located over face-shell mortar beds, and are fully embedded in the mortar for their entire length. Joint reinforcement shall have a minimum clear cover of 5/8 inch when exposed to earth or weather and 1/2 inch otherwise. Reinforcement shall be lapped a minimum of 6 inches. Reinforcement shall be placed in the second and in each alternate course. At openings, reinforcement shall be provided in the first course above and below the opening, extending at least 2 feet beyond the opening on each side. Joint reinforcement shall be interrupted at all control and isolation joints.

3. Intersecting bearing or shear walls shall be joined by strap anchors, 1/4 inch by 1-1/2 inch by 24 inches, including a 2-inch long, 90 degree bend at each end to form a Z-shape. The strap anchors shall be spaced at 4 feet maximum.

4. Intersections where partition walls intersect interior nonbearing shear walls or partition walls, shall be joined at vertical intervals of not more than 16 inches by prefabricated tee joint reinforcement or by 16-gauge by 1/2 inch mesh galvanized hardware cloth.

5. Steel bar reinforcement shall be completely embedded in grout. Place reinforcement in grout spaces prior to grouting. Pushing reinforcement into grout shall be strictly prohibited. Fasten reinforcement together and provide hot-dip galvanized bar supports and spacers to prevent reinforcement displacement beyond the permitted tolerances. Where units are placed where vertical reinforcement projects, the block shall be either positioned into place over the top of the vertical bar, or open-ended units shall be provided. The clear distance between parallel bars shall not be less than the nominal diameter of the bar, nor less than 1 inch. In columns and pilasters, the clear distance between vertical bars shall not be less than 1 and 1/2 times the nominal bar diameter, nor less than 1-1/2 inches. Steel reinforcement shall be positioned as follows.

a. The thickness of grout between the reinforcement and the masonry units shall not be less than 1/4 inch

b. Where masonry wythe contains a single row of reinforcement, it shall be positioned at the center of the units, equidistant from each masonry face

c. Where masonry wythe contains 2 rows of reinforcement, each masonry face shall be reinforced. The clear cover shall be 2 inches at each face, with zero negative tolerance.

d. Splice lengths for bar reinforcement shall conform to the following

1) #4: 2 feet – 6 inches

2) #5: 3 feet – 3 inches

3) #6: 3 feet – 9 inches

4) #7: 4 feet – 5 inches

6. Grout

a. At the time of placement, the grout shall have a slump between 8 inches and 11 inches as determined by ASTM C143.

b. Grout lifts shall not exceed 5 feet. Grout pours shall meet the height limitations of ACI 530.1. The level of grout for each grout pour shall be stopped 1-1/2 inches from the top of the masonry.

c. Grout shall be consolidated in place between grout lifts by vibration or other approved methods to ensure complete filling of cells.

d. For grout pours exceeding 5 feet, clean-outs are required at the base of each grout pour.

D. Veneer Construction

1. Brick from various pallets shall be blended so that there is a maximum mixing of dark and light face bricks. In no case shall 2 dark or 2 light range units be laid next to one another in either the horizontal or vertical direction.

2. Exterior face brick and CMU veneer shall be laid in full running bond. Soldier or other special coursing shall be constructed in areas shown on the Drawings. Veneer masonry shall be laid with complete filled mortar joints. The ends of masonry shall be buttered with sufficient mortar to fill the head joints. Closures shall be rocked into place with the head joints thrown against the two adjacent, in-place units. Grout or mortar shall be prevented from staining the face of masonry to be exposed. Should grout

or mortar contact the face of such masonry, it shall be removed immediately.

3. Veneer wythe joint reinforcement and ties shall be embedded as described in this section. For exterior CMU veneer wythe, and at brick soldier coursing, 2 rod ladder-type reinforcement shall be placed in the alternate courses which do not have pintle ties. Joint reinforcement shall be interrupted at all control joints. Provide ties within 12 inches of control joints and openings. Pintle to tie vertical offset shall not exceed 1-1/4 inches.

4. Pounding corners and jambs to fit stretcher units after they are set shall be avoided. Where an adjustment must be made after the mortar has started to harden, the mortar shall be removed and replaced with fresh mortar.

5. Any mortar fins that protrude into the cavity space as the wall is built shall be troweled flat onto the inner face.

6. Maintain cavity free of mortar dropping.

E. Weep Vents

1. Weep vents at the bottom of all cavity walls shall be spaced at 32 inches on center immediately above flashing. Weep vents over all openings shall be similar, except spaced at 16 inches on center.

2. Weep vents at the top of all veneer cavities shall be spaced 32 inches on center.

F. Cutting and Fitting

1. Wherever possible, full units shall be used in lieu of cut units. Where cut units are required to accommodate the design, cutting shall be done by masonry mechanics using power masonry saws, except that cutting of units in unexposed Work may be accomplished with masonry hammers and chisels. Wet-cut units shall be dried to the same surface-dry appearance as uncut units before being placed in the Work. Cut edges shall be clean, true, and sharp. Openings to accommodate pipes, conduits, and other accessories shall be neatly formed so that framing or escutcheons required will completely conceal the cut edges. Insofar as practicable, all cutting and fitting shall be accomplished while masonry work is being erected.

G. Penetrations

1. Conduits, pipes, and sleeves in masonry shall be no closer than 3 diameters on center.

H. Flashing

1. Where flashing is to be laid on or against masonry, the surface of the masonry shall be smooth and free from projections. Flashing shall be continuous, and installed in accordance with the details shown on Drawings and manufacturer's recommendations. Flashing shall be installed with 1/2 beds of mortar above and below the flashing. Joints shall be lapped 4 inches, and the contact surface coated with fibrated asphalt mastic made for use with the flashing. Membrane flashing at masonry openings shall be extended a minimum of 8 inches beyond the opening. The flashing ends shall be turned up to form a pan.

2. Self-adhered wall flashing is to be applied only when surface temperatures are above 25°F. Substrate must be smooth, clean, dry, and sound, without any sharp protrusions. Apply primer to substrate where recommended by flashing manufacturer. Seal all top termination edges with a bead of flashing mastic.

I. Tooling

1. Mortar joints, which have become thumbprint hard, shall be tooled with a round jointer. The jointer shall be slightly larger than the width of the mortar joint so that complete contact is made along the edges of the units, compressing and sealing the surface of the joint. Joints in unexposed surfaces shall be cut flush.

J. Caulking Recesses

1. Outside joints around the perimeter of exterior door, louver and window frames shall be cleaned out, ready for placement of caulking specified elsewhere.

K. Pointing and Cleaning

1. At the completion of the Work, holes in joints of masonry surfaces to be exposed, except weep holes, shall be filled with mortar and suitably tooled. Masonry walls shall be dry brushed at the end of each day's Work, and after final pointing and shall be left clean and free from mortar spots and droppings. Defective joints shall be repointed.

L. Repointing

1. Joint Preparation

a. Tools: Use of power chisels, or any other power tool, which might damage masonry, is not permitted. Provide chisels sized for narrow mortar joints.

b. Removal of old mortar: Hand tools shall be sized for joints of less dimension than actual. Contractor shall exercise all necessary diligence to avoid abrading joint faces at the outer edge of the arris, and to not chip edges or otherwise widen joints at the arris. Use only chisels of constant rectangular shape for cutting. Cold chisels or other tapered end cutting tools will not be permitted.

1) Remove old mortar to a depth of 1-1/2 times the thickness of the joint, or 3/4 inch, whichever is greater.

2) Remove mortar from both surfaces of the adjacent masonry and square out at the back of the joint.

3) Remove all loose mortar, even if it is deeper than the depths indicated, to reach sound, existing mortar.

c. Thoroughly rinse raked joints with water to remove fine particles. Do not use compressed air. Clean and rinse joints sufficiently before filling the joints and allow evaporation of any freestanding water in the joints.

2. Pre-hydrated Mortar Preparation

a. Mix sand, cement and hydrated lime thoroughly for at least 3 minutes before adding any water, and until the even color of the mixed materials indicates that they have been thoroughly distributed throughout the mass.

b. After mixing dry ingredients, then mix again adding only enough water to produce a damp workable mix, which will retain its form when pressed into a ball. After 1 to 2 hours, add sufficient water to bring it to the proper consistency that is somewhat drier than conventional masonry mortars.

c. Clean mixing equipment thoroughly after each use to prevent hardened or partially hardened lumps of mortar from contaminating a new batch.

d. No additional substances shall be added to the mortar without the written permission of the Engineer.

e. Use mortar within 20 minutes of mixing. Do not add water (re-temper) in the attempt to make the mortar workable.

3. Joint Moistening

a. If the joints have dried since being rinsed, moisten again with a fine water spray. Allow no freestanding water to be present.

4. Joint Filling

   a. Apply mortar from mortarboard to joint with pointing tool sufficiently narrow to enter the joint, and to achieve good compaction.

   b. Apply mortar in layers not exceeding 3/8 inch in depth. Apply first layers to deepest voids only, to enable applying each subsequent layer to a uniform depth.

   c. Apply each layer fully compacted into the joint and allow to become thumbprint hard prior to the application of the next layer.

5. Joint Finishing

   a. Tool final layer of mortar to match existing joints after it has become thumbprint hard, to slightly exceed depth of recess of adjacent sound joints. Mortar joints shall be tooled so that the arris stands free of the joint face. No feathering of mortar edges will be permitted. Rod and caulk cracks where required with sealant.

   b. Expose aggregate of mortar joints to match adjacent sound joints by applying water with a stiff bristle brush just after mortar has set, but before it has dried.

   c. Remove excess mortar from masonry just after it has set, but before it has dried to prevent smearing. As needed, use natural bristle brush or wood paddle with water. Use of muriatic acid or any acid based masonry cleaners is prohibited.

M. Replacement of Loose or Damaged Face Brick

1. Carefully remove mortar from head and bed joints adjacent to units designated for replacement, and remove units and surrounding mortar complete to full depth. Contractor shall exercise all necessary care to protect adjacent units from loosening or damage, especially the faces and edges, and to protect adjacent sound mortar joints from cracking or otherwise breaking bond. Avoid further damage to units scheduled for removal.

2. Thoroughly clean resultant pocket of all loose mortar and other debris. Moisten pockets and adjacent surfaces prior to bedding of new units.

3. Install replacement units fully bedded in mortar in precise position and alignment for continuation of adjacent coursing and patterns. Do not attempt to reposition units after bedding mortar has set. Using hand tooling, compress bedding mortar in surrounding joints to sufficient depth to allow separate application of pointing mortar after bedding mortar has set. Execute final pointing and tooling of joints, only after bedding mortar has fully set.

N. Cleaning Masonry Veneer

1. The exposed face of all new and existing exterior veneer masonry shall be cleaned thoroughly from top down of all stains, mortar deposits and efflorescence. Proprietary cleaning compounds that are proposed for use shall be approved by the Engineer. Before applying the cleaning agent, it shall be applied to a Sample wall area of approximately 20 square feet in a location approved by the Engineer. No further cleaning work may proceed until the Sample application has been approved. Note that colored mortars are adversely affected by strong acid solutions. High-pressure water cleaning shall not be used.

O. Final Cleanup

1. At the conclusion of masonry work, remove all scaffolding and equipment used in the Work, clean up all debris, refuse, and surplus material, and remove from the premises. Remove Sample panel from premises after acceptance of the Work by the Engineer.

3.03 ENVIRONMENTAL CONDITIONS

A. Masonry work shall not be performed when climatic conditions or the limitations of the facilities furnished by the Contractor prevent setting and curing of mortar joints or obtaining proper bond.

B. Hot weather: When the ambient temperature exceeds 100°F, or exceeds 90°F with wind velocity exceeding 8 mph, the hot weather procedures of ACI 530.1 shall be implemented.

C. Cold weather: When the ambient temperature is below 40°F, the cold weather procedures of ACI 530.1 shall be implemented. Admixtures shall meet ASTM C1384 or ASTM C494, Type C, and shall not be used without the Engineer's written approval. Type III cement may be substituted for Type I and Type II cement in masonry grout.

D. Masonry not constructed in accordance with the protective measures listed above will be considered defective and rejected.

3.04 FIELD QUALITY CONTROL

A. Provide in accordance with Division 01 General Requirements.

3.05 CLOSEOUT ACTIVITIES

A. Provide in accordance with Division 01 General Requirements.

END OF SECTION

SECTION 05 50 00

METAL FABRICATIONS

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes

1. Provide the following metal fabrications in accordance with this Section and applicable reference standards listed in Article 1.03.

   a. Railings and components including mounting brackets
   b. Guard chains
   c. Bar racks
   d. Grating and grating supports not attached to structural steel
   e. Frames for miscellaneous openings
   f. Nosings for interior concrete stairs
   g. Hatches
   h. Miscellaneous steel items
   i. Expansion Bolts
   j. Adhesive Anchors
   k. Steel lintels and relieving angles not attached to structural steel
   l. Steel bollards
   m. Embedded metal items not receiving structural steel (excluding items embedded in precast concrete)
   n. Equipment supports not attached to structural steel
   o. Monorails not attached to structural steel and components including all connections and stops

2. Epoxy adhesive for installing drilled and epoxy rebar is specified in Section 03 16 00 CONCRETE SPECIALTIES.

B. Related Requirements

1. Division 03, Section 03 11 00 CONCRETE FORMING

2. Division 03, Section 03 16 00 CONCRETE SPECIALITIES

3. Division 04, Section 04 20 00 UNIT MASONRY

4. Division 09, Section 09 90 00 PAINTING AND COATING

1.02 PRICE AND PAYMENT PROCEDURES

A. Measurement and payment requirements: per Division 01 General Requirements.

1.03 REFERENCES

A. Reference Standards

1. AMERICAN CONCRETE INSTITUTE (ACI)

   a. ACI 355.2 Qualification of Post-Installed Mechanical Anchors in Concrete

   b. ACI 355.4 Qualification of Post-Installed Adhesive Anchors in Concrete Elements

2. AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

   a. AISC 303 Code of Standard Practice for Steel Buildings and Bridges

3. AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

   a. A14.3 American National Standard for Ladders-Fixed-Safety Requirements

4. AMERICAN WELDING SOCIETY (AWS)

   a. AWS D1.1 Structural Welding Code - Steel

   b. AWS D1.2 Structural Welding Code - Aluminum

   c. AWS D1.6 Structural Welding Code - Stainless Steel

5. ASTM INTERNATIONAL (ASTM)

   a. ASTM A6 Standard Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling

   b. ASTM A36 Standard Specification for Carbon Structural Steel

   c. ASTM A53 Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless

   d. ASTM A123 Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

   e. ASTM A153 Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware

   f. ASTM A239 Standard Practice for Locating the Thinnest Spot in a Zinc (Galvanized) Coating on Iron or Steel Articles

g. ASTM A325 Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength

h. ASTM A500 Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes

i. ASTM A563 Standard Specification for Carbon and Alloy Steel Nuts

j. ASTM A572 Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel

k. ASTM A653 Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process

l. ASTM A780 Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings

m. ASTM A992 Standard Specification for Structural Steel Shapes

n. ASTM A36 Standard Specification for Carbon Structural Steel

o. ASTM B209 Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate

p. ASTM B211 Standard Specification for Aluminum and Aluminum-Alloy Bar, Rod, and Wire

q. ASTM B308 Standard Specification for Aluminum-Alloy 6061-T6 Standard Structural Profiles

r. ASTM D6386 Standard Practice for Preparation of Zinc (Hot-Dip Galvanized) Coated Iron and Steel Product and Hardware Surfaces for Painting

s. ASTM F436 Hardened Steel Washers

t. ASTM F959 Compressible-Washer-Type Direct Tension Indicators for Use with Structural Fasteners

u. ASTM F1554 Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength

v. ASTM F1852 Standard Specification for "Twist Off" Type Tension Control Structural Bolt/Nut/Washer Assemblies, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength

6. ICC EVALUATION SERVICES (ICC-ES)

a. ICC-ES AC58 Acceptance Criteria for Adhesive Anchors in Masonry Elements

b. ICC-ES AC308 Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete Elements

7. NATIONAL ASSOCIATION OF ARCHITECTURAL METAL MANUFACTURERS (NAAMM)

   a. AMP 500 Metal Finishes Manual

   b. MBG 531 Metal Bar Grating Manual

   c. MBG 533 Welding Specification for Fabrication of Steel, Aluminum, & Stainless Steel Bar Grating

8. RESEARCH COUNCIL ON STRUCTURAL CONNECTIONS (RCSC)

   a. Specification for Structural Joints Using High-Strength Bolts

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination, Sequencing, and Scheduling: per Division 01 General Requirements.

1.05 SUBMITTALS

A. Submit in accordance with Division 01 General Requirements.

B. Shop Drawings

1. Details of connections, copes, splices, holes, hardware, finish, and other pertinent information

2. Anchor bolt embedment Drawings

3. Indicate welds by standard AWS symbol

4. Indicate bolts and identify slip-critical connections as applicable

5. Identify areas of slip-critical connections to be masked from shop painting

C. Product Data

1. Expansion Bolts

   a. ICC-ES Compliance Report

   b. Allowable and ultimate load tables per embedment depths

   c. Capacity reduction factors for bolt spacing and edge distances

   d. Installation Instructions including bolt torque

2. Adhesive Anchors

   a. ICC-ES Compliance Report

   b. Allowable and ultimate load tables per embedment depths

c. Storage requirements

d. Gel and cure times as a function of temperature

e. Installation temperature requirements

f. Drilling method (diamond drill bit shall be prohibited)

g. Drill bit diameter and depth of hole for each size anchor

h. Hole cleaning procedure and required condition of hole

i. Dual-nozzle instructions to ensure proper mixing

j. Hole Filling procedure

k. Time period anchor cannot be contacted or disturbed

D. Samples and Mockups: as specified in Article 1.06.

E. Manufacturer Instructions

F. Source and Field Quality Control Submittals

G. Certificates

1. Mill test reports for structural shapes, bolts, nuts, and washers

2. Welding certifications for welding procedures and personnel

H. Closeout and Maintenance Material Submittals: per Division 01 General Requirements.

1.06 QUALITY ASSURANCE

A. Provide in accordance with Division 01 General Requirements.

B. Samples

1. Railings indicating weld, splicing, and finish

2. Stair nosing

C. Epoxy Adhesive Installation Contractor Requirements

1. In structures assigned to Seismic Design Category C, D, E, or F as noted on the Drawings: qualified for earthquake loading (use in cracked concrete) in accordance with ACI 355.4.

2. Anchors installed horizontally or upwardly inclined: qualified in accordance with ACI 355.4 requirements for sensitivity to installation direction.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Provide in accordance with Division 01 General Requirements.

B. Assemble and ship ASTM F1852 and galvanized ASTM A325 bolt assemblies in the same container. Do not re-lubricate ASTM F1852 tension-control bolt assemblies.

C. Carefully unload material and equipment and stack to prevent deformation and damage. Store items on substantial pallets, dunnage, or other supports and spacers, free from the earth and properly drained, preventing splattering with dirt and other foreign matter.

D. Store material and equipment to permit easy access for inspection and identification. Protect from deterioration and maintain markings.

E. Provide protective storage for fastener components. Protect fastener components removed from protective storage from dirt and moisture in closed containers at the location of installation. Do not clean or modify fastener components from as-delivered condition. Do not use fastener components accumulating rust or dirt, and remove from the Site.

1.08 SITE CONDITIONS

A. Existing Conditions: per Division 01 General Requirements.

1.09 WARRANTY

A. Special Warranty/Extended Correction Period

1. Hatch covers: 5-year manufacturer’s warranty covering proper operation and defects in material or workmanship.

PART 2 – PRODUCTS

2.01 GENERAL

A. Make field measurements prior to fabrication to ensure proper fit. Report discrepancies in existing conditions that require detail changes to Engineer prior to fabrication.

B. Assemble built-up Work in sections in the shop as much as practicable and match mark components for field assembly.

C. Bolt holes (including those for attaching wood blocking and other components): by fabricator and not made or modified by burning.

D. Gauges

1. For iron sheets and steel: U.S. Standard

2. For non-ferrous products: Brown & Sharpe

3. For wire: United States Steel Wire

E. Weld carbon steel per ANSI/AWS D1.1, with electrodes with a tensile strength of 70 ksi.

F. Fusion weld aluminum by the inert gas-shielded arc method per ANSI/AWS D1.2. Use alloy rods similar to alloy being welded where appearance match is required. Alloy 4043 rods may be used where appearance is not a factor and anodizing is not required.

G. Weld stainless steel per AWS D1.6

H. Steel

1. Comply with AISC 303

2. Steel mill material tolerances: per ASTM A6

3. Steel W-shapes: ASTM A992 (50 ksi yield strength)

4. Steel channels and angles: ASTM A992 (50 ksi yield strength) ASTM A572 grade 50, or ASTM A36

5. Other steel shapes, plates and bars: ASTM A36

6. Steel pipe: ASTM A53, Grade B

7. Hollow structural shapes: ASTM A500, Grade B.

I. Bolts: ASTM A325 Type I, heavy-hex

J. Nuts: ASTM A563, heavy-hex

K. Washers: ASTM F436 hardened steel

L. Tension-control bolt assemblies: ASTM F1852 Type I, heavy-hex

M. Direct tension indicators: ASTM F959, Type 325, compressible washer type

N. Threaded rods: ASTM A36

O. Aluminum items: Fabricated from bars, plates, pipes, rolled and extruded shapes conforming to the following alloy designation unless otherwise specified.

1. Standard structural shapes: Rolled 6061-T6 per ASTM B308

2. Rolled rod and bar: 6061-T6 per ASTM B211

3. Sheets, Plates, Checkered Plates: 6061-T6 per ASTM B209

4. Bolts: 2024-T4

5. Nuts: 6061-T6

6. Washers: Alclad 2024-T4

P. Stainless steel items: Type 316 (Type 316L if welded)

2.02 ALUMINUM RAILING

A. Aluminum railing: All-welded construction formed of 1-1/2 inch round aluminum pipe.

B. Furnish railing in the largest practical sections with the locations and details of field connections indicated on Shop Drawings. Close exposed ends of railing members. After fabrication, clean, lightly circumferentially brush, caustic etch and clear anodize (0.4 mil minimum thickness) railings in accordance with NAAMM AMP 500, M3lC22A31.

C. Welds: Continuous at intersections and ground smooth on all exposed areas. Use radius corners only, do not use mitered corners. Where intersections occur, shape and cut pieces to fit with no distortion of the circular shape.

D. Posts

1. Schedule 80, alloy 6061-T6, single un-spliced pipe length

2. Spacing: Maximum 4-feet on centers measured along the rail

E. Rails

1. Schedule 40, alloy 6063-T6

2. Top rails

a. Continuous wherever possible with single un-spliced length attached to minimum of 3 posts.

b. At platforms and other level runs: 42 inches from the top of rail to floor, tank wall or other horizontal surface unless otherwise specified.

c. On stair flights: 42 vertical inches from the top of rail to a line connecting the toes of the treads.

3. Lower rails

a. Single, un-spliced length between posts

b. At level runs and at stairs: Approximately half the height of the top rail

F. Toeboard: Extruded aluminum toeboard 4-inches high, mechanically clamped to posts except where specifically shown to be omitted on Drawings. Do not weld, drill or screw directly to the posts.

G. Provide expansion joints at each railing and toe plate, allowing 1/2 inch of joint movement at each location and space at intervals of maximum 24 feet. Provide internal aluminum slip sleeve fastened securely to one side and extend a minimum of 2 inches beyond each side of the joint. Locate within 6 inches of posts.

H. On stairs: Provide additional (third) rail forming a handrail, bracketed off the vertical posts at height of 36 inches from the upper surface to a line connecting the toes of the treads. Provide 1.5-inch minimum clearance from posts and obstructions.

I. Completed railing structure and anchorage: Capable of withstanding the loads prescribed by the building code at Project location.

J. Mount railing posts into flanged cast or extruded aluminum sleeve brackets, and secure with stainless steel set screws. Support wall mounted railing with cast brackets and fasten with stainless steel expansion or toggle bolts.

K. Furnish removable railings where indicated on the Drawings, and mounted so that when the railing is removed, it is separated from the mounting bracket.

2.03 STEEL RAILING

A. Steel railing: 1-1/2 inch round steel pipe in all welded construction.

B. Furnish railing in the largest practical sections with the locations and details of field connections indicated on Shop Drawings. Close exposed ends of railing members.

C. Welds: Continuous at intersections and ground smooth on all exposed areas. Use radius corners only, do not use mitered corners. Where intersections occur, shape and cut pieces to fit with no distortion of the circular shape.

D. Posts

1. Schedule 40, single, un-spliced pipe length

2. Spacing: Maximum 6-feet on center measured along the rail

E. Rails

1. Schedule 40

2. Top rails

a. Continuous wherever possible with single un-spliced length attached to minimum of 3 posts.

b. At platforms and other level runs: 42 inches from the top of rail to floor, tank wall or other horizontal surface unless otherwise specified.

c. On stair flights: 42 vertical inches from the top of rail to a line connecting the toes of the treads.

3. Lower rails

a. Single un-spliced length between posts

b. At level runs and at stairs: approximately half the height of the top rail.

F. Toeboard: 4-inches high, 1/4 inch thick, connected to posts except where specifically shown to be omitted on the Drawings.

G. Provide expansion joints at each railing and toe plate, allowing 1/2 inch of joint movement at each location and space at intervals of maximum 24 feet. Provide internal slip sleeve fastened securely to one side and extend a minimum of 2 inches beyond each side of the joint. Locate within 6 inches of posts.

H. On stairs: Provide additional (third) rail forming a handrail, bracketed off the vertical posts at a height of 34 inches from the upper surface to a line connecting the toes of the treads. Provide 3-inch minimum clearance from posts and obstructions.

I. Completed railing structure and anchorage: Capable of withstanding the loads prescribed by the building code of Project location.

J. Support wall mounted railing with cast brackets and fasten with stainless steel expansion or toggle bolts.

K. Furnish removable railings where indicated on the Drawings, mounted so that when the railing is removed, it is separated from the mounting bracket.

L. Hot-dip galvanized steel railing per ASTM A123 after fabrication.

2.04 STEEL GUARD CHAIN

A. Manufacturers: Lawrence Metal Products, Inc., American Chain & Cable Co., Turner & Seymour Manufacturing Company, or equal.

B. Material: 3/16 inch diameter stainless steel wire with welded links, 13 links per foot. Permanently fasten each chain at one end, and provide with swivel snap hook to attach to the other end.

C. Provide in lengths sufficient to span openings with a minimal amount of slack.

2.05 BAR RACK

A. Material: 6061-T6 aluminum alloy stock per Drawings details.

B. Provide a rake for each rack per Drawings.

2.06 ALUMINUM GRATINGS AND FRAMES

A. Manufacturers: IKG Industries, Klemp Corporation, Ohio Gratings, Inc., or equal.

1. Grating: I-bar swage locked with 1/4 inch flanged bars at 1-3/16 inches on center and cross bars at 4 inches on center per NAAMM AMP 500, NAAMM MBG 531, and NAAMM MBG 533.

2. Supporting members: Aluminum of the size and shape per Drawings.

3. Grating: Alloy 6063-T6 bearing bars and alloy 6063-T5 cross bars with mill finish.

4. Straps, bolts, ties, and accessories: Aluminum

5. Band grating with 1/4 inch thick band of width equal to the full depth of grating, welded on at the ends of all sections and at openings.

6. Where not shown, provide suitable supporting members as required when span of grating changes direction.

B. Fasteners: manufacturer's standard clips using micarta between the aluminum and dissimilar materials.

C. Coat portions of aluminum to be embedded in, or in contact with, concrete with heavy bodied bituminous paint.

D. Limit grating sections to a size that can be removed by one man.

2.07 STEEL FRAMES FOR MISCELLANEOUS OPENINGS

A. Fabricate from structural shapes and plates in sizes per Drawings.

B. Accurately square, miter, butt, or cope frames. Weld flush and grind smooth.

C. Stops: Plug-welded and ground smooth.

D. Seal weld joints exposed to weather.

2.08 STAIR NOSING FOR INTERIOR CONCRETE STAIRS

A. Manufacturers: Style 801 with crosshatched surface by American Safety Tread Co.; Type 101 Alumogrit by Wooster Products, Inc., Type AX by Safe-T-Metal or equal.

B. Material: 4 inch width abrasive aluminum.

C. Fabricate to stop 6-inches from each end of tread.

2.09 EXPANSION BOLTS (INTO CONCRETE)

A. General: Torque controlled expansion anchor suitable for seismic loads and cracked concrete applications.

B. Material

1. AISI 316 stainless steel anchor body, nut, washer, and expansion sleeve, unless noted otherwise

C. Evaluation Requirements: ICC-ES evaluation report stating product is compliant with 2015 International Building Code and approved for use to resist static, wind and earthquake (Seismic Design Categories A through F) tension and shear loads in cracked and uncracked normal-weight concrete having a compressive strength of 2,500 psi to 8,500 psi. Evaluation reports with a listed renewal date month/year which is prior to the month/year the product is submitted for engineer's review will be rejected.

D. Approved expansions bolts

1. Simpson Strong-Tie: Strong-Bolt 2
    a. Compliance Report (ESR-3037)
2. Hilti: Kwik Bolt TZ
    a. Compliance Report (ESR-1917)
3. Powers: Power-Stud + SD6
    a. Compliance Report (ESR-2502)

2.10 EXPANSION BOLTS (INTO CMU)

A. General: Mechanical expansion anchor designed for anchorage to hollow masonry, solid masonry, and brick. Anchors shall be suitable for through-hole installation.

B. Material: AISI 304 stainless steel anchor components.

C. Approved Products

1. Simpson Stron-Tie
2. Hilti: HLC Sleeve Anchor
3. Powers: Lok-Bolt AS

2.11 ADHESIVE ANCHORS (INTO CONCRETE)

A. General: Epoxy adhesive for installing post-installed bolts into concrete denoted as “Adhesive Anchors” on drawings.

B. Evaluation Requirements: ICC-ES evaluation report stating product is compliant with 2015 International Building Code and approved for use to resist static, wind and earthquake (Seismic Design Categories A through F) tension and shear loads in cracked and uncracked normal-weight concrete having a compressive strength of 2,500 psi to 8,500 psi. Evaluation reports with a listed renewal date month/year which is prior to the month/year the product is submitted for engineer’s review will be rejected.

C. Epoxy adhesive for anchoring reinforcement to concrete shall be a 2 component solid epoxy based system supplied in manufacturer's standard side-by-side cartridge and dispensed through manufacturer's standard static-mixing nozzle. Epoxy adhesive shall be:

1. Simpson Strong Tie: SET-XP or ET-HP
    a. SET-XP Compliance Report (ESR-2508)
    b. ET-HP Compliance Report (ESR-3372)
2. Hilti: HIT-RE 500-SD
    a. Compliance Report (ESR-2322)
3. Powers: PE1000+
    a. Compliance Report (ESR-2583)

D. Epoxy adhesive shall pass the creep test requirements of ICC-ES AC58.

E. Hardware: From same manufacturer as epoxy adhesive for a complete anchoring system.

1. Threaded Steel Rods: Continuously threads (all-thread).

2. Material: AISI 316 stainless steel threaded steel rods, nut and washers, unless noted otherwise.

2.12 ADHESIVE ANCHORS (INTO MASONRY)

A. General: Adhesive anchor system for installing post-installed threaded steel rods to grouted and ungrouted CMU, solid and hollow brick walls, and unreinforced multiple wythe brick walls denoted as “Adhesive Anchors” on drawings.

1. All products shall be furnished by the same manufacturer including steel threaded rods, mesh screen tubes, adhesive, and installation equipment.

B. Evaluation Requirements: ICC-ES evaluation report stating product is compliant with 2015 International Building Code and approved to anchor building components to hollow (ungrouted) and fully grouted concrete masonry walls to resist static, wind , and earthquake loads.

C. Adhesive for anchoring reinforcement to masonry shall be furnished in a side-by-side cartridge and dispensed through manufacturer's standard static-mixing nozzle. Adhesive system shall be:

1. Simpson Strong Tie: SET-XP or ET-HP

a. SET Compliance Report (ESR-1772)

b. ET-HP Compliance Report (ESR-3638)

2. Hilti: HIT-HY 70

a. Compliance Report (ESR-3342)

3. Powers: AC100+ Gold

a. Compliance Report (ESR-3200)

D. Hardware: From same manufacturer as epoxy adhesive for a complete anchoring system.

1. Threaded Steel Rods: Continuously threads (all-thread).

2. Material: AISI 316 stainless steel threaded steel rods, nut and washers, unless noted otherwise.

3. Screen Tubes/ threaded insets: Manufacturer’s standard screen tubes or threaded inserts.

2.13 ALUMINUM HATCH COVERS

A. Manufacturers: Bilco Company, Halliday Products, Inc., Babcock-Davis, Syracuse Casting, or equal.

B. Styles, types and sizes: Per Drawings, and of single manufacturer. Sizes indicated on drawings is the required clear opening. Contractor shall box-out openings per manufacturer instructions to account for hatch frame thickness.

1. Type J and JD: Single leaf and double leaf, respectively, watertight, self-draining type

   a. Door leaf: 1/4-inch thick aluminum diamond pattern plate reinforced with aluminum stiffeners, capable of withstanding live load of 300 pounds per square foot or AASHTO H20 if indicated on drawings. Equip each door leaf with minimum 2 hinges with stainless steel pins, compression spring operators enclosed in telescopic tubes to afford easy operation.

   b. Provide automatic hold-open arm with vinyl grip handle to release cover for closing.

   c. Equip with snap lock and removable handle.

   d. Channel frame: 1/4-inch thick aluminum with anchor flange around the perimeter. Except where connected to a drainage system per Drawings, provide extension from frame drainage coupling to drain to area below.

   e. Mechanically attach a continuous EPDM debris gasket to frame. Provide 1-1/2 inch drainage coupling in channel frame.

   f. Hardware: Stainless steel with factory mill finish .

   g. Bituminous coating applied to areas to be embedded in concrete.

   h. Where not connected to a drainage system per Drawings with extensions to the drainage coupling to allow drainage to the area below.

2. Type K and KD: Single leaf and double leaf, respectively.

   a. Door leaf: 1/4-inch thick aluminum diamond pattern plate reinforced with aluminum stiffeners, capable of withstanding live load of 150 pounds per square foot. Equip door leaf with minimum 2 hinges bolted to underside and pivoted on torsion bars to counterbalance door for easy operation.

   b. Provide automatic hold-open arm at 90-degree open position, with vinyl grip handle to release cover for closing.

   c. Equip with snap lock and removable handle.

d. Channel frame: 1/4-inch thick extruded aluminum with built-in neoprene cushion and strap anchors.

e. Hardware: Stainless steel with factory mill finish.

f. Bituminous coating applied to areas to be embedded in concrete.

3. Type T: Same as Type K except provide recessed door leaf to receive floor covering.

C. Fall protection

1. Equip hatch covers with fall protection grating system of fiberglass or aluminum construction and 316 stainless steel hardware, with live load capacity of 300 psf.

2. Safety color: Orange or yellow

3. Provide with spring-loaded lifting handle and aluminum or stainless steel hold open arm and release handle, and automatic lock at 90-degree open position.

4. Provide capability for locking with padlock in the closed position.

2.14 MISCELLANEOUS STEEL ITEMS

A. Fabricate and furnish miscellaneous steel items, galvanized angles, relieving angles, plates, channels, and all required fastenings per Drawing details. Miscellaneous steel items shall be galvanized as specified.

2.15 STEEL LINTELS

A. Material: Galvanized steel in sizes and shapes per Drawings

B. Minimum bearing on the masonry: 8 inches, except as otherwise shown on Drawings

C. Lintel angles bolted to masonry or concrete lintels supporting masonry veneer: provide standard short slotted (SSL) bolt holes spaced per Drawings to permit longitudinal thermal expansion and contraction of lintel angles.

2.16 STEEL BOLLARDS

A. Pipe: ASTM A53/A53M, 6 inches nominal diameter, schedule 40, galvanized

B. Length: To allow bollards to extend 4 feet above and below grade, except as otherwise shown on the Drawings

2.17 SHOP COATING

A. Prepare ferrous items and paint per Section 09 90 00 PAINTING AND COATING, except where otherwise specified.

B. Do not prime paint galvanized steel not specified to be painted, stainless steel surfaces embedded in concrete or masonry (except for partially embedded components, extend priming 2 inches into the embedment), surfaces to be field welded, and faying surfaces at bolted connections designated as slip-critical.

C. Coat items specified as galvanized by the hot-dip process per ASTM A123, ASTM A153, or ASTM A653, as applicable, in molten zinc, to produce a continuous coating of uniform thickness of weight required by the referenced standards.

1. Coating: Commercial quality, free from injurious defects, flux and uncoated spots, and per ASTM A239: capable of enduring not less than 4 immersions in copper sulfate without penetration of the coating.

2. Identify galvanized items with a stamp showing the name of the galvanizer, the weight of the coating, and applicable ASTM compliance.

D. Galvanized steel specified to be painted

1. Do not quench.

2. Phosphatize and prepare to be painted per ASTM D6386

3. Prime with paint compatible with the finish paints specified in Section 09 90 00 PAINTING AND COATING.

2.18 SOURCE OF QUALITY CONTROL

A. Provide in accordance with Division 01 General Requirements.

PART 3 – EXECUTION

3.01 DISSIMILAR MATERIAL

A. Keep aluminum surfaces from direct contact with metals other than stainless steel by painting the dissimilar metal with a coating of zinc chromate paint, or provide non-absorptive tape between dissimilar metals.

B. Paint aluminum with a coat of bituminous paint where aluminum is embedded in, or comes in contact with, concrete, masonry or by-products of these materials.

3.02 STEEL CONNECTIONS

A. Comply with RCSC Specifications for Structural Joints Using ASTM A325 or A490 Bolts.

B. Design bolted connections as N-type bearing connections, installed snug-tight, except where shown as slip critical on Drawings.

C. Minimum size: 3/4 inch

D. Minimum number of bolts per connection: 2

E. Slip critical joints are required per Drawings and at connections that include oversized holes or slotted holes, including braces, except where the direction of the load is normal to the slot.

F. Where bolts are specified to be installed loose or finger tight, snug up the connection to ensure that plies are in contact. Then back off between 1/2 and 1 turn to permit intended movement of the connection. Provide double nuts on bolts to prevent loosening.

G. Weld steel per AWS D1.1. Grind exposed welds smooth.

3.03 INSTALLATION

A. Verify elevations of concrete and masonry bearing surfaces and locations of anchor rods, bearing plates, and other embedments. Clean concrete and masonry bearing surfaces of bond reducing materials and roughen surfaces prior to setting plates.

B. Set bearing plates using leveling nuts or galvanized leveling plates, and grout with non-shrink grout as specified in Section 03 16 00 CONCRETE SPECIALTIES. Promptly grout leveling plates after set and checked for line, levelness and elevation.

C. Grout bearing plates after framing is plumb when leveling nuts are used.

D. Concrete embedments: Installed under Section 03 11 00 CONCRETE FORMING

E. Bar rack components to be fastened to concrete: Install from field measurements of cast concrete.

F. Use stainless steel hardware when anchoring aluminum and in submerged locations.

G. Steel lintels and masonry embedments: Installed under Section 04 20 00 UNIT MASONRY

H. Steel bollards: Encased in concrete and filled inside of pipe per Section 03 30 00 CAST-IN-PLACE CONCRETE

3.04 BOLTS

A. Install bolts snug tight except where indicated as slip critical. Install bolt at least flush with the outer face of the nut. Cut off bolts projecting more than 5/8 inch beyond the nut in exposed Work as close to nut as possible and as directed.

B. Provide required cutting, fitting, drilling, and tapping. Do not use thermal cutting during installation and erection. Do not make or modify bolt holes by burning.

3.05 ADHESIVE BOLTS

A. Installation: Per manufacturer's installation instructions and as listed in the product ICC-ES Evaluation Report.

B. Drilled and epoxied bolts shall be installed in concrete having a minimum age of 21 days at time of installation.

C. All cartridges shall have the expiration date clearly visible. Material past its expiration date shall not be used, and shall be immediately removed from the Site.

D. Diamond drill bits are not permitted. Hammer drills shall be used.

E. Drill Holes

1. Diameter: Per manufacturer's instructions

2. Embedment: Manufacturer's standard embedment for anchor size, unless noted otherwise on drawings. Depth stop shall be used to ensure correct drilling depth.

3. Installation Torque: Per manufacturer's instructions

F. The initial material extruded from each cartridge shall be discarded in accordance with the manufacturer's instructions to ensure that all material is properly mixed.

G. Drilled holes shall be blown out with air, thoroughly wire brushed with a repeated back and forth movement, blown out, thoroughly wire brushed, and blown out again. Adhesive shall be injected, starting from the bottom of the hole and slowly withdrawn as filling progresses to prevent air pockets.

H. Installed bolt shall remain completely undisturbed between the manufacturer's specified gel time and the full cure time. Zero load shall be applied during this time.

3.06 EXPANSION BOLTS

A. Installation: Per manufacturer's installation instructions and as listed in the product ICC-ES Evaluation Report.

B. Drill Holes

1. Diameter: Per manufacturer's instructions

2. Embedment: Manufacturer's standard embedment for anchor size, unless noted otherwise on drawings. Depth stop shall be used to ensure correct drilling depth

C. Installation Torque: Per manufacturer's instructions

3.07 ALUMINUM GRATINGS, SUPPORTS, AND NECESSARY ACCESSORIES

A. Components embedded in concrete: installed under Section 03 11 00 CONCRETE FORMING

3.08 STAIR NOSINGS FOR INTERIOR CONCRETE STAIRS

A. Install per Section 03 11 00 CONCRETE FORMING, and anchor in accordance with manufacturer's recommendations.

3.09 FIELD TOUCH UP

A. Where galvanized steel is field cut and locations where galvanized coating is removed: Touch up steel surface with zinc rich paint meeting ASTM A780 and containing a minimum of 65 percent zinc at locations.

3.10 CLEANING

A. Immediately after installation, round or chamfer sharp edges and grind burrs, jagged edges and surface defects smooth. Remove weld splatter.

3.11 FIELD QUALITY CONTROL

A. Provide in accordance with Division 01 General Requirements.

3.12 CLOSEOUT ACTIVITIES

A. Provide in accordance with Division 01 General Requirements.

END OF SECTION

SECTION 06 10 00

ROUGH CARPENTRY

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes

1. Provide materials, tools, equipment and labor required to furnish, fabricate and complete the rough carpentry work in accordance with this Section and applicable reference standards listed in Article 1.03.

2. Items to be embedded in concrete and masonry shall be furnished under this section, but installed under Division 03, Concrete, or Division 04, Masonry.

1.02 PRICE AND PAYMENT PROCEDURES

A. Measurement and payment requirements: per Division 01 General Requirements.

1.03 REFERENCES

A. Reference Standards

1. ASME INTERNATIONAL (ASME)

   a. ASME B18.2.1 Square and Hex Bolts and Screws (Inch Series)

   b. ASME B18.6.1 Wood Screws (Inch Series)

2. ASTM INTERNATIONAL (ASTM)

   a. ASTM A153/A153M Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware

   b. ASTM A563 - Standard Specification for Carbon and Alloy Steel Nuts

   c. ASTM D2559 Standard Specification for Adhesives for Bonded Structural Wood Products for Use Under Exterior Exposure Conditions

   d. ASTM E84 Standard Test Method for Surface Burning Characteristics of Building Materials

   e. ASTM F1554 Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength

   f. ASTM F1667 Driven Fasteners: Nails, Spikes, and Staples

3. AMERICAN WOOD PROTECTION ASSOCIATION (AWPA)

   a. AWPA U1 Use Category System: User Specification for Treated Wood

4. ICC-EVALUATION SERVICES

   a. ESR-1539 Power-Driven Staples and Nails

5. NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY (NIST)

   a. NIST PS 1 DOC Voluntary Product Standard PS 1-07, Structural Plywood

   b. NIST PS 20 American Softwood Lumber Standard

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination, Sequencing, and Scheduling: per Division 01 General Requirements.

1.05 SUBMITTALS

A. Submit in Accordance with Division 01 General Requirements.

B. Product Data

1. Engineered Wood Products: including manufacturer's load tables

2. Building Paper

3. Metal Framing Anchors

4. Wood Treatment Data: including chemical treatment manufacturer's instructions for storage, handling, installation and finishing

5. Water-Borne-Treated Products: include statement that moisture content of treated materials was reduced to levels indicated prior to shipment to Project Site

6. Warranty of chemical treatment manufacturer for each type of treatment

C. Material Certificates

1. For dimension Lumber, indicating species and grade for each use, and compliance with minimum specified allowable unit stresses per values approved by the American Lumber Standards Committee.

2. 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.

3. For fire-retardant-treated wood products include certification by treating plant that treated material complies with specified standard.

4. Certificates of inspection stating species and grades of plywood used for roof and wall sheathing

1.06 QUALITY ASSURANCE

A. Provide in accordance with Division 01 General Requirements.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Provide in accordance with Division 01 General Requirements.

B. Keep materials under cover and dry. Protect against exposure to weather and contact with damp or wet surfaces. Stack lumber and plywood; provide for air circulation within and around stacks and under temporary coverings including polyethylene and similar materials.

C. For lumber and plywood pressure-treated with waterborne chemicals, place spacers between each bundle to provide air circulation.

1.08 SITE CONDITIONS

A. Existing Conditions: per Division 01 General Requirements.

PART 2 – PRODUCTS

2.01 LUMBER GENERAL

A. Furnish lumber manufactured to comply with NIST PS 20 and with applicable grading rules of inspection agencies certified by ALSC Board of Review.

B. Inspection Agencies

1. RIS - Redwood Inspection Service

2. SPIB - Southern Pine Inspection Bureau

3. WCLIB - West Coast Lumber Inspection Bureau

4. WWPA - Western Wood Products Association

5. NELMA - Northeastern Lumber Manufacturers Association

6. NSLB - Northern Softwood Lumber Bureau

7. NLGA - National Lumber Grades Authority

C. Each piece of lumber shall factory-marked with grade stamp of inspection agency indicating grade, species, and moisture content at time of surfacing and milling.

D. Nominal sizes are indicated, except as shown by detail dimensions. Provide actual sizes as required by NIST PS 20 for moisture content specified for each use.

1. Provide dressed lumber, S4S, unless otherwise indicated.

2. Provide lumber with 19 percent maximum moisture content at time of dressing and shipment for sizes 2 inches or less in nominal thickness, unless otherwise indicated.

2.02 DIMENSION LUMBER

A. For structural framing (2 to 4 inches nominal thickness) provide the following (size factors NOT included):

1. Allowable bending stress of 575 psi minimum (661 psi under repetitive member use); allowable compressive stress parallel to the grain of 825 psi minimum; and a modulus of elasticity of 1,100,000 psi minimum. These values are for No. 2 Eastern Softwoods graded under NELMA or NSLB. Other species and grades meeting these properties are acceptable.

B. Top sill plate shall meet the specifications for dimension lumber. Bottom sill plate shall meet the specifications for miscellaneous lumber.

2.03 BOARDS

A. Exposed Boards: 15 percent maximum moisture content: Eastern White Pine, Idaho White, Lodgepole, Ponderosa, or Sugar Pine; D Select (Quality), grade per NELMA, NLGA, WCLIB, or WWPA. Exposed boards shall be pre-primed.

B. Concealed Boards: 15 percent maximum moisture content: Hem-Fir (North), Spruce-Pine-Fir (South), Spruce-Pine-Fir; Construction or 2 Common, grade per NELMA, NLGA, WCLIB, or WWPA.

2.04 MISCELLANEOUS LUMBER

A. Provide miscellaneous lumber for support and attachment of other construction, including bottom sill plate, nailers, blocking, furring, and similar members. Provide 19 percent maximum moisture content at time of dressing & shipment; Hem-Fir, Hem-Fir (North), Spruce-Pine-Fir; Construction or No. 2 grade per NELMA, NLGA, WCLIB, or WWPA.

B. Fabricate miscellaneous lumber from dimension lumber of sizes indicated and into shapes shown.

2.05 ENGINEERED WOOD PRODUCTS

A. General

1. Provide engineered wood products for which current model code evaluation/research reports provide evidence of compliance for the indicated application and the building code of Project state.

B. Plywood Sheathing

1. All sheathing shall conform to NIST PS 1, and shall be factory marked.

2. Roof sheathing: 5/8 inch APA Rated Sheathing, 32/16, C-D Grade; Exposure 1 Durability; ply clips as required

3. Wall sheathing: 1/2 inch APA Rated Sheathing, C-D Grade, Exposure 1 Durability

2.06 BACKING PANELS

A. Plywood panels for mounting electrical or telephone equipment: provide fire-retardant-treated plywood panels with grade designation, NIST PS 1 A-C, Exterior, not less than 3/4 inch.

2.07 FASTENERS

A. Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture. Provide fasteners with a hot-dip zinc coating per ASTM A153/A153M or of Type 304 stainless steel. Where in contact with pressure-treated wood, use hot-dip galvanized or Type 316 stainless steel, and as noted. Use Type 316 stainless steel where stainless steel framing anchors are used.

B. Nails, Brads, and Staples: ASTM F1667. Nails shall be common nails, except as otherwise noted.

C. Power Driven Fasteners: ESR-1539

D. Wood Screws: ASME B18.6.1

E. Lag Bolts: ASME B18.2.1

F. Anchor Bolts: Steel bolts complying with ASTM F1554, Grade 36; with ASTM A563 hex nuts and where indicated, flat washers.

2.08 METAL FRAMING ANCHORS

A. Provide metal framing anchors of type, size, metal, and finish indicated that comply with requirements specified including the following

1. Provide products for which current model code evaluation/research reports provide evidence of compliance for the indicated application and the building code of Project state.

2. Provide products for which manufacturer publishes allowable design loads that are determined from empirical data or by rational engineering analysis and that are demonstrated by comprehensive testing performed by a qualified independent testing laboratory.

3. Where in contact with pressure-treated wood, provide stainless steel or hot-dip galvanized steel with minimum G185 coating (1.85-ounce zinc per square foot).

2.09 PRESERVATIVE TREATED WOOD

A. Where lumber or plywood is indicated as pressure-treated, preservative-treated, or is specified herein to be treated, comply with applicable requirements of AWPA U1 Commodity Specifications A-Sawn Products for lumber, and F-Wood Composites for plywood.

B. Pressure-treat items with water-borne preservative chemicals, legal for use in the Project state, with a minimum chemical preservative retention of 0.25 per cubic foot. After treatment, kiln-dry lumber and plywood to a maximum moisture content, of 19 percent for lumber and 15 percent for plywood. Discard materials that are warped or that do not comply with requirements for untreated materials.

C. Treat indicated items and: bottom wood sill plate, sleepers, blocking, furring, stripping, and similar members in contact with masonry or concrete.

2.10 BUILDING PAPER

A. Nonwoven non-perforated, spun bonded polypropylene weather membrane with micro porous coating, Tyvek by DuPont, Typar by BBA Fiberweb, Weather Trek by Valeron, or approved equal. Provide compatible sealing tape.

2.11 SILL SEAL

A. Flexible polyethylene foam gasketing strip, 1/4 inch thick by 5-1/2 inch wide. Styrofoam Sill Seal by Dow, Reflectix Sill Sealer by Reflectix Inc., Slex Sill Sealer by Protecto Wrap, or equal.

2.12 SOURCE QUALITY CONTROL

A. Provide in accordance with Division 01 General Requirements.

PART 3 – EXECUTION

3.01 INSTALLATION - GENERAL

A. Discard pieces with defects that impair quality of rough carpentry construction and that are too small to use in fabricating rough carpentry with minimum joints or optimum joint arrangement.

B. Set rough carpentry to required levels and lines, with members plumb and true to line and 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. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated.

E. Countersink nail heads on exposed carpentry work and fill holes.

F. Use common wire nails, unless otherwise indicated. Use finishing nails for finish work. Select fasteners of size 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 of wood; predrill as required.

3.02 SILL PLATES

A. The bottom sill plate attached to the concrete foundation shall be pressure-treated. The top sill plate that is attached to the bottom sill plate shall not be pressure-treated, and shall comply with the Specifications for Dimension Lumber.

B. Prior to bolting to the foundation, 2 by 6 sill plates shall be nailed together with 2 rows of 10D galvanized common nails spaced 9 inches on center. Adjacent nails within each row shall be driven from opposite sides. Rows shall be spaced approximately 2-1/2 inches apart and not greater than 3 inches apart. Nail edge distance shall be approximately 1-1/2 inches and not less than 1 inch. Where sill plate segments terminate at the same location, nail rows shall terminate 2-1/2 inches from the end; alternatively, sill plates shall be spliced with a minimum stagger of 4 feet.

C. Bottom sill plate shall be isolated from concrete with specified sill seal.

3.03 WOOD NAILERS AND BLOCKING

A. Install wood nailers and blocking where shown and where required for attachment of other work. Form to shapes as shown and as required for true line and level of work to be attached. Coordinate location with other work involved.

B. Attach to substrates as required to support applied loading. Countersink bolts and nuts flush with surfaces, unless otherwise indicated.

3.04 FURRING

A. Install plumb and level with closure strips at edges and openings. Shim with wood as required for tolerance of finished work.

B. Firestop furred spaces on walls at each floor level and at ceiling line of top story, with wood blocking or noncombustible materials, accurately fitted to close furred spaces.

3.05 FRAMING – GENERAL

A. Anchor and nail as shown, and to comply with the following:

1. ESR-1539

2. Published requirements of manufacturer of metal framing anchors

B. Do not splice structural members between supports.

C. Firestop concealed spaces of wood frame walls and partitions at each floor level and at the ceiling line of the top story. Where firestops are not automatically provided by the framing system used, use closely fitted wood blocks of nominal 2 inch thick lumber of the same width as framing members.

3.06 STUD FRAMING

A. Arrange studs so that wide face of stud is perpendicular to direction of wall or partition and narrow face is parallel. Install double bottom plate and double top plates using nominal 2 inch thick members whose widths equal that of studs; except single top plate may be used for non-load-bearing partitions. Nail or anchor plates to supporting construction.

B. For exterior walls and interior load bearing and/or shear walls, install 2 inch by 6 inch wood studs spaced as indicated, unless noted otherwise. Provide blocking, same size as studs, at all plywood panel edges.

C. Construct corners and intersections with not less than 3 studs. Install miscellaneous blocking and framing as shown as required for support of facing materials, fixtures, specialty items, and trim. Install continuous horizontal blocking row at mid-height of single-story non-load-bearing partitions over 8 feet high using 2-inch thick members of same width as wall or partitions unless noted otherwise on Drawings.

D. Frame openings with multiple trimmer studs and headers. Install nailed header members of thickness equal to width of studs. Set headers on edge and support on trimmer studs.

1. For non-bearing partitions, install double trimmer studs and headers not less than 4 inches deep for openings 3 feet and less in width, and not less than 6 inches deep for wider openings.

2. For load-bearing partitions, install double trimmer studs for openings 6 feet and less in width, and triple trimmer studs for wider openings.

3.07 ROOF SHEATHING

A. Configuration of panel sheets shall be as shown on the Drawings. Panel sheets shall span perpendicular to supporting members.

B. Blocking: Continuous at ridge; as shown on the Drawings at eaves; additional continuous blocking where shown on the Drawings.

C. Nailing: As shown on Drawings

D. Panels shall be placed with 1/16-inch clearance at end joints and 1/8 inch clearance at side joints.

3.08 WALL SHEATHING

A. Panel sheets shall span perpendicular to supporting studs.

B. Blocking at all panel edges.

C. The bottom of the wall sheathing shall be nailed to upper sill plate.

D. 8d Nailing: 6 inches on center at panel edges, 12 inches on center at intermediate supports.

E. Panels shall be placed with 1/16 inch clearance at end joints and 1/8 inch clearance at side joints.

3.09 LAMINATED VENEER LUMBER

A. Beams and connections shall be installed in accordance with the building code of the Project state, manufacturer's recommendations, and as indicated on the Drawings.

B. Beam connections shall be concealed for all members that will be exposed to view.

3.10 BUILDING PAPER

A. Apply building paper horizontally with 2-inch overlap and 6-inch end lap; fasten to sheathing with galvanized staples or roofing nails. Cover upstanding flashing with 4-inch overlap. Tape vertical seams.

3.11 FIELD QUALITY CONTROL

A. Provide in accordance with Division 01 General Requirements.

3.12 CLOSEOUT ACTIVITIES

A. Provide in accordance with Division 01 General Requirements.

END OF SECTION

SECTION 06 17 53

SHOP FABRICATED WOOD TRUSSES

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes

1. Provide metal-plate-connected wood trusses in accordance with this Section and applicable reference standards listed in Article 1.03.

2. The Work of this section comprises all materials, tools, equipment and labor required to furnish, fabricate and install the metal-plate-connected wood trusses as shown on the Drawings, specified herein, and evidently required to complete the Work.

1.02 PRICE AND PAYMENT PROCEDURES

A. Measurement and payment requirements: per Division 01 General Requirements.

1.03 REFERENCES

A. Reference Standards

1. AMERICAN FOREST & PAPER ASSOCIATION (AF&PA)

   a. AF&PA T101 National Design Specification (NDS) for Wood Construction

2. ASME INTERNATIONAL (ASME)

   a. ASME B18.2.1 Square and Hex Bolts and Screws (Inch Series)

   b. ASME B18.6.1 Wood Screws (Inch Series)

3. ASTM INTERNATIONAL (ASTM)

   a. ASTM A153/A153M Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware

   b. ASTM A653/A653M Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process

   c. ASTM F1667 Driven Fasteners: Nails, Spikes, and Staples

4. ICC-EVALUATION SERVICES

   a. ESR-1539 Power-Driven Staples and Nails

5. NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY (NIST)

   a. NIST PS 20 American Softwood Lumber Standard

6. TRUSS PLATE INSTITUTE (TPI)

   a. TPI 1 National Design Standard for Metal Plate Connected Wood Truss Construction; Commentary and Appendices

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination, Sequencing, and Scheduling: per Division 01 General Requirements.

1.05 SUBMITTALS

A. Submit in accordance with Division 01 General Requirements.

1. Shop Drawings

   a. Lumber species and group, size, and stress grade for each truss component

   b. Span, pitch, configuration, and spacing for each truss

   c. Size, material, finish, locations of connector plates

   d. Bearing details: Truss connectors for each location where trusses are supported by other trusses

   e. Design loads, load combinations, and allowable and actual stresses

   f. Permanent bracing requirements and details

   g. Shop Drawings shall be stamped by a professional Engineer licensed in the Project state.

2. Product Data

   a. Lumber, hardware, metal connector plates, and fasteners

   b. Wood Treatment Data: including chemical treatment manufacturer's instructions for storage, handling, installation, and finishing

3. Material Certificates

   a. Certificates of inspection stating species, grade, and percent moisture content of all lumber used in truss fabrication

   b. Certification by treating plant, stating type of preservative solution, pressure process used, net amount of preservative retained, and compliance with applicable standards

c. Water-Borne-Treated Products: include statement that moisture content of treated materials was reduced to levels indicated prior to shipment to Project Site.

d. Warranty of chemical treatment manufacturer for each type of treatment.

4. Manufacturer's Instructions

a. Requirements for handling, storage, erection, temporary and permanent bracing, and connections

1.06 QUALITY ASSURANCE

A. Provide in accordance with Division 01 General Requirements.

B. Truss manufacturer shall be a member of the Truss Plate Institute (TPI), and shall comply with TPI quality control procedures for the manufacturer of connector plates published in TPI 1.

C. Manufacturer shall comply with applicable requirements of TPI 1.

D. Manufacturer shall comply with applicable requirements of AF&PA T101.

E. A professional Engineer licensed in the Project state, who is experienced in the design of wood trusses similar to those used in the Work, with a successful record of in-service performance, shall be responsible for the truss designs, and shall sign and stamp the Shop Drawings.

F. Connector plates and wood trusses shall each be provided by a single manufacturer.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Provide in accordance with Division 01 General Requirements.

B. Comply with manufacturer's instructions and TPI recommendations for handling and storing trusses. Avoid damage from improper handling which can induce stresses the trusses are not designed to resist.

C. Stack trusses off the ground. Protect from rain and snow inside a well-ventilated enclosure.

D. Contractor shall coordinate delivery and erection of trusses to avoid lengthy on-site storage.

E. Defective or damaged trusses shall be removed from the Site and replaced by the Contractor, at no additional cost to the Owner.

1.08 SITE CONDITIONS

A. Existing Conditions: per Division 01 General Requirements.

PART 2 – PRODUCTS

2.01 METAL CONNECTOR PLATES

A. Fabricate connector plates from hot-dip galvanized steel sheet complying with ASTM A653/A653M, grade A, G60. Minimum-coated metal thickness is 0.036 inches.

B. Acceptable manufacturers include, but are not limited to:

1. Alpine Engineered Products, Inc.,

2. Truswal Systems Corporation,

3. MiTek Industries, Inc.

2.02 LUMBER

A. Each piece of lumber shall be factory marked with grade stamp of inspection agency indicating type, grade, species, and moisture content at time of surfacing and milling, and grading agency.

B. Lumber shall comply with NIST PS 20 and with applicable grading rules of inspection agencies certified by the American Lumber Standards Committee (ALCS) Board of Review. Machine stress rated (MSR) lumber grades shall be used except that visual graded lumber may be used for web members.

C. Inspection agencies include the following:

1. SPIB - Southern Pine Inspection Bureau

2. WCLIB - West Coast Lumber Inspection Bureau

3. WWPA - Western Wood Products Association

D. Provide dressed lumber, S4S, manufactured to sizes required by NIST PS 20. Lumber shall have 19 percent maximum moisture content at time of dressing and shipment for dimension lumber, except as otherwise indicated.

2.03 PRESERVATIVE TREATED WOOD

A. Where trusses are indicated as pressure-treated or preservative-treated, comply with applicable requirements of AWPA C2.

B. Pressure-treat lumber with water-borne preservative chemicals, legal for use in the Project state, with a minimum chemical preservative retention of 0.25 per cubic foot. After treatment, kiln-dry lumber to a maximum moisture content of 19 percent. Discard warped lumber that doesn't comply with requirements for untreated lumber.

2.04 BRACING

A. Sway bracing, lateral bracing, and runners shall be provided as recommended by the truss manufacturer. Permanent truss diagonal web bracing shall be coordinated with web lateral bracing as required by the truss designer.

2.05 FASTENERS

A. Provide fasteners of size and type indicated, with a galvanized coating per ASTM A153/A153M, or AISI Type 304 stainless steel.

B. Nails, brads, and staples shall conform to ASTM F1667.

C. Power driven fasteners shall conform to ESR-1539.

D. Wood screws shall conform to ASME B18.6.1.

E. Lag bolts shall conform to ASME B18.2.1.

2.06 METAL FRAMING ANCHORS

A. Provide metal framing anchors of type, size, and finish indicated, that comply with requirements specified including the following:

1. Current model code evaluation/research reports that provide evidence of compliance for the indicated application and the building code of Project state.

2. Manufacturer published allowable design loads that are determined from empirical data or by rational engineering analysis, and that are demonstrated by comprehensive testing performed by a qualified independent testing laboratory.

3. Galvanized anchors shall be manufactured from ASTM A653/A653M, Grade A, G60 zinc coated by the hot-dip process on continuous lines prior to fabrication.

4. Truss tie-downs (hurricane ties) shall be as indicated on the Drawings.

5. Acceptable manufacturers include, but are not limited to:

a. Alpine Engineered Products, Inc.

b. Simpson Strong-Tie Company, Inc.

c. United Steel Products Company, Inc.

2.07 FABRICATION

A. Cut truss members to accurate lengths, angles, and sizes to produce close-fitting joints with wood-to-wood bearing in assembled units.

B. Assemble truss members using jigs or other means to ensure uniformity and accuracy of assembly, with joints closely fitted to comply with specified tolerances.

C. Fabricate metal connector plates to size, configuration, thickness, and anchorage required to withstand design loads.

D. Metal connector plates shall be accurately located and securely fastened to each side of wood members.

E. Finished trusses shall conform to the following tolerances:

1. Overall length and height of each truss shall be accurate within 1/4 inch.

2. Chord members shall be straight between panel points within 1/4 inch.

3. Camber shall be measured with the truss supported at its normal bearing points and supporting its own weight, and shall be within 1/8 inch. Trusses shall be designed such that there is no camber when subjected to full dead load.

F. Ends of chords shall be cut to exact design length and bevel. Bearing surfaces shall be flat and square across. Foreign matter shall be cleaned from bearing surfaces.

2.08 SOURCE QUALITY CONTROL

A. Provide in accordance with Division 01 General Requirements.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Erect and brace trusses to comply with applicable requirements of TPI standards specified herein.

B. Trusses shall not be altered in the field, except for minor modifications as approved by the Engineer. Trusses that do not fit shall be returned to the fabricator and replaced with properly sized trusses.

C. Trusses shall be erected with the plane of the truss webs vertical and parallel to each other. Trusses shall be accurately located at the proper design spacing.

D. Trusses shall be hoisted into place by means of lifting equipment suited to sizes and types of trusses. Care shall be taken not to damage truss members or joints by out-of-plane (weak axis) bending and other causes.

E. Trusses shall be securely anchored at all bearing points. Toe nailing truss bottom chords to wall top plates at bearing locations shall be prohibited due to the likelihood for splitting the truss chord.

F. Install permanent bracing to ensure trusses maintain design spacing along their span and properly withstand all design loads.

3.02 FIELD QUALITY CONTROL

A. Provide in accordance with Division 01 General Requirements.

3.03 STARTUP & COMMISSIONING

A. Provide in accordance with Division 01 General Requirements.

3.04 CLOSEOUT ACTIVITIES

A. Provide in accordance with Division 01 General Requirements.

END OF SECTION

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SECTION 06 20 00

FINISH CARPENTRY

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes

1. Provide the following finish carpentry in accordance with this Section and applicable reference standards listed in Article 1.03:

a. Exterior trim

b. Interior trim

B. Related Requirements

1. Division 07, Section 07 92 00 JOINT SEALANTS

2. Division 09, Section 09 90 00 PAINTING AND COATING

1.02 PRICE AND PAYMENT PROCEDURES

A. Measurement and payment requirements: per Division 01 General Requirements.

1.03 REFERENCES

A. Reference Standards

1. AMERICAN HARDBOARD ASSOCIATION (AHA)

a. AHA A135.6 Hardboard Siding

2. AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

a. ANSI A208.1 Mat-Formed Wood Particle Board

b. ANSI B18.2.1 Square and Hex Bolts and Screws Inch Series

c. ANSI B18.6.1 Wood Screws

3. AMERICAN WOOD-PRESERVERS' ASSOCIATION (AWPA)

a. AWPA C1 All Timber Products - Preservative Treatment by Pressure Processes

b. AWPA C2 Lumber, Timber, Bridge Ties and Mine Ties - Preservative Treatment by Pressure Processes

c. AWPA C20 Structural Lumber Fire-Retardant Treatment by Pressure Processes

d. AWPA C27Plywood - Fire-Retardant Treatment by Pressure Processes

e. AWPA C9 Plywood - Preservative Treatment by Pressure Processes

f. AWPA M2 Standard for Inspection of Treated Wood Products

g. AWPA M4 Standard for the Care of Preservative-Treated Wood Products

4. APA - THE ENGINEERED WOOD ASSOCIATION (APA)

a. APA E445S Performance Standards and Qualification Policy for Structural-Use Panels (APA PRP-108)

5. ARCHITECTURAL WOODWORK INSTITUTE (AWI)

a. AWI Qual. Stds. AWI Quality Standards

6. ASME INTERNATIONAL (ASME)

a. ASME B18.2.2 Square and Hex Nuts

7. ASTM INTERNATIONAL (ASTM)

a. ASTM A 687 Standard Specification for High-Strength Nonheaded Steel Bolts and Studs

b. ASTM D 2898 Accelerated Weathering of Fire-Retardant- Treated Wood for Fire Testing

c. ASTM F 547 Nails for Use with Wood and Wood-Base Materials

8. BUILDERS HARDWARE MANUFACTURERS ASSOCIATION (BHMA)

a. BHMA A156.9 Cabinet Hardware

9. HARDWOOD PLYWOOD AND VENEER ASSOCIATION (HPVA)

a. HPVA HP-1 American National Standard for Hardwood and Decorative Plywood

10. NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

a. NEMA LD 3 High-Pressure Decorative Laminates

11. NATIONAL HARDWOOD LUMBER ASSOCIATION (NHLA)

a. NHLA Rules - Rules for the Measurement & Inspection of Hardwood & Cypress

12. NORTHEASTERN LUMBER MANUFACTURERS ASSOCIATION (NELMA)

    a. NELMA Grading Rules - Standard Grading Rules for Northeastern Lumber

13. REDWOOD INSPECTION SERVICE (RIS) OF THE CALIFORNIA REDWOOD ASSOCIATION (CRA)

    a. RIS Grade Use - Redwood Lumber Grades and Uses

14. SOUTHERN CYPRESS MANUFACTURERS ASSOCIATION (SCMA)

    a. SCMA Spec - Standard Specifications for Grades of Southern Cypress

15. SOUTHERN PINE INSPECTION BUREAU (SPIB)

    a. SPIB 1003 Standard Grading Rules for Southern Pine Lumber

16. U.S. DEPARTMENT OF COMMERCE (DOC)

    a. PS-58 Basic Hardboard

    b. PS1 Construction and Industrial Plywood (APA V995)

    c. PS2 Wood-Based Structural-Use Panels (APA 5350)

    d. PS20 American Softwood Lumber Standard

17. WEST COAST LUMBER INSPECTION BUREAU (WCLIB)

    a. WCLIB 17 Standard Grading Rules

18. WESTERN WOOD PRODUCTS ASSOCIATION (WWPA)

    a. WWPA G-5 Western Lumber Grading Rules

19. WINDOW AND DOOR MANUFACTURERS ASSOCIATION (WDMA)

    a. WDMA I.S. 4 Water-Repellent Preservative Non-Pressure Treatment for Millwork

20. WOOD MOULDING AND MILLWORK PRODUCERS ASSOCIATION (WMMPA)

    a. WMMPA WM 6 Industry Standard for Non-Pressure Treating of Wood Millwork

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination, Sequencing, and Scheduling: per Division 01 General Requirements.

1.05 SUBMITTALS

A. Submit in accordance with Division 01 General Requirements.

B. Product data for wood items and trim

C. Samples for hardwood interior window trim and treated exterior composite trim

D. Certificates of grade from the grading agency on graded but unmarked lumber or plywood attesting that materials meet the grade requirements specified

E. Certificates of compliance unless materials bear certification markings or statements

1.06 QUALITY ASSURANCE

A. Provide in accordance with Division 01 General Requirements.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Provide in accordance with Division 01 General Requirements.

B. Deliver lumber, plywood, trim, and millwork to job Site in an undamaged condition. Stack materials to ensure ventilation and drainage. Protect against dampness before and after delivery. Store materials under cover in a well-ventilated enclosure and protect against extreme changes in temperature and humidity. Do not store products in building until wet trade materials are dry.

1.08 SITE CONDITIONS

A. Existing conditions: per Division 1 General Requirements.

PART 2 – PRODUCTS

2.01 WOOD

A. Identify each piece or each bundle of lumber, millwork, and trim by the grade mark of a recognized association or independent inspection agency that is certified by the Board of Review, American Lumber Standards Committee, to grade the species.

B. Sizes and Patterns of Wood Products: Yard and board lumber sizes shall conform to PS20. Provide shaped lumber and millwork in the patterns indicated and standard patterns of the association covering the species. Size references, unless otherwise specified, are nominal sizes, and actual sizes shall be within manufacturing tolerances allowed by the applicable standard.

2.02 EXTERIOR AND INTERIOR TRIM

A. Treated Composite Trim

1. Provide prefinished Miratec Exterior Trim manufactured by Craftmaster Manufacturing, Inc., or AZEK trimboards, or approved equal. Provide manufacturer's standard white prefinished color.

2. Product shall have a minimum 25-year manufacturer's warranty covering substrate and a minimum 15-year warranty on finish.

3. Provide widths as indicated on Drawings. All trim shall be 5/4 thickness (1 inch nominal).

B. Stainless Steel Nails

1. Attach all exterior fascia and trim with AISI 316 stainless steel nails.

C. Field Finishing

1. Provide joint sealant per Section 07 92 00 JOINT SEALANTS to infill any gaps between trim boards or between trim boards and adjacent materials or construction.

2. Infill all nail holes with trim board manufacturer’s recommended material.

3. Field prime and paint all trim boards per Section 09 00 00 PAINTING AND COATING.

2.03 MOISTURE CONTENT OF WOOD PRODUCTS

A. Air-dry or kiln-dry lumber. Kiln-dry treated lumber after treatment. Maximum moisture content of wood products at time of delivery to the job Site, and when installed, shall be as follows.

1. Exterior Treated and Untreated Finish Lumber and Trim 89 mm (4 Inches Nominal) or Less in Thickness: 19 percent

2. Exterior Wood Siding: 15 percent

3. Moisture content of other materials shall be in accordance with the applicable standards.

2.04 HARDWARE

A. Provide sizes, types, and spacing of manufactured building materials recommended by the product manufacturer except as otherwise indicated or specified.

1. Wood Screws

   a. ANSI B18.6.1

2. Bolts, Nuts, Lag Screws, and Studs

   a. ANSI B18.2.1, ASME B18.2.2, and ASTM A 687

3. Nails

   a. Nails shall be the size and type best suited for the purpose and shall conform to ASTM F 547. Nails shall be stainless steel when used on exterior Work. For siding, length of nails shall be sufficient to extend 40 mm (1-1/2 inches) into supports, including wood sheathing over framing. Screws for use where nailing is impractical shall be size best suited for purpose.

2.05 FABRICATION

A. The terms "Premium," "Custom," and "Economy" refer to the quality grades defined in AWI Quality Standards. Items not specified to be of a specific grade shall be Custom grade.

2.06 SOURCE QUALITY CONTROL

A. Provide in accordance with Division 01 General Requirements.

PART 3 – EXECUTION

3.01 FINISH WORK

A. Provide Samples, sizes, materials, and designs as indicated and as specified. Apply primer to finish Work before installing. Where practicable, shop assemble and finish items of built-up millwork. Joints shall be tight and constructed in a manner to conceal shrinkage. Miter trim and moldings at exterior angles and cope at interior angles and at returns. Material shall show no warp after installation. Install millwork and trim in maximum practical lengths. Fasten finish Work with finish nails. Provide blind nailing where practicable. Set face nails for putty stopping.

B. Exterior Finish Work

1. General: Machine-sand exposed flat members and square edges. Machine-finish semi-exposed surfaces. Construct joints to exclude water. In addition to nailing, glue joints of built-up items with waterproof glue as necessary for weather-resistant construction. Provide well-distributed end joints in built-up members. Provide shoulder joints in flat Work. Hold backs of wide-faced miters together with metal rings and waterproof glue. Fascia’s and other flat members, unless otherwise indicated, shall be 19 mm (3/4 inch) thick. Provide door and window trim in single lengths.

Provide braced, blocked, and rigidly anchored cornices for support and protection of vertical joints. Install soffits in largest practical size. Joints of plywood shall occur over center lines of supports. Fasten soffits with stainless steel nails. Back prime all concealed surfaces of exterior trim.

2. Exterior Composite Trim: Install treated exterior composite trim with smooth side exposed. Attach per manufacturer's written recommendations. All fasteners shall be concealed and not visible after final installation. Flashing shall be installed at all horizontal trim applications including window and door headers.

3. Interior Finish Work: After installation, sand exposed surfaces smooth. Provide window and door trim in single lengths.

4. Window Stools and Aprons: Provide stools with rabbet over windowsill. Provide aprons with returns cut accurately to profile of member.

3.02 FASCIA'S AND EXTERIOR TRIM

A. Exposed surfaces and square edges shall be machine sanded, caulked, and constructed to exclude water. Joints of built-up items, in addition to nailing, shall be glued as necessary for weather-resistant construction. End joints in built-up members shall be well distributed. Joints in flat Work shall be shouldered. Backs of wide-faced miters shall be held together with metal rings and glue. Fascia's and other flat members shall be in maximum practicable lengths. Cornices shall be braced, blocked, and rigidly anchored for support and protection of vertical joints.

3.03 MOLDING AND INTERIOR TRIM

A. Molding and interior trim shall be installed straight, plumb, level and with closely fitted joints. Exposed surfaces shall be machine sanded at the mill. Molded Work shall be coped at returns and interior angles and mitered at external corners. Intersections of flatwork shall be shouldered to ease any inherent changes in plane. Window and door trim shall be provided in single lengths. Blind nailing shall be used to the extent practicable, and face nailing shall be set and stopped with a non-staining putty to match the finish applied. Screws shall be used for attachment to metal; setting and stopping of screws shall be of the same quality as required where nails are used.

3.04 FIELD QUALITY CONTROL

A. Provide in accordance with Division 01 General Requirements.

3.05 CLOSEOUT ACTIVITIES

A. Provide in accordance with Division 01 General Requirements.

END OF SECTION

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SECTION 07 10 00

DAMPPROOFING

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes

1. Provide materials, tools, equipment and labor required for the application of trowel applied dampproofing necessary for the proper completion of the Work in accordance with this Section and applicable reference standards listed in Article 1.03. However, dampproofing for masonry walls that meets the requirements of this section is to be furnished and installed under Section 04 20 00 UNIT MASONRY.

B. Related Requirements

1. Division 03, 03 30 20 CONCRETE PLACING, CURING AND FINISHING

2. Division 04, 04 20 00 UNIT MASONRY

1.02 PRICE AND PAYMENT PROCEDURES

A. Measurement and payment requirements: per Division 01 General Requirements.

1.03 REFERENCES

A. Reference Standards

1. ASTM INTERNATIONAL (ASTM)

a. ASTM D1187 Standard Specification for Asphalt-Base Emulsions for Use as Protective Coatings for Metal

b. ASTM D1227 Standard Specification for Emulsified Asphalt Used as a Protective Coating for Roofing

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination, Sequencing, and Scheduling: per Division 01 General Requirements.

1.05 SUBMITTALS

A. Submit in accordance with Division 01 General Requirements.

B. Product Data and manufacturer's instructions

C. Installer Qualifications: Minimum 10 years' experience of successful installations of material type specified.

D. Closeout and Maintenance Material Submittals: per Division 01 General Requirements.

1.06 QUALITY ASSURANCE

A. Provide in accordance with Division 01 General Requirements.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Provide in accordance with Division 01 General Requirements.

B. Deliver material in original packaging bearing the manufacturer's identification and labels. Store materials off the ground and keep dry prior to installation.

1.08 SITE CONDITIONS

A. Existing Conditions: per Division 01 General Requirements.

PART 2 – PRODUCTS

2.01 MATERIALS

A. Dampproofing: Hydrocide 700 by Sonneborn, Karnak 920AF Fibered Emulsion Mastic, or approved equal conforming to ASTM D 1227, Type 2, Class I, and ASTM D1187, Type 1

2.02 SOURCE QUALITY CONTROL

A. Provide in accordance with Division 01 General Requirements.

PART 3 – EXECUTION

3.01 CONSTRUCTION

A. Application of Dampproofing

1. Application will not be permitted in spaces exposed to inclement weather or when air temperature is below 40°F, or expected to fall below 40°F within 24 hours after application.

2. Dampproofing can be applied to green or slightly damp concrete.

3. Apply dampproofing at a rate of 4 to 6 gallons per 100 square feet. If applying two coats, each coat shall be 2 to 3 gallons per 100 square feet.

The first coat must be allowed to dry prior to application of the second coat. The coating must be continuous and free from breaks and pinholes.

3.02 FIELD QUALITY CONTROL

A. Provide in accordance with Division 01 General Requirements.

3.03 CLOSEOUT ACTIVITIES

A. Provide in accordance with Division 01 General Requirements.

END OF SECTION

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SECTION 07 19 00

WATER REPELLENTS

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes

1. Provide water repellent treatment to all exterior exposed brick veneer including, edges and returns adjacent to doorframes in accordance with this Section and applicable reference standards listed in Article 1.03.

1.02 PRICE AND PAYMENT PROCEDURES

A. Measurement and payment requirements: per Division 01 General Requirements.

1.03 REFERENCES

A. Reference Standards

1. ASTM INTERNATIONAL (ASTM)

a. ASTM C140 Standard Test Methods for Sampling and Testing Concrete Masonry Units and Related Units

b. ASTM C642 Standard Test Method for Density, Absorption, and Voids in Hardened Concrete

c. ASTM C672 Standard Test Method for Scaling Resistance of Concrete Surfaces Exposed to Deicing Chemicals

d. ASTM D1653 Standard Test Methods for Water Vapor Transmission of Organic Coating Films

e. ASTM D2369 Standard Test Method for Volatile Content of Coatings

f. ASTM E96 Standard Test Methods for Water Vapor Transmission of Materials

g. ASTM E514 Standard Test Method for Water Penetration and Leakage Through Masonry

2. AMERICAN ASSOCIATION OF STATE AND HIGHWAY TRANSPORTATION OFFICIALS (AASHTO)

a. AASHTO T259 Standard Method of Test for Resistance of Concrete to Chloride Ion Penetration

b. AASHTO T260 Standard Method of Test for Sampling and Testing for Chloride Ion in Concrete and Concrete Raw Materials

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination, Sequencing, and Scheduling: per Division 01 General Requirements.

1.05 SUBMITTALS

A. Submit in accordance with Division 01 General Requirements.

B. Product data for water repellent.

C. Certificates:

1. Manufacturer warranty

2. Material Safety Data Sheets

D. Manufacturer instructions including preparation, application, and recommended equipment to be used, safety measures, and protection of completed application

E. Closeout and Maintenance Material Submittals: per Division 01 General Requirements.

1.06 QUALITY ASSURANCE

A. Provide in accordance with Division 01 General Requirements.

B. Qualifications

1. Manufacturer's qualifications: Minimum 5 years record of successful in-service experience of water repellent treatments manufactured for concrete masonry application

2. Applicator's qualifications: Minimum 5 years successful experience in projects of similar scope using specified or similar treatment materials and manufacturer's approval for application

C. Performance Requirements

1. Water absorption: ASTM C140; Comparison of treated and untreated specimens

2. Moisture vapor transmission: ASTM E96; Comparison of treated and untreated specimens

3. Water penetration and leakage through masonry: ASTM E514

D. Evidence to support request for substitution

1. The difference between the specified product and the proposed substitution

2. A comparative analysis of the specified product and the proposed substitution, including tabulations of the composition of pigment and vehicle

1.07 DELIVERY, STORAGE, AND HANDLING

A. Provide in accordance with Division 01 General Requirements.

B. Deliver materials in original sealed containers, clearly marked with the manufacturer's name, brand name, type of material, batch number, percent solids by weight and volume, and date of manufacturer. Store materials off the ground, in a dry area where the temperature will be not less 50°F or more than 85°F.

1.08 SITE CONDITIONS

A. Existing Conditions: per Division 01 General Requirements.

1.09 WARRANTY

A. Special Warranty/Extended Correction Period: 5-year joint warranty from manufacturer and applicator of the water repellent treatment against moisture penetration through the treated structurally sound surface covering material, labor, and equipment necessary to remedy problems

PART 2 – PRODUCTS

2.01 MATERIALS

A. Water repellent solution shall be a clear, non-yellowing, deep-penetrating, VOC compliant solution. Material shall not stain or discolor and shall produce a mechanical and chemical interlocking bond with the substrate to the depth of the penetration.

2.02 WATER REPELLENT

A. Equal to Series 632 Prime-A-Pell H_20 Concentrate by Chemprobe.

1. Composition: Alkylalkoxy silane

2. Active alkylalkoxy silane content: ASTM D2369, 49 percent by weight, plus or minus 1 percent

3. Appearance: White, milky liquid (wet)

4. Average depth of penetration: Up to 3/8 inch depending on substrate

5. VOC content: Less than 350 grams per liter

6. Flash point > 212°F

7. Density: 8.18 pounds per gallon

2.03 PERFORMANCE CRITERIA

A. Water Repellent

1. Water absorption test: ASTM C642 and ASTM E 514

2. Moisture vapor transmission: ASTM D1653, 28.33 perms or 51.61 percent maximum compared to untreated surfaces

3. Scaling resistance: ASTM C672, non-air-entrained concrete, zero rating, no scaling, 100 cycles treated concrete

4. Resistance to chloride ion penetration: AASHTO T259 and AASHTO T260

5. Water penetration and leakage through masonry, ASTM E514 percentage reduction of leakage: 97 percent minimum

6. Drying time under normal conditions: 4 hours per 75°F

2.04 SOURCE QUALITY CONTROL

A. Provide in accordance with Division 01 General Requirements.

PART 3 – EXECUTION

3.01 EXAMINATION

A. Examine brick surfaces to be treated to ensure that:

1. Visible cracks, voids or holes have been repaired.

2. Mortar joints are tight and sound, have not been re-set or misaligned and show no cracks or spalling.

3. Moisture contents of walls does not exceed 15 percent when measured on an electronic moisture register, calibrated for the appropriate substrate.

B. Do not start water repellent treatment Work until all deficiencies have been corrected, examined and found acceptable to the Engineer and the water repellent treatment manufacturer. Do not apply treatment to damp, dirty, dusty or otherwise

unsuitable surfaces. Comply with the manufacturer's recommendations for suitability of surface.

3.02 PREPARATION

A. Surface Preparation: Prepare substrates in accordance with water repellent treatment manufacturer's recommendation. Clean surfaces of dust, dirt, efflorescence, alkaline, and foreign matter detrimental to proper application of water repellent treatment.

B. Protection: Provide masking or protective covering for materials which could be damaged by water repellent treatment.

1. Protect glass, glazed products, and prefinished products from contact with water repellent treatment

2. Protect landscape materials with breathing type drop cloths: plastic covers are not acceptable

C. Compatibility: Confirm treatment compatibility with each type of joint sealer within or adjacent to surfaces receiving water repellent treatment in accordance with manufacturer's recommendations

3.03 SAFETY METHODS

A. Apply coating materials using safety methods and equipment in accordance with manufacturer's application recommendations

B. Toxic Materials: To protect personnel from overexposure to toxic materials, conform to the most stringent guidance of the coating manufacturer when using solvents or other chemicals

1. Use impermeable gloves, chemical goggles or face shield, and other recommended protective clothing and equipment to avoid exposure of skin, eyes, and respiratory system. Conduct Work in a manner to minimize exposure of building occupants and the general public.

2. OSHA 29 CFR 1910.1000, Air Contaminants

3. Threshold Limit Values (R) of the American Conference of Governmental Industrial Hygienists

4. Manufacturer's Material Safety Data Sheets

3.04 ENVIRONMENTAL CONDITIONS

A. Apply coating materials using safety methods and equipment in accordance with manufacturer's weather and substrate conditions. Do not proceed with application

of water repellents under any of the following conditions, except with written recommendations of manufacturer.

1. Ambient temperature is less than 40°F.

2. Substrate faces have cured less than one month.

3. Rain or temperature below 40°F are predicted for a period of 24 hours before or after treatment.

4. Earlier than 3 days after surfaces are wet.

5. Substrate is frozen or surface temperature is less than 40°F and falling.

B. Moisture Condition: Determine moisture content of substrate meets manufacturer's requirements prior to application of water repellent material.

3.05 SEQUENCING AND SCHEDULING

A. Masonry Surfaces: Do not start water repellent coating until all joint tooling, pointing, and masonry-cleaning operations have been completed. Allow masonry to cure for at least 60 days under normal weather conditions before applying water repellent.

B. Sealants: Do not apply water repellents until the sealants for joints adjacent to surfaces receiving water repellent treatment have been installed and cured

1. Water repellent Work may precede sealant application only if sealant adhesion and compatibility have been tested and verified using substrate, water repellent, and sealant materials identical to those used in the Work

2. Provide manufacturers' test results of compatibility.

3.06 MIXING

A. Mix water repellent material thoroughly in accordance with the manufacturer's recommendations. Mix, in quantities required for that days' Work, all containers prior to application. Mix each container the same length of time.

3.07 APPLICATION

A. Water Repellent Treatment: In strict accordance with the manufacturers written requirements, do not start application without the manufacturer's representative being present or his written acceptance of the surface to be treated

1. Spray Application: Spray apply water repellent material to exterior masonry surfaces using low-pressure airless spray equipment in strict accordance with manufacturer's printed application, instructions, and precautions. Maintain copies at the job Site. Apply flood coat in an

overlapping pattern allowing approximately 8 to 10-inch rundown on the vertical surface. Maintain a wet edge at all overlaps, both vertical and horizontal. Hold gun maximum 18 inches from wall

2. Brush or Roller Application: Apply water repellent material only at locations where overspray would affect adjacent materials and where not practical for spray applications.

3. Covered Surfaces: Coat all exterior masonry surfaces including back faces of parapets, tops of walls, edges and returns adjacent to window and door frames, window sills, and free-standing walls.

4. Rate of Application: Apply materials to exterior surfaces at 150 square feet per gallon coverage rate.

5. Number of Coats: The sample panel test shall determine the number of coats required to achieve full coverage and protection.

6. Appearance: If unevenness in appearance, lines of Work termination, or scaffold lines exists, or detectable changes from the approved sample panel occur, the Engineer may require additional treatment at no additional cost to the Owner. Apply any required additional treatment to a natural break off point.

3.08 CLEANING

A. Clean all runs, drips, and overspray from adjacent surfaces while the water repellent treatment is still wet in a manner recommended by the manufacturer.

3.09 FIELD QUALITY CONTROL

A. Provide in accordance with Division 01 General Requirements.

B. Do not remove drums containing water repellent material from the Site until completion of all water repellent treatment and authorized by the Engineer.

3.10 CLOSEOUT ACTIVITIES

A. Provide in accordance with Division 01 General Requirements.

END OF SECTION

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SECTION 07 21 00

THERMAL INSULATION

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes

1. Provide insulation in accordance with this Section and applicable reference standards listed in Article 1.03.

1.02 PRICE AND PAYMENT PROCEDURES

A. Measurement and Payment requirements: per Division 01 General Requirements.

1.03 REFERENCES

A. Reference Standards

1. ASTM INTERNATIONAL (ASTM)

a. ASTM C578 Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation

b. ASTM C764 Standard Specification for Mineral Fiber Loose-Fill Thermal Insulation

c. ASTM D4397 Standard Specification for Polyethylene Sheeting for Construction, Industrial, and Agricultural Applications

d. ASTM E96 Standard Test Methods for Water Vapor Transmission of Materials

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination, Sequencing, and Scheduling: per Division 01 General Requirements.

1.05 SUBMITTALS

A. Submit in accordance with Division 01 General Requirements.

B. Product Data

1. Extruded polystyrene board insulation

2. Glass fiber loose fill insulation

C. Manufacturer's Instructions: Submit manufacturer's installation instructions

1.06 QUALITY ASSURANCE

A. Provide in accordance with Division 01 General Requirements.

1.07 DELIVERY, STORAGE AND HANDLING:

A. Provide in accordance with Division 01 General Requirements.

B. Protect insulation materials from physical damage and from deterioration by moisture, soiling, and other sources. Store inside and in a dry location.

C. Protect plastic insulation as follows:

1. Do not expose to sunlight, except to extent necessary for period of installation and concealment.

2. Protect against ignition at all times. Do not deliver plastic insulating materials to the Project Site ahead of installation time.

3. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

1.08 SITE CONDITIONS

A. Existing Conditions: per Division 01 General Requirements.

PART 2 – PRODUCTS

2.01 INSULATING MATERIALS

A. Preformed Units: Sized to fit applications indicated, selected from manufacturer's standard thicknesses, widths, and lengths.

B. Glass fiber loose fill insulation: Glass fibers processed to comply with the following;

1. ASTM C764, Type 1 for pneumatic application

2. ASTM C764, Type 2 for poured application

3. Maximum flame spread and smoke developed values of 5 and 5, respectively.

2.02 VAPOR RETARDERS

A. Polyethylene vapor retarder: 6 mil thick polyethylene sheeting conforming to ASTM D4397 and having a water vapor permeance of 1 perm or less when tested in accordance in with ASTM E96.

B. Tape for vapor retarder: Pressure sensitive tape of type recommended by vapor retarder manufacturer for sealing joints and penetration in vapor retarder.

2.03 AUXILIARY INSULATING MATERIALS

A. Adhesive for Bonding Insulation: Product with demonstrated capability to bond insulation or mechanical anchors securely to substrates indicated without damaging or corroding either insulation, anchors, or substrates.

B. Adhesively attached pin anchors: Perforated plate, 2 inches square, welded to projecting pin, with self-locking washer, complying with the following requirements:

1. Plate: Zinc plated steel, 0.106 inch thick

2. Pin: Copper coated low carbon steel, fully annealed, 0.106 inch in diameter, length to suit depth of insulation indicated and, with washer in place, to hold insulation tightly to substrate behind insulation.

3. Self-locking Washer: Mild steel, 0.016-inch thick, size as required to hold insulation securely. Where spindles will be exposed to human contact after installation, protect ends with capped self-locking washers.

C. Protection Board: Pre-molded, semi rigid asphalt or fiber composition board, 1/4-inch thick, formed under heat and pressure, standard sizes

D. Eave Insulation Baffle: Preformed rigid fiberboard or plastic sheets designed and sized to fit between roof framing members and to provide cross ventilation between insulated attic spaces and vented eaves.

2.04 SOURCE QUALITY CONTROL

A. Provide in accordance with Division 01 General Requirements.

PART 3 – EXECUTION

3.01 PREPARATION

A. Examine substrates and conditions with installer present, for compliance with requirements of the Sections in which substrates and related work are specified and to determine if other conditions affecting performance of insulation are satisfactory. Do not proceed with installation of insulation until unsatisfactory conditions have been corrected.

B. Clean substrates of substances harmful to insulations or vapor retarders, including removal or projections that might puncture vapor retarders.

C. Close off opening in cavities receiving poured in place insulation to prevent the escape of insulation. Provide bronze or stainless steel screen inside where openings must be maintained for drainage or ventilation.

3.02 INSTALLATION

A. Installation in accordance with manufacturer's installation instructions.

3.03 INSTALLATION OF GENERAL BUILDING INSULATION

A. Apply installation units to substrate by method indicated, complying with manufacturer's recommendations. If no specified method is indicated, bond units to substrate with adhesive or use mechanical anchorage to provide permanent placement and support of units. Where insulation units are not held tightly in place by adjacent materials on all sides, provide wire ties or another acceptable mechanical means to prevent displacement or sagging of insulation.

B. Extend insulation to full thickness as 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.

C. Apply a single layer of insulation of required thickness, unless otherwise shown or required to make up total thickness.

D. Seal joints between closed cell, non-breathing insulation units by applying adhesive, mastic, or sealant to edges of each unit to form a tight seal as units are shoved into place. Fill voids in completed installation with adhesive, mastic, or sealant as recommended by insulation manufacturer.

E. Set vapor retarder faced units with vapor retarder to warm side of construction, except as otherwise indicated. Do not obstruct ventilation spaces, except for fire stopping. Tape joints and ruptures in vapor retarder, and seal each continuous area of insulation to surrounding construction to ensure airtight installation.

F. Place glass fiber loose fill insulation into spaces and onto surfaces as shown, either by pouring or by machine blowing. Level horizontal applications to uniform thickness as indicated, lightly settle to uniform density, but do not excessively compact.

G. Stuff glass fiber loose fill insulation into miscellaneous voids and cavity spaces where shown. Compact to approximately 40 percent of normal maximum volume, to a density of approximately 2.5 per cubic feet.

3.04 INSTALLATION OF VAPOR RETARDERS

A. Extend vapor retarder to extremities of areas to be protected from vapor transmission. Secure in place with adhesives or other anchorage system as indicated. Extend vapor retarder to cover miscellaneous voids in insulated substrates, including those filled with loose fiber insulation.

B. Seal vertical joints in vapor retarders over framing by lapping not less than 2 wall studs. Fasten vapor retarders to framing at top, end, and bottom edges, at perimeter of wall openings, and at lap joints; space fasteners 16-inches on center.

C. Seal overlapping joints in vapor retarders with adhesives or tap per vapor retarder manufacturer's printed directions. Seal butt joints and fasteners penetrations with tape of type recommended by vapor retarder manufacturer. Locate all joints over framing members or other solid substrates.

D. Firmly attach vapor retarders to substrates with mechanical fasteners or adhesives as recommended by vapor retarder manufacturer.

E. Repair any tears or punctures in vapor retarders immediately before concealment by other work. Cover with tape or another layer of vapor retarder.

3.05 PROTECTION

A. Protect installed insulation and vapor retarders from damage due to harmful weather exposures, physical abuse, and other causes.

B. Provide temporary coverings or enclosures where insulation will be subject abuse and cannot be concealed and protected by permanent construction immediately after installation.

3.06 FIELD QUALITY CONTROL

A. Provide in accordance with Division 01 General Requirements.

3.07 CLOSEOUT ACTIVITIES

A. Provide in accordance with Division 01 General Requirements.

END OF SECTION

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SECTION 07 31 13

ASPHALT SHINGLES

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes

1. Provide the labor, tools, equipment, and materials necessary to furnish and install asphalt shingles in accordance with this Section and applicable reference standards listed in Article 1.03.

1.02 PRICE AND PAYMENT PROCEDURES

A. Measurement and Payment requirements: per Division 01 General Requirements.

1.03 REFERENCES

A. Reference Standards

1. ASTM INTERNATIONAL (ASTM)

a. ASTM D 1970 Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection

b. ASTM D 226 Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing

c. ASTM D 3018 Class A Asphalt Shingles Surfaced With Mineral Granules

d. ASTM D 3462 Asphalt Shingles Made From Glass Felt and Surfaced with Mineral Granules

e. ASTM D 41 Standard Specification for Asphalt Primer Used in Roofing, Damp proofing, and Waterproofing

f. ASTM D 4586 Asphalt Roof Cement, Asbestos-Free

g. ASTM D 4869 Asphalt-Saturated Organic Felt Underlayment Used in Steep Slope Roofing

h. ASTM E 108 Fire Tests of Roof Coverings

2. UNDERWRITERS LABORATORIES (UL)

a. UL 790 Test Methods for Fire Tests of Roof Coverings

b. UL 997 Wind Resistance of Prepared Roof Covering Materials

B. Definitions

1. Top Lap: That portion of shingle overlapping shingle in course below.

2. Head Lap: The triple coverage portion of top lap which is the shortest distance from the butt edge of an overlapping shingle to the upper edge of a shingle in the second course below.

3. Exposure: That portion of a shingle exposed to the weather after installation.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination, Sequencing, and Scheduling: per Division 01 General Requirements.

1.05 SUBMITTALS

A. Submit in accordance with Division 01 General Requirements.

B. Product Data: Including type, weight, class, UL labels, and special types of underlayment and eave flashing

C. Samples: Color charts

D. Manufacturer's instructions for application

1.06 QUALITY ASSURANCE

A. Provide in accordance with Division 01 General Requirements.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Provide in accordance with Division 01 General Requirements.

B. Deliver materials in the manufacturer's unopened bundles and containers bearing the manufacturer's brand name. Keep materials dry, completely covered, and protected from the weather. Roll goods shall be stored on end in an upright position or in accordance with manufacturer's recommendations. Immediately before laying, roofing felt shall be stored for 24 hours in an area maintained at a temperature not lower than 50°F.

1.08 SITE CONDITIONS

A. Existing Conditions: per Division 01 General Requirements.

1.09 WARRANTY

A. Special Warranty/Extended Correction Period:

1. Manufacturer's Warranty: Furnish the asphalt shingle manufacturer's lifetime warranty with 10-year SureStart Protection.

PART 2 – PRODUCTS

2.01 MATERIALS

A. Shingles: Landmark TL by CertainTeed or approved equal, 13-1/4 inch by 40-inch three-piece laminated fiber glass, architectural-grade shingles consisting of the following properties; UL certified to meet ASTM D 3462, ASTM E 108 Class A external fire exposure label, wind warranty up to 110 miles per hour, weighing not less than 305 pounds per square. Color as selected by Owner from manufacturer's color charts.

B. Underlayment: Grace Ice & Water Shield self-adhesive sheet membrane or approved equal.

C. Nails for applying shingles and asphalt-saturated felt: Aluminum or hot-dipped galvanized steel or equivalent corrosion resistant with sharp points and flat heads 3/8 inch to 7/16 inches in diameter. Shank diameter of nails shall be a minimum of 0.105 inch and a maximum of 0.135 inch, with garb or otherwise deformed for added pullout resistance. Nails shall be long enough to penetrate completely through, or extend a minimum of 3/4 inch into roof deck, whichever is less, when driven through materials to be fastened.

D. Asphalt Roof Cement: ASTM D 4586, Type II

E. Asphalt Primer: ASTM D 41

F. Rain Diverters: 16-ounce red copper, 7-inch wide, 1.5-inch high (double thickness), manufactured by Bendtek Inc., or approved equal. Lengths shall be as specified on the Drawings.

G. Eave Soffit: Triple 4-inch, fully vented vinyl soffit panel, manufactured by CertainTeed, or approved equal.

1. Minim Net Free Area = 5.9 square-inch per square-foot

2.02 SOURCE QUALITY CONTROL

A. Provide in accordance with Division 01 General Requirements.

PART 3 – EXECUTION

3.01 VERIFICATION OF CONDITIONS

A. Ensure that roof deck is smooth, clean, dry, and without loose knots. Roof surfaces shall be firm and free from loose boards, large cracks, and projecting ends that might damage the roofing. Vents and other projections through roofs

shall be properly flashed and secured in position, and projecting nails shall be driven flush with the deck.

3.02 SURFACE PREPARATION

A. Cover knotholes and cracks with sheet metal nailed securely to sheathing. Flash and secure vents and other roof projections, and drive projecting nails firmly home.

3.03 APPLICATION

A. Apply roofing materials as specified herein unless specified or recommended otherwise by shingle manufacturer's written instructions.

B. Underlayment: Install Grace Ice and Water Shield over all roof sheathing according to manufacturer's written instructions. Underlayment shall be covered with shingles within one week of installation.

C. Drip Edges: Provide alum drip edges as specified in Section 07 60 00 FLASHING AND SHEET METAL applied directly on the wood deck at eaves and over the underlayment at rakes. Extend back from edge of deck a minimum of 3 inches, and secure with nails spaced a maximum of 4 inches on center along inner edge.

D. Starter Strip: Apply starter strip at eaves, using 9-inch wide strip of mineral-surfaced roll roofing of a color to match shingles. Optionally, use a row of shingles with tabs removed and trimmed to ensure that joints are not exposed at shingle cutouts. Apply starter strip along eaves, overlaying and finishing even with lower edge of eave flashing strip; fasten in a line parallel to, and 3 to 4 inches above eave edge. Place nails so top of nail is not exposed in cutouts of first course of shingles. Fasten with 6 nails per strip of shingles or space nails at 6 inches on center for roll roofing. Seal tabs of first course of shingles with asphalt roof cement as specified below.

E. Shingle Courses: Start first course with full shingle, and apply succeeding courses with joints staggered at thirds or halves. Butt-end joints of shingles shall not align vertically more often than every fourth course. Apply shingle courses as follows:

1. Fastening: Do not drive fasteners into or above the factory-applied adhesive unless adhesive is located 5/8 inch or closer to top of cutouts. Place fasteners so they are concealed by shingle top lap and penetrate the head lap.

2. Shingles applied with nails: Nominal 5-5/8 inch exposure. Apply each shingle with minimum of four nails. Place 1 nail 1 inch from each end, and evenly space nails on a horizontal line a minimum of 5/8-inch above top of cutouts.

F. Hips and Ridges: Form with 12 by 12-inch shingles cut from 12 by 36 inch strip shingles. Bend shingles lengthwise down center with equal exposure on each side of hip or ridge. Lap shingles to provide a maximum 5-inch exposure, and nail each side in unexposed area 5-1/2 inches from butt, and one inch in from edge. Use CertainTeed's Shadow Ridge shingles of like color.

G. Flashing

1. Eave Flashing: Install Grace Bituthene over all roof sheathing. Bituthene shall overhang metal drip edge 1/4 inch to 3/8 inch.

2. Vent and Stack Flashing: Apply shingles up to point where vent or stack pipe projects through roof, and cut nearest shingle to fit around pipe. Before applying shingles beyond pipe, prepare flange of metal pipe vent flashing as specified in Section 07 60 00 FLASHING AND SHEET METAL, by applying a 1/8 inch thick coating of asphalt roof cement on bottom side of flashing flange. Slip flashing collar and flange over pipe, and set coated flange in 1/16 inch coating of asphalt roof cement. After applying flashing flange, continue shingling up roof. Lap lower part of flange over shingles. Overlap flange with side and upper shingles. Fit shingles around pipe, and embed in 1/16 inch thick coating of asphalt roof cement where shingles overlay flange.

3.04 FIELD QUALITY CONTROL

A. Provide in accordance with Division 01 General Requirements.

3.05 CLOSEOUT ACTIVITIES

A. Provide in accordance with Division 01 General Requirements.

END OF SECTION

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SECTION 07 60 00

FLASHING AND SHEET METAL

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes

1. Provide finished sheet metal work in accordance with this Section and applicable reference standards listed in Article 1.03.

2. Provide finished sheet metal work in accordance with this Section and applicable reference standards listed in Article 1.03, including cutting, fitting, drilling, and other operations in connection with sheet metal required to accommodate the Work of other trades.

3. Coordinate installation of sheet metal items used in conjunction with roofing work to permit continuous roofing operations.

1.02 PRICE AND PAYMENT PROCEDURES

A. Measurement and payment requirements: per Division 01 General Requirements.

1.03 REFERENCES

A. Reference Standards

1. SHEET METAL & AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION (SMACNA)

   a. Architectural Manual

2. ASTM INTERNATIONAL (ASTM)

   a. ASTM A653 Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process

   b. ASTM B32 Standard Specification for Solder Metal

   c. ASTM B69 Standard Specification for Rolled Zinc

   d. ASTM B101 Standard Specification for Lead-Coated Copper Sheet and Strip for Building Construction

   e. ASTM B209 Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate

f. ASTM B221 Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes

g. ASTM B370 Standard Specification for Copper Sheet and Strip for Building Construction

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination, Sequencing, and Scheduling: per Division 01 General Requirements.

1.05 SUBMITTALS

A. Submit in accordance with Division 01 General Requirements.

B. Product Data

C. Samples and Mockups: as specified in Article 1.06.

D. Manufacturer Instructions

E. Closeout and Maintenance Material Submittals: per Division 01 General Requirements.

1.06 QUALITY ASSURANCE

A. Provide in accordance with Division 01 General Requirements.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Provide in accordance with Division 01 General Requirements.

B. Package and protect materials during shipment. Uncrate and inspect materials for damage, dampness, and wet-storage stains upon delivery to the Site. Remove from the Site and replace damaged materials that cannot be restored to like-new condition. Handle sheet metal items to avoid damage to surfaces, edges, and ends. Store materials in dry, weather-tight, ventilated areas until immediately before installation.

1.08 SITE CONDITIONS

A. Provide in accordance with Division 01 General Requirements.

PART 2 – PRODUCTS

2.01 MATERIALS

A. Do not use lead, lead-coated metal, or galvanized steel. Use any metal listed by SMACNA Architectural Manual for a particular item, unless otherwise specified or indicated. Conform to the requirements specified and to the thicknesses and configurations established in SMACNA Architectural Manual for the materials.

Different items need not be of the same metal, except that if copper is selected for any exposed item, all exposed items must be copper.

B. Furnish sheet metal items in 8 to 10 foot lengths. Single pieces less than 8 feet long may be used to connect to factory-fabricated inside and outside corners, and at ends of runs. Factory-fabricate corner pieces with minimum 12-inch legs. Provide accessories and other items essential to complete the sheet metal installation. Make these accessories of the same materials as the items to which they are applied. Fabricate sheet metal items of the materials specified below.

1. Exposed sheet metal items: Must be of the same material. Consider the following as exposed sheet metal; cap, valley, steeped, base, and eave flashings and related accessories.

2. Copper, sheet and strip: ASTM B 370, cold-rolled temper, H 00 standard

3. Lead-coated copper sheet: ASTM B 101

4. Steel sheet, zinc-coated (galvanized): ASTM A 653/A 653M

5. Zinc sheet and strip: ASTM B 69, Type I, a minimum of 0.024 inch thick

6. Stainless steel: ASTM A 167, Type 302 or 304, 2D Finish, fully annealed, dead-soft temper

7. Aluminum alloy sheet and plate: ASTM B 209, Baked enamel finish; 0.032 inch thick except as otherwise indicated. Brake form to profiles needed.

8. Aluminum alloy, extruded bars, rods, shapes, and tubes: ASTM B 221

9. Solder: ASTM B 32, 95-5 tin-antimony

10. Fasteners: Use the same metal or a metal compatible with the item fastened. Use stainless steel fasteners to fasten dissimilar materials.

11. Roof expansion joint cover: Provide factory-manufactured flexible, weatherproof, exterior covers for structural expansion joints. Cover shall be manufactured of 3-ply flexible reinforced Hypalon Bellow supported by closed cell foam with aluminum mounting flanges factory locked to each edge of bellow. Provide roof expansion joint covers by Portals Plus or approved equal.

12. Elastic sheet flashing: Manufacturer's standard flexible, elastic, black, non-reinforced, flashing sheet of 60 mil minimum total thickness. Provide perm-a-barrier wall flashing by Grace Construction Products or approved equal.

2.02 SOURCE QUALITY CONTROL

A. Provide in accordance with Division 01 General Requirements.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Workmanship: Make lines and angles sharp and true, forming weather tight construction without waves, warps, buckles, fastening stresses or distortion, which allows for expansion and contraction. Free exposed surfaces from visible wave, warp, buckle, and tool marks. Fold back exposed edges neatly to form a 1/2 inch hem on the concealed side. Make sheet metal exposed to the weather watertight with provisions for expansion and contraction.

1. Make surfaces to receive sheet metal plumb and true, clean, even, smooth, dry, and free of defects and projections. For installation of items not shown in detail or not covered by Specifications, conform to the applicable requirements of SMACNA Architectural Manual, Architectural Sheet Metal Manual. Provide sheet metal flashing in the angles formed where roof decks abut walls, curbs, ventilators, pipes, or other vertical surfaces and wherever indicated and necessary to make the Work watertight.

B. Nailing: Confine nailing of sheet metal generally to sheet metal having a maximum width of 18 inches. Confine nailing of flashing to one edge only. Space nails evenly not over 3 inches on center and approximately 1/2 inch from edge, unless otherwise specified or indicated. Face nailing is not permitted. Where sheet metal is applied to other than wood surfaces, include in Shop Drawings, the locations for sleepers and nailing strips required to secure the Work.

C. Cleats: Provide cleats for sheet metal 18 inches and over in width. Space cleats evenly not over 12 inches on center unless otherwise specified or indicated. Unless otherwise specified, provide cleats of 2 inches wide by 3 inches long and of the same material and thickness as the sheet metal being installed. Secure one end of the cleat with two nails and the cleat folded back over the nail heads. Lock the other end into the seam. Where the fastening is to be made to concrete or masonry, use screws and drive in expansion shields set in concrete or masonry.

D. Bolts, rivets, and screws: Install bolts, rivets, and screws where indicated or required. Provide compatible washers where required to protect surface of sheet metal and to provide a watertight connection. Make joints in aluminum sheets 0.050 inch or less in thickness.

E. Seams: Straight and uniform in width and height

1. Flat-lock seams: Finish not less than 3/4 inch wide.

2. Lap seams: Overlap seams not soldered, not less than 3 inches.

3. Flat seams: Make seams in the direction of the flow.

F. Metal drip edge: Provide a metal drip edge, designed to allow water run-off to drip free of underlying construction at eaves and rakes prior to the application of roofing shingles. Apply directly on the wood deck at the eaves and over the underlay along the rakes. Extend back from the edge of the deck not more than 3 inches and secure with compatible nails spaced not more than 10 inches on center along upper edge.

G. Flashing at roof penetrations and equipment supports: Provide pre-fabricated flashing for all pipes, ducts, and conduits projecting through the roof surface and for equipment supports, guy wire anchors, and similar items supported by or attached to the roof deck.

H. Stepped flashing: Stepped flashing shall be installed where sloping roofs surfaced with shingles abut vertical surfaces. Separate pieces of base flashing shall be placed in alternate shingle courses.

3.02 PROTECTION FROM CONTACT WITH DISSIMILAR MATERIALS

A. Copper or copper-bearing alloys: Paint with heavy-bodied bituminous paint surfaces in contact with dissimilar metal, or separate the surfaces by means of moisture-proof building felts.

B. Aluminum: Do not allow aluminum surfaces in direct contact with other metals except stainless steel, zinc, or zinc coating. Where aluminum contacts another metal, paint the dissimilar metal with a primer followed by two coats of aluminum paint. Where drainage from a dissimilar metal passes over aluminum, paint the dissimilar metal with a non-lead pigmented paint.

C. Metal surfaces: Paint surfaces in contact with mortar, concrete, or other masonry materials with alkali-resistant coatings such as heavy-bodied bituminous paint.

3.03 CLEANING

A. Clean exposed sheet metal work at completion of installation. Remove grease and oil films, handling marks, contamination from steel wool, fittings and drilling debris, and scrub clean. Free the exposed metal surfaces of dents, creases, waves, scratch marks, and solder or weld marks.

3.04 REPAIRS

A. Scratches, abrasions, and minor surface defects of finish may be repaired in accordance with the manufacturer's printed instructions and as approved. Repair damaged surfaces caused by scratches, blemishes, and variations of color and surface texture. Replace items that cannot be repaired.

3.05 FIELD QUALITY CONTROL

A. Provide in accordance with Division 01 General Requirements.

3.06 CLOSEOUT ACTIVITIES

A. Provide in accordance with Division 01 General Requirements.

END OF SECTION

SECTION 07 84 00

FIRESTOPPING

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes

1. Provide all materials, tools, equipment and labor required to furnish and install firestopping in accordance with this Section and applicable reference standards listed in Article 1.03.

1.02 PRICE AND PAYMENT PROCEDURES

A. Measurement and payment requirements: per Division 01 General Requirements.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Coordination, Sequencing, and Scheduling: per Division 01 General Requirements.

1.04 SUBMITTALS

A. Submit in accordance with Division 01 General Requirements.

B. Product Data

1. Caulk and Putty

2. Fastners

C. Show Drawings: Provide shop drawings showing each condition requiring firestopping, showing the proposed UL listed system and materials to be used. Show anchorage details, methods of installation, and actual adjacent construction.

D. Closeout and Maintenance Material Submittals: per Division 01 General Requirements.

1.05 QUALITY ASSURANCE

A. Provide in accordance with Division 01 General Requirements.

B. Installer: A firm with a minimum of three years experience in type of Work required by this Section and which is acceptable to manufacturers of primary materials.

C. UL Listed Designs: Firestopping materials and systems shall be installed in each location and type of installation conforming to listed UL designs.

1. Firestopping materials shall be UL Classified as "Fill, Void, or Cavity Material" for use in through-penetration firestop systems.

2. Provide firestop systems that are UL listed with a fire-resistance rating equal to the hourly resistance rating of the fire-rated barrier being penetrated.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Provide in accordance with Division 01 General Requirements.

B. Materials shall be delivered in the original unopened packages or containers showing name of the manufacturer and the brand name. Materials shall be stored off the ground in interior spaces, protected against damage. Damaged or deteriorated materials shall be removed from the site. Schedule deliveries to minimize on-site storage.

1.07 SITE CONDITIONS

A. Provide in accordance with Division 01 General Requirements.

PART 2 – PRODUCTS

2.01 CAULK AND PUTTY

A. Provide one of the following products, or Engineer approved equal, that meet or exceed specified requirements:

1. Bio Therm; Bio Fireshield.

2. Fire-Barrier Series; 3M Fire Protection Products.

3. Flamesafe; International Protective Coatings Corp.

4. Flame Stop V Putty and Caulking; Flame Stop, Inc.

5. Fyre Putty; Standard Oil Engineered Materials Company.

6. Silicone Firestop Foam 2001, and Sealant 2000; Dow Corning Corp.

2.02 FASTENERS

A. Provide anchorage accessories complying with UL designs and other components and accessories as needed.

2.03 SOURCE QUALITY CONTROL

A. Provide in accordance with Division 01 General Requirements.

PART 3 – EXECUTION

3.01 INSPECTION

A. Examine substrates, supports, and conditions under which work shall be performed. Report of conditions detrimental to performance of work in writing to Engineer. Do not proceed with Work until unsatisfactory conditions are corrected. Beginning Work shall establish acceptance of substrates and conditions.

3.02 PREPARATION

A. Review extent and types of required firestopping with governing authorities before beginning Work. Obtain approval of thicknesses and installation methods, including non-typical locations.

3.03 INSTALLATION

A. Comply with manufacturers' instructions and recommendations, except where more restrictive requirements are specified.

B. Provide firestopping material and thickness as required to provide indicated ratings.

C. Anchor with manufacturers' recommended system.

D. Install without gaps and voids. Do not use damaged materials. Remove and replace nonfitting or disturbed Work.

3.04 FIELD QUALITY CONTROL

A. Provide in accordance with Division 01 General Requirements.

B. Coordinate installation of firestopping work with other work to minimize cutting and removal of installed fireproofing. As work of other sections is completed, review firestopping work and repair or replace work which has been damaged or removed.

3.05 CLOSEOUT ACTIVITIES

A. Provide in accordance with Division 01 General Requirements.

END OF SECTION

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SECTION 07 92 00

JOINT SEALANTS

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes

1. Provide joint sealant accordance with this Section and applicable reference standards listed in Article 1.03.

1.02 PRICE AND PAYMENT PROCEDURES

A. Measurement and payment requirements: per Division 01 General Requirements.

1.03 REFERENCES

A. Reference Standards

1. ASTM C 920 Standard Specification for Elastomeric Joint Sealants

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination, Sequencing, and Scheduling: per Division 01 General Requirements.

1.05 SUBMITTALS

A. Submit in accordance with Division 01 General Requirements.

B. Product Data

1. Shelf Life

2. Curing Time

3. Mixing and Application Instructions

4. Primer Data

C. Samples and Mockups: as specified in Article 1.06.

1. Initial selection: Submit Samples of manufacturer's color charts showing complete range of colors, textures, and finishes available for each material used.

D. Certificates

1. Material Safety Data Sheets

2. Certification of Compliance

E. Closeout and Maintenance Material Submittals: per Division 01 General Requirements.

1.06 QUALITY ASSURANCE

A. Provide in accordance with Division 01 General Requirements.

B. Compatibility with substrate: Verify that each of the sealants are compatible for use with joint substrates.

C. Joint tolerance: Provide joint tolerances in accordance with manufacturer's printed instructions.

D. Mock-up: Project personnel is responsible for installing sealants in mock-up prepared by other trades, using materials and techniques approved for use on the Project.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Provide in accordance with Division 01 General Requirements.

B. Deliver materials to the Site in unopened manufacturers' external shipping containers, with brand names, date of manufacture, color, and material designation clearly marked thereon. Label elastomeric sealant containers to identify type, class, grade, and use. Carefully handle and store materials to prevent inclusion of foreign materials or subjection to sustained temperatures exceeding 90°F or less than 0°F.

1.08 SITE CONDITIONS

A. Existing Conditions: per Division 01 General Requirements.

1.09 ENVIRONMENTAL CONDITIONS

A. Apply sealant when the ambient temperature is between 40 and 90°F.

1.10 WARRANTY

A. Special Warranty/Extended Correction Period: 5 years against failure of sealant and against water penetration through each sealed joint.

PART 2 – PRODUCTS

2.01 SEALANTS

A. Typical interior sealant: Provide polyurethane sealants that meet requirements of ASTM C 920, Type M, Grade NS, Class 25, Use NT, M, G, A, O. Locations and color of sealant for the following:

LOCATION	COLOR
Small voids between walls or partitions and adjacent lockers, casework, shelving, door frames, built-in or surface-mounted equipment and fixtures, and similar items	As selected by Engineer
Perimeter of frames at doors, windows, and access panels that adjoin exposed interior concrete and masonry surfaces	As selected by Engineer
Joints of interior masonry walls and partitions which adjoin columns, pilasters, concrete walls, and exterior walls unless otherwise detailed	As selected by Engineer
Interior locations, not otherwise indicated or specified, where small voids exist between materials specified to be painted	As selected by Engineer
Joints formed between tile floors and tile base cove; joints between tile and dissimilar materials; joints occurring where substrates change	As selected by Engineer

B. Exterior sealant: For joints in vertical and horizontal surfaces, polyurethane sealant that meets requirements of ASTM C 920, Type M, Grade NS, Class 25, Use M, G, A, O. Provide locations and colors of sealant as follows:

LOCATION	COLOR
Joints and recesses formed where frames and sub-sills of windows, doors, louvers, and vents adjoin masonry, concrete, or metal frames. Use sealant at both exterior and interior surfaces of exterior wall penetrations	As selected by Engineer
Joints between new and existing exterior masonry walls	As selected by Engineer
Masonry joints where shelf angles occur	As selected by Engineer
Expansion and control joints	As selected by Engineer
Interior face of expansion joints in exterior concrete or masonry walls where metal expansion joint covers are not required	As selected by Engineer
Voids where items pass through exterior walls	As selected by Engineer
Metal reglets, where flashing is inserted into masonry joints, and where flashing is penetrated by coping dowels	As selected by Engineer
Metal-to-metal joints where sealant is indicated or specified	As selected by Engineer

C. General Sealant

1. Floor joint sealant: ASTM C 920, Type M, Grade P or NS, Class 25, Use T. Provide locations and colors of sealant as follows:

LOCATION	COLOR
Seats of metal thresholds for exterior doors	As selected by Engineer
Control and expansion joints in floors, slabs, ceramic tile, and walkways	As selected by Engineer

2. Preformed sealant: Provide preformed sealant of polybutylene or isoprene-butylene based pressure sensitive weather resistant tape or bead sealant capable of sealing out moisture, air and dust when installed as recommended by the manufacturer. At temperatures from minus 34° to plus 71°C (30° to plus 160°F), the sealant must be non-bleeding and no loss of adhesion.

3. Concrete slab joint sealant: For joints in concrete slabs, provide polyurethane elastomeric sealant meeting the requirements of ASTM C 920, Type S, Grade P or NS, Class 25, Use T. Color selected by Engineer from submitted Samples.

4. Concrete wall joint sealants: For joints in concrete walls, provide polyurethane elastomeric sealant meeting the requirements on ASTM C 920, Type S, Grade NS, Class 25, Use NT. Color selected by Engineer from submitted Samples.

2.02 PRIMERS

A. Provide a non-staining, quick-drying type and consistency recommended by the sealant manufacturer for the particular application.

2.03 BOND BREAKERS

A. Provide the type and consistency recommended by the sealant manufacturer to prevent adhesion of the sealant to backing or to bottom of the joint.

2.04 SEALANT BACK-UP ROD

A. Provide polyethylene foams free from oil or other staining elements as recommended by sealant manufacturer. Provide 25 percent to 33 percent oversized backing for closed cell, unless otherwise indicated. Make backstop material compatible with sealant. Do not use oakum and other types of absorptive materials as backstops.

2.05 CLEANING SOLVENTS

A. Provide types recommended by the sealant manufacturer except for aluminum and bronze surfaces that will be in contact with sealant.

2.06 SOURCE OF QUALITY CONTROL

A. Provide in accordance with Division 01 General Requirements.

PART 3 – EXECUTION

3.01 SURFACE PREPARATION

A. Clean surfaces from dirt frost, moisture, grease, oil, wax, lacquer, paint, or other foreign matter that would tend to destroy or impair adhesion. Remove oil and grease with solvent. Surfaces must be wiped dry with clean cloths. When resealing an existing joint, remove existing calk or sealant prior to applying new sealant. For surface types not listed below, contact sealant manufacturer for specific recommendations.

B. Steel surfaces: Remove loose mill scale by sandblasting or, if sandblasting is impractical or would damage finish work, scraping and wire brushing. Remove protective coatings by sandblasting or using a residue-free solvent.

C. Aluminum or bronze surfaces: Remove temporary protective coatings from surfaces that will be in contact with sealant. When masking tape is used as a protective coating, remove tape and any residual adhesive just prior to sealant application. For removing protective coatings and final cleaning, use non-staining solvents recommended by the manufacturer of the items containing aluminum or bronze surfaces.

D. Concrete and masonry surfaces: Where surfaces have been treated with curing compounds, oil, or other such materials, remove materials by sandblasting or wire brushing. Remove laitance, efflorescence, and loose mortar from the joint cavity.

E. Wood surfaces: Keep wood surfaces to be in contact with sealants free of splinters and sawdust or other loose particles.

3.02 SEALANT PREPARATION

A. Do not add liquids, solvents, or powders to the sealant. Mix multi-component elastomeric sealants in accordance with manufacturer's instructions

3.03 APPLICATION

A. Joint width-to-depth ratios

1. Acceptable Ratios

Joint Width	Joint Depth	
	Minimum	Maximum
For metal, glass, or other nonporous surfaces:		
1/4 inch (minimum)	1/4 inch	1/4 inch
over 1/4 inch	1/2 of width	Equal to width
For wood, concrete, or masonry:		
1/4 inch (minimum)	1/4 inch	1/4 inch
Over 1/4 inch to 1/2 inch	1/4 inch	Equal to width
Over 1/2 inch to 2 inch	1/2 inch	5/8 inch
Over 2 inch	(As recommended by sealant manufacturer)	

2. Unacceptable ratios: Where joints of acceptable width-to-depth ratios have not been provided, clean out joints to acceptable depths and grind or cut to acceptable widths without damage to the adjoining Work. Grinding is not required on metal surfaces.

B. Masking tape: Place masking tape on the finish surface on one or both sides of a joint cavity to protect adjacent finish surfaces from primer or sealant smears. Remove masking tape within 10 minutes after joint has been filled and tooled.

C. Backstops: Install backstops dry and free of tears or holes. Tightly pack the back or bottom of joint cavities with backstop material to provide a joint of the depth specified. Install backstops in the following locations.

1. Where indicated

2. Where backstop is not indicated but joint cavities exceed the acceptable maximum depths specified in paragraph entitled, Joint Width-to-Depth Ratios.

D. Primer: Immediately prior to application of the sealant, clean out loose particles from joints. Where recommended by sealant manufacturer, apply primer to joints in concrete masonry units, wood, and other porous surfaces in accordance with sealant manufacturer's instructions. Do not apply primer to exposed finish surfaces.

E. Bond breaker: Provide bond breakers to the back or bottom of joint cavities, as recommended by the sealant manufacturer for each type of joint and sealant used, to prevent sealant from adhering to these surfaces. Carefully apply the bond breaker to avoid contamination of adjoining surfaces or breaking bond with surfaces other than those covered by the bond breaker.

F. Sealants: Provide a sealant compatible with the materials to which it is applied. Do not use a sealant that has exceeded shelf life or has jelled and cannot be discharged in a continuous flow from the gun. Apply the sealant in accordance with the manufacturer's printed instructions with a gun having a nozzle that fits the joint width. Force sealant into joints to fill the joints solidly without air pockets. Tool sealant after application to ensure adhesion. Make sealant uniformly smooth and free of wrinkles. Upon completion of sealant application, roughen partially filled or unfilled joints, apply sealant, and tool smooth as specified. Apply sealer over the sealant when and as specified by the sealant manufacturer.

3.04 PROTECTION AND CLEANING

A. Protection: Protect areas adjacent to joints from sealant smears. Masking tape may be used for this purpose if removed 5 to 10 minutes after the joint is filled.

B. Final cleaning: Upon completion of sealant application, remove remaining smears and stains and leave the Work in a clean and neat condition.

1. Masonry and other porous surfaces: Immediately scrape off fresh sealant that has been smeared on masonry and rub clean with a solvent as recommended by the sealant manufacturer. Allow excess sealant to cure for 24 hours, then remove by wire brushing or sanding.

2. Metal and other non-porous surfaces: Remove excess sealant with a solvent-moistened cloth.

3.05 FIELD QUALITY CONTROL

A. Provide in accordance with Division 01 General Requirements.

3.06 CLOSEOUT ACTIVITIES

A. Provide in accordance with Division 01 General Requirements.

END OF SECTION

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SECTION 08 11 00

METAL DOORS AND FRAMES

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes

1. Provide metal doors and frames in accordance with this Section and applicable reference standards listed in Article 1.03.

B. Related Requirements

1. Division 08, Section 08 71 00 DOOR HARDWARE

2. Division 09, Section 09 90 00 PAINTING AND COATING

1.02 PRICE AND PAYMENT PROCEDURES

A. Measurement and payment requirements: per Division 01 General Requirements.

1.03 REFERENCES

A. Reference Standards

1. American Welding Society (AWS)

a. AWS D1.1 Structural Welding Code – Steel

2. ASTM INTERNATIONAL (ASTM)

a. ASTM A 653 Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy- Coated (Galvannealed) by the Hot-Dip Process

b. ASTM A 924 Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process

c. ASTM C 578 Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation

d. ASTM D 2863

3. BUILDERS HARDWARE MANUFACTURERS ASSOCIATION (BHMA)

a. BMHA A115 Specifications for Steel Door and Frame Preparation for Hardware

4. NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

   a. NFPA 80 Standard for Fire Doors and Other Opening Protectives

   b. NFPA 105 Standard for Smoke Doro Assemblies and Other Opening Protectives

   c. NFPA 252 Standard Methods of Fire Tests of Door Assemblies

5. STEEL DOOR INSTITUTE (SDI/DOOR)

   a. SDI/DOOR 113 Standard Practice for Determining the State Date Thermal Transmittance of Steel Door and Frame Assemblies

   b. SDI/DOOR A250.4 Test Procedure and Acceptance Criteria for - Physical Endurance for Steel Doors, Frames and Frame Anchors.

   c. SDI/DOOR A250.6 Recommended Practice for Hardware Reinforcing on Standard Steel Doors and Frames

   d. SDI/DOOR A250.8 Specifications for Stand Steel Doors and Frames

   e. SDI/DOOR A250.11 Recommended Erection Instructions for Steel Frames

6. UNDERWRITERS LABORATORIES (UL)

   a. UL 10B Standard for Fire Tests of Door Assemblies

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination, Sequencing, and Scheduling: per Division 01 General Requirements.

1.05 SUBMITTALS

A. Submit in accordance with Division 01 General Requirements.

B. Product Data

   1. Doors

   2. Frames

   3. Accessories

C. Shop Drawings

   1. Doors

   2. Frames

   3. Accessories

4. Schedule of doors

5. Schedule of frames

6. Submit door and frame locations.

D. Closeout and Maintenance Material Submittals: per Division 01 General Requirements.

1.06 QUALITY ASSURANCE

A. Provide in accordance with Division 01 General Requirements.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Provide in accordance with Division 01 General Requirements.

B. Packing, Shipping, Handling, and Unloading

1. Deliver doors, frames, and accessories undamaged and with protective wrappings or packaging. Strap knockdown frames in bundles. Provide temporary steel spreaders securely fastened to the bottom of each welded frame.

C. Storage and Protection

1. Store doors and frames on platforms under cover in clean, dry, ventilated, and accessible locations, with 1/4 inch airspace between doors. Remove damp or wet packaging immediately and wipe affected surfaces dry. Replace damaged materials with new.

1.08 SITE CONDITIONS

A. Provide in accordance with Division 01 General Requirements.

PART 2 – PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Stanley

B. Republic Builders Products Corp.

C. Ceco Door

D. Curries

E. Approved Equal

2.02 STANDARD STEEL DOORS

A. SDI/DOOR A250.8, except as specified otherwise:

1. Thickness: 1-3/4 inch

2. Face Sheets: 16 gauge galvanized steel

3. Edges: 16 gauge galvanizes steel

4. Undercut where indicated.

B. Exterior doors: Top edge closed flush and sealed to prevent water intrusion.

C. Hardware: Prepare doors to receive specific door hardware.

D. Testing: In accordance with SDI/DOOR A250.4, must meet the requirements for Level C

2.03 DOOR INSULATION CORES

A. Where specified, provide insulated cores in accordance with SDI/DOOR 113 and as specified:

1. Material: Rigid Polyurethane Form

2. Minimum R Factor: 10.0; ASTM C 518

3. Maximum U Factor: 0.10; ASTM C 518

2.04 DOOR ACCESSORIES

A. Moldings: Provide around glass of interior and exterior doors.

1. Provide non-removable moldings on outside of exterior doors and on corridor side of interior doors.

2. Other moldings may be stationary or removable. Secure inside moldings to stationary moldings, or provide snap on moldings.

3. Muntins shall interlock at intersections and shall be fitted and welded to stationary moldings

2.05 STANDARD STEEL FRAMES

A. SDI/DOOR A250.8, except as otherwise specified. Form frames to sizes and shapes with either welded corners or knockdown field-assembled corners. Provide steel frames for doors, transoms, sidelights, and mullions, unless otherwise indicated.

1. Welded frames: Continuously weld frame faces at corner joints. Mechanically interlock or continuously weld stops and rabbets. Grind welds smooth. Weld frames in accordance with the recommended practice of the Structural Welding Code Sections 1 through 6, AWS D1.1 and in accordance with the practice specified by the producer of the metal being welded.

2. Mullions and transom bars: Mullions and transom bars shall be closed or tubular construction and be a member with heads and jambs butt-welded thereto or knockdown for field assembly. Bottom of door mullions shall have adjustable floor anchors and spreader connections.

3. Stops and beads: Form stops and beads from 20-gauge steel. Provide for glazed and other openings in standard steel frames. Secure beads to frames with oval-head, countersunk Phillips self-tapping sheet metal screws or concealed clips and fasteners. Space fasteners approximately 12 to 16 inches on center. Miter molded shapes at corners. Butt or miter square or rectangular beads at corners.

4. Anchors: Provide anchors to secure the frame to adjoining construction. Provide steel anchors, zinc-coated, not lighter than 18 gauge.

5. Wall Anchors: Provide at least three bolts for each jamb. For frames that are more than 7.5 feet in height, provide one additional bolt for each jamb for each additional 2.5 feet or fraction. Provide retrofit frames with bolt holes and dimples for 316 stainless steel expansion bolts

6. Floor Anchors: Provide floor anchors drilled for 3/8 inch anchor bolts at bottom of each jamb member.

2.06 FIRE AND SMOKE DOORS AND FRAMES

A. NFPA 80 and NFPA 105 and this Specification. The requirements of NFPA 80 and NFPA 105 shall take precedence over details indicated or specified.

B. Door and frame labels: Fire doors and frames shall bear the label of Underwriters Laboratories (UL), Factory Mutual Engineering and Research (FM), or Warnock Hersey International (WHI) attesting to the rating required. Testing shall be in accordance with NFPA 252 or UL 10B. Labels shall be metal with raised letters, and shall bear the name or file number of the door and frame manufacturer. Labels shall be permanently affixed at the factory to frames and to the hinge edge of the door. Door labels shall not be painted.

2.07 WEATHER STRIPPING

A. As specified in Section 08 71 00 DOOR HARDWARE.

2.08 HARDWARE PREPARATION

A. Provide minimum hardware reinforcing gauges as specified in SDI/DOOR A250.6.

B. Drill and tap doors and frames to receive finish hardware.

C. Prepare doors and frames for hardware in accordance with the applicable requirements of SDI/DOOR A250.8 and SDI/DOOR A250.6. For additional requirements, refer to BHMA A115.

D. Drill and tap for surface-applied hardware at the Project Site.

E. Build additional reinforcing for surface-applied hardware into the door at the factory.

F. Locate hardware in accordance with the requirements of SDI/DOOR A250.8, as applicable.

G. Punch doorframes, with the exception of frames that will have weather stripping gasketing, to receive a minimum of two rubber or vinyl door silencers on lock side of single doors and one silencer for each leaf at heads of double doors.

H. Set lock strikes out to provide clearance for silencers.

2.09 FINISHES

A. Hot-dip zinc-coated and factory-primed finish: Fabricate all doors and frames from hot-dipped zinc-coated steel, alloyed type, that complies with ASTM A 924 and ASTM A 653.

1. Coating Weight: Meet or exceed the minimum requirements for coatings having 0.4 ounces per square foot, total both sides, i.e., A40.

2. Repair damaged zinc-coated surfaces by the application of zinc dust paint.

3. Thoroughly clean and chemically treat to insure maximum paint adhesion.

B. Factory-Primed Finish: Factory prime as specified in SDI/DOOR A250.8.

2.10 FABRICATION AND WORKMANSHIP

A. Finished doors and frames shall be strong and rigid, neat in appearance, and free from defects, waves, scratches, cuts, dents, ridges, holes, warp, and buckle.

1. Molded members shall be clean cut, straight, and true, with joints coped or mitered, well formed, and in true alignment.

2. Dress exposed welded and soldered joints smooth.

3. Design doorframe sections for use with the wall construction indicated.

4. Corner joints shall be well formed and in true alignment.

5. Conceal fastenings where practicable.

6. Design frames in exposed masonry walls or partitions to allow sufficient space between the inside back of trim and masonry to receive caulking compound.

B. Grouted frames: For frames to be installed in exterior walls, fill with foam insulation

2.11 SOURCE QUALITY CONTROL

A. Provide in accordance with Division 01 General Requirements.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Frames: Set frames in accordance with SDI/DOOR A250.11. Plumb, align, and brace securely until permanent anchors are set. Anchor bottoms of frames with expansion bolts or powder-actuated fasteners. Build in or secure wall anchors to adjoining construction. For frames in exterior walls, ensure that stops are filled with rigid insulation before grout is placed.

B. Doors: Hang doors in accordance with clearances specified in SDI/DOOR A250.8. After erection and glazing, clean and adjust hardware.

C. Fire and smoke doors and frames: Install fire doors and frames, including hardware, in accordance with NFPA 80. Install fire rated smoke doors and frames in accordance with NFPA 80 and NFPA 105.

3.02 FIELD QUALITY CONTROL

A. Provide in accordance with Division 01 General Requirements.

3.03 STARTUP & COMMISSIONING

A. Provide in accordance with Division 01 General Requirements.

3.04 CLEANING

A. Upon completion, clean exposed surfaces of doors and frames thoroughly. Remove mastic smears and other unsightly marks.

3.05 CLOSEOUT ACTIVITIES

A. Provide in accordance with Division 01 General Requirements.

3.06 PROTECTION

A. Protect doors and frames from damage. Repair damaged doors and frames prior to completion and acceptance of the Project or replace with new, as directed. Wire brush rusted frames until rust is removed. Clean thoroughly.

B. Apply an all-over coat of rust-inhibitive paint of the same type used for shop coat, by the Painting Subcontractor in accordance with Section 09 90 00 PAINTING AND COATING.

END OF SECTION

SECTION 08 16 15

FIBERGLASS DOORS AND FRAMES

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes

1. Provide fiberglass doors and frames in accordance with this Section and applicable reference standards listed in Article 1.03.

2. Design Requirements for design door opening assemblies to resist failure from corrosion. Design door opening assemblies to have minimum fiberglass content of 30 percent mean, by weight.

B. Related Requirements

1. Door opening assemblies: Maximum flame spread 25 in accordance with ASTM E 84, self-extinguishing in accordance with ASTM D 635

2. Door opening assemblies: FDA accepted

3. Door opening assemblies: USDA accepted

1.02 PRICE AND PAYMENT PROCEDURES

A. Measurement and payment requirements: per Division 01 General Requirements.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Coordination, Sequencing, and Scheduling: per Division 01 General Requirements.

1.04 REFERENCES

A. Reference Standards

1. ASTM D 635 Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position

2. ASTM E 84 Standard Test Method for Surface Burning Characteristics of Building Materials

1.05 SUBMITTALS

A. Submit in accordance with Division 01 General Requirements.

B. Product Data

1. Manufacturer's printed product data indicating characteristics of products specified in this section.

2. Manufacturer's Installation Instructions

3. Manufacturer's standard warranty documents, executed by manufacturer's representative, countersigned by Contractor.

C. Shop Drawings

1. Fabrication and Installation Drawings

2. Plans: Indicate location of each door opening assembly in Project

3. Dimensioned elevation of each type of door opening assembly in Project, indicate sizes and locations of door hardware.

4. Schedule: Indicate each door opening assembly in Project, cross-reference to Plans, elevations, and details .

D. Closeout and Maintenance Material Submittals: per Division 01 General Requirements.

1.06 QUALITY ASSURANCE

A. Provide in accordance with Division 01 General Requirements.

B. Qualifications: per Division 01 General Requirements for and as follows.

1. Manufacturer: Minimum 20 continuous years documented experience producing products specified in this section.

C. Source: Provide doors and frames by a single manufacturer for the entire Project.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Provide in accordance with Division 01 General Requirements.

B. Packing, Shipping, Handling, and Unloading

1. Deliver, handle, and store doors and frames at the job Site in such a manner as to prevent damage. Only remove cartons upon arrival of doors at job Site if cartons are wet or damaged. All damaged or otherwise unsuitable doors and frames, when so ascertained, shall be immediately removed from the job Site.

C. Acceptance at Site

1. Doors shall not be received before the building is enclosed.

D. Storage and Protection

1. Doors shall be stored out of weather and extreme temperatures. The doors shall be stored in a vertical position on blocking, clear of the floor and with blocking between the doors to permit air circulation between the doors.

1.08 SITE CONDITIONS

A. Existing Conditions: per Division 01 General Requirements.

1.09 WARRANTY

A. Manufacturer's Warranty: Manufacturer's 10-year warranty against failure due to corrosion from specified environment. Warranty shall include 10 years free from defects in material and workmanship from date of shipment, and 25 years from degradation of failure due to corrosion from date of shipment, provided the structural integrity of the doors and frames has not been violated or compromised. No unauthorized cuts, bores, or other structural alterations affecting the core of the door, or the structure of the frame.

PART 2 – PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Products manufactured by the following companies complying with these Specifications will be acceptable for interior and exterior doors:

1. Corrim Company

2. Chem-Pruf Door Company

3. Simon Door Company

4. Approved Equal

B. Products manufactured that have successfully completed ANSI A250.4 Mod. Swing Cycle test in excess of 1,000,000 cycles, with no failure of any design features of the door.

2.02 DOORS

A. Door Fabrication FRP (Fiberglass Reinforced Plastic) Face Sheets

1. Face sheets: Standard face sheets shall be manufactured using a corrosion resistant resin system with light stabilizing additives. The resin shall be reinforced with fiberglass.

2. Face sheets shall be 0.070-inch to 0.125-inch thickness, with the standard being 0.120-inch. Total door thickness to be a nominal 1-3/4 inches.

3. Finish

a. Color shall be selected by Engineer from manufacturer's full range of colors, including all available standard and optional colors.

b. Minimum 15 mils thick coverage, plus or minus 3 mils

c. Smooth, seamless finish

d. Provide final field coat.

B. Internal Construction: Polyurethane foam core, a 1-1/2-inch thick rigid block of polyurethane, or a 2 psf expanded polyurethane foam shall be laminated to the interior or the panels. The R factor shall be 11–12.

C. Stiles and rails shall be 1-1/2-inch square pultruded fiberglass tubes. A polyester-based resin filled with 1/4 inch chopped glass strands and aerosol shall be used for reinforcements and corner blocks. The bottom rail shall allow 1-1/4 inches of height alterability without loss of the panel’s integrity. No metal or wood lumber reinforcements will be allowed.

D. Hardware Preparations

1. Reinforcement Blocking

a. Lockset: Non-swelling polymer blocking

b. Surface mount hardware: Non-swelling polymer blocking

c. Thru-bolted hardware: Non-swelling polymer blocking

2. Mortise Hardware

a. Full mortise hinges: Non-swelling polymer blocking

b. Mortise locksets: To suit template provided

c. Exit devices: To suit template provided

3. All doors shall be mortised and reinforced to allow application of hinges and locks, in accordance with hardware schedule and manufacturer’s templates. The hinges shall be attached by using stainless steel wood

screws. Pilot holes shall be in strict accordance to manufacturer's recommendations.

2.03 FRAMES

A. Frame fabrication FRP (Fiberglass Reinforced Plastic): Fire rated and non-rated frames shall be FRP. Fire rated frames are required to be FRP, similar to non-rated frames in manufacture and appearance and shall be in compliance with the labeling agency in accordance with UL 10C. Fire rated frames manufactured in a material other than fiberglass will not be accepted.

1. Jamb depth: Refer to Architectural Drawings.

2. Face dimension: 2-inch standard. Headers available in 2-inch and 4-inch. Refer to Architectural Drawings.

3. Return: 7/16 inch

4. Stop: 5/8 inch

5. Rabbet: 1-15/16 inch

6. Corner miter: Head and Jamb members shall be standard 45 degree miter, providing a neatly mitered corner connection, fabricated for Knocked Down (KD) field assembly.

7. Pultrusion: In compliance with pultrusion industry standards.

B. Reinforcements and Supports

1. Corner reinforcement: 4 inch by 4 inch by 5-3/8 inch by 1/4 inch thick pultruded fiberglass angle. Attached to head bar at factory using stainless steel screws or suitable polymer rivets.

2. Mortise hinge reinforcement: 1-1/2 inch by 7 inch by 1/4 inch thick polymer. Attached to frame by means of bonding and stainless steel countersunk screws.

3. Closer reinforcement: Same as mortise hinge reinforcement, less screws.

4. Strike reinforcement: 1-1/2-inch by 9-inch x ¾-inch thick polymer material. Attached to frame by means of bonding and stainless steel countersunk screws or suitable polymer rivets.

C. Anchoring systems: T-strap or wire anchor for masonry construction or concealed 316 stainless steel anchors per Contractor's option.

D. Finish: Gel coat; 15 mils thick, plus or minus 3 mils on all exposed surfaces. Color to match door unless otherwise indicated. Provide final field coat.

2.04 FABRICATION

A. Fabricate FRP doors and frames as shown on the Drawings and in accordance with best shop practices. Frames shall be rigid, neat in appearance, and free from defects. Field measurements shall be taken as required for coordinating with adjoining Work.

B. Form exposed surfaces free from warp, wave, and buckle, with all corners square, unless otherwise shown. Set each member in proper alignment and relationship to other members with all surfaces straight and in a true plane.

C. Reinforce members and joints with plates, tubes, or angles for rigidity and strength.

D. Doors and frames shall be mortised and reinforced for hardware in accordance with the hardware manufacturer's instructions and templates. The reinforcing shall be designed to receive hinges, locks, strikes, closures

E. Furnish at least 3 metal anchors or polymer spacers in each jamb of frames up to 84 inches high and 1 additional anchor for each 24-inch height above 84 inches, in shapes, sizes and spacing shown or required for anchorage into adjoining wall construction. Fabricate joint anchor of stainless steel.

F. Terminate bottom of frames at the indicated finished floor level.

G. Provide clearance for doors of 1/8 inch at jambs and heads; ¼-inch clearance above threshold.

2.05 SOURCE QUALITY CONTROL

A. Provide in accordance with Division 01 General Requirements.

PART 3 – EXECUTION

3.01 INSPECTION

A. Installer shall examine the substrate and conditions under which fiberglass reinforced plastic work is to be installed and notify the Contractor 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 in a manner acceptable to the installer.

3.02 INSTALLATION

A. Install FRP doors, frames and accessories in accordance with fabrication and installation Drawings, NFPA 80 standards at fire-rated openings, and as herein specified. Installation to be similar to that of hollow metal doors and frames, and in accordance with FRP manufacturer's installation instructions.

B. Place frames prior to construction of enclosed walls and ceilings. Set frames accurately in position, plumed, aligned, and braced securely until permanent anchors are set. After wall construction is completed, remove temporary braces and spreaders leaving surfaces smooth and undamaged. Frame must not be drilled for bracing supports as finish may be damaged.

C. In masonry construction, locate 3 wall anchors per jamb at hinge and strike levels. Frames may be grouted full of mortar at jambs and anchors shall be built into the joints as walls are laid up. A continuous bead of silicone sealant is to be applied between the head and jamb at the miter joint.

D. Fit FRP doors accurately in frames, within clearances specified in this section.

3.03 TOLERANCES

A. Maximum diagonal distortion: 1/4 inch measured with a straight edge, corner to corner. Maximum measurable plane is 4 feet by 7 feet.

3.04 ADJUSTING

A. At substantial completion, adjust all operable components to ensure proper installation and that they function smooth and freely.

3.05 FIELD QUALITY CONTROL

A. Provide in accordance with Division 01 General Requirements.

3.06 STARTUP & COMMISSIONING

A. Provide in accordance with Division 01 General Requirements.

3.07 CLEANING

A. Remove dirt and excess sealant from exposed surfaces. Follow the manufacturers' recommended cleaning techniques and procedures for cleaning all surfaces. Use only cleaning products that will not scratch or damage the surfaces, and are recommended by the manufacturer.

B. Remove debris from Project Site.

3.08 CLOSEOUT ACTIVITIES

A. Provide in accordance with Division 01 General Requirements.

END OF SECTION

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SECTION 08 51 13

ALUMINUM WINDOWS

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes

1. Provide aluminum windows and related items in accordance with this Section and applicable reference standards listed in Article 1.03.

a. Factory Glazing

b. Sealant within window system

c. Hardware, accessories and appurtenances

1.02 PRICE AND PAYMENT PROCEDURES

A. Measurement and payment requirements: per Division 01 General Requirements.

1.03 REFERENCES

A. Reference Standards

1. AMERICAN ARCHITECTURAL MANUFACTURERS ASSOCIATION (AAMA)

a. AAMA 101 Voluntary Performance Specifications Standard for Windows, Doors and Unit Skylights

b. AAMA 603.8 Voluntary Performance Requirements And Test Procedures For Pigmented Organic Coatings On Extruded Aluminum

2. ASTM INTERNATIONAL (ASTM)

a. ASTM B 117 Standard Practice for Operating Salt Spray (Fog) Apparatus

b. ASTM E 283 Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen

c. ASTM E 330 Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference

d. ASTM E 331 Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference

e. ASTM E 547 Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Cyclic Static Air Pressure Difference

3. Federal Specifications DD-4516

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination, Sequencing, and Scheduling: per Division 01 General Requirements.

1.05 SUBMITTALS

A. Submit in accordance with Division 01 General Requirements.

B. Shop Drawings: Submit only window types listed on the Drawings. Shop Drawings showing installation conditions throughout shall be submitted for approval. Shop Drawings shall include elevations of all windows (minimum scale 1/2 inch equals 1 foot), and full size details of every conditions indicating thickness of aluminum, fastenings, the size and spacing of anchor, method of glazing, details of operations hardware, methods and materials for weather stripping, and method of attaching screens

C. Product data: Submit catalogue cuts for all window types and screens

D. Samples: Submit color chips for selection by Engineer from manufacturer's standard

E. Test Reports: Submit reports for window types listed on the Drawings indicating compliance with AAMA Specifications and performance criteria.

1.06 QUALITY ASSURANCE

A. Provide in accordance with Division 01 General Requirements.

B. Samples: Provide color Samples and glass Samples for selection by Engineer from manufacturer's standard colors

1.07 DELIVERY, STORAGE AND HANDLING

A. Provide in accordance with Division 01 General Requirements.

B. All materials shall be delivered, stored, handled, and installed so as not to be damaged or deformed.

1.08 SITE CONDITIONS

A. Existing Conditions: per Division 01 General Requirements.

1.09 WARRANTY

A. Special Warranty/Extended Correction Period

1. Manufacturer's 10 year limited warranty on window unit parts with free replacement for any defective window part; except glass or screening.

2. Manufacturer's 5 year limited warranty on window finish against chipping, peeling, or cracking.

3. Manufacturer's 15 year limited warranty on insulated glass units.

a. Insulated glass portion of the window: Warranted not to fail for a period of 15 years from the date of purchase. A failed unit is one that develops a significant obstruction of vision resulting from film formation or dust collection between the interior glass surfaces of the unit caused by failure of the hermetic seal. Small marks, scratches, and spots that do not exceed manufacturer's standards or Federal Specifications DD-4516 do not make insulating glass units defective. Cracks or broken glass of any kind are excluded.

PART 2 – PRODUCTS

2.01 GENERAL INSULATED GLASS REQUIREMENTS

A. Low-emissivity tempered glass

1. Provide tempered glass for all windows.

2. Provide low-emissivity, Low-E, coating for specified windows.

2.02 FIXED WINDOW

A. Manufacturers: Provide one of the following windows that comply with AAMA 101 performance requirements for fixed window, heavy commercial, minimum rating shall be FW-HC40.

1. Series 400 Fixed Lite Aluminum Prime Window as manufactured by Universal Window and Door, LLC

2. Series TR-9500 Fixed Aluminum Window as manufactured by TRACO

3. Approved Equal

B. Material: Aluminum shall be of commercial quality aluminum alloy 6063-T5 free from defects impairing strength durability. All window members shall be of extruded aluminum and shall have a guaranteed minimum ultimate tensile strength of 22,000 per square inch, and a yield of 670,000 per square inch. Secondary members such as self-alignment clips, weather stripping, guides, etc., shall be made of a suitable and compatible material.

C. Finish: Standard finish shall be factory-applied thermo setting acrylic enamel. Finish to conform to AAMA 603.8 standard.

D. Glazing: Where specified, provide insulating glass with overall thickness of 1 inch consisting of 2 lites of 1/4 inch thick clear tempered glass with a Low-E coating and one space created by a desiccant-filled aluminum spacer system. Refer to Architectural Drawings for tint.

E. General requirements: All windows shall be of the thermally broken type, including sash and frame members.

F. Performance criteria for fixed windows: All windows shall conform to FW-HC40 Specifications in AAMA 101 when tests are performed on the prescribed 60 inch by 71-inch minimum test size with the following minimum test results.

1. Uniform load deflection test: Under an exterior load of 40 per square foot, no member in the completely assembled window shall deflect more than L/175 of its span per ASTM E 330.

2. Uniform load structural test: The window shall be subjected separately to an exterior and interior uniform load of 60 per square foot with no glass breakage or permanent damage causing the unit to be inoperable. Tests shall be conducted in accordance to ASTM E 330.

3. Maximum Air infiltration per ASTM E 283: 0.1 cfm/sf at 6.24 per square foot.

4. Water penetration per ASTM E 331 and ASTM E 547: No leakage at 8 per square foot minimum static air pressure.

5. Glass U-Value (winter) equals 0.45 maximum

6. Glass R-Value (winter) equals 2.22 minimum

7. Condensation resistance factor equals 60 frame and 69 glass

G. Muntins: Muntins shall be extruded aluminum or roll-formed aluminum; with exposed surfaces finished to match window color; concealed fasteners; designed for unrestricted expansion and contraction. Muntin bar cross-section profile and material chosen from manufacturer's standard. Grid pattern as shown on Drawings.

2.03 SOURCE OF QUALITY CONTROL

A. Provide in accordance with Division 01 General Requirements.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Install all windows in accordance with manufacturer's installation instructions and Shop Drawings.

B. Windows shall be set plumb, level to a tolerance of not more than 1/16 inch in 10 feet and in alignment without frame distortion and securely anchored in place as indicated, in accordance with the manufacturer's printed instructions and the Drawings.

C. Fasteners, clips, fittings, aluminum trim, closures, and shapes shall be provided as indicated and as required to provide a complete installation.

D. Joints shall be sealed between sash units, aluminum sills, and covers and similar metal-to-metal contact surfaces with sealant or tape as recommended and furnished by the window manufacturer. Installations shall be weather tight.

E. Joint sealing and calking between metal and masonry is specified in Section 07 92 00 JOINT SEALANTS.

3.02 DISSIMILAR MATERIALS

A. Aluminum shall be kept from direct contact with steel or other dissimilar materials by painting, non-absorptive tape, gasket, or other approved system as recommended by the manufacturer and as specified.

B. Aluminum surfaces in contact with steel shall be given one coat of zinc-chromate primer, applied to a dry-film thickness of not less than 1.5 mils, or one coat of a suitable non-hardening joint compound capable of excluding moisture from the joint during prolonged service.

C. Steel surfaces in contact with aluminum shall be given one coat of zinc-chromate paint, applied to a dry-coat thickness of 1.5 mils, and two or more coats of aluminum paint conforming to SSPC Paint 101, aluminum alkyd, Type II, applied to a dry-film thickness of 1.5 mils for each coat and a total dry-film thickness of 3 mils.

D. Corrosion-resistant, aluminized, or hot-dip galvanized steel placed in contact with aluminum need not be painted.

E. Aluminum surfaces placed in contact with wood, concrete, or masonry construction shall be given one coat of bituminous paint conforming to SSPC Paint 12, applied to a thickness of at least 1/16 inch.

3.03 CLEANING

A. Clean interior and exterior surfaces of window units of mortar, plaster, paint spattering spots, and other foreign matter to present a neat appearance and to prevent fouling of weathering surfaces and weather stripping, and to prevent interference with the operation of hardware.

3.04 FIELD QUALITY CONTROL

A. Provide in accordance with Division 01 General Requirements.

3.05 STARTUP & COMMISSIONING

A. Provide in accordance with Division 01 General Requirements.

3.06 CLOSEOUT ACTIVITIES

A. Provide in accordance with Division 01 General Requirements.

END OF SECTION

SECTION 08 62 23

TUBULAR SKYLIGHTS

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes

1. Provide tubular lighting devices consisting of roof domes, reflective tubes, diffuser assemblies, and accessories in accordance with this Section and applicable reference standards listed in Article 1.03.

1.02 PRICE AND PAYMENT PROCEDURES

A. Measurement and payment requirements: per Division 01 General Requirements.

1.03 REFERENCES

A. Reference Standards

1. ASTM INTERNATIONAL (ASTM)

a. ASTM B 209 Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate

b. ASTM E 84 Standard Test Method for Surface Burning Characteristics of Building Materials

c. ASTM A 463Standard Specification for Steel Sheet, Aluminum Coated, by the Hot Dip Process

d. ASTM A 653Standard Specification for Steel Sheet, Zinc Coated (Galvanized), by the Hot Dip Process

e. ASTM 792Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process

f. ASTM E 283 Test Method for Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen

g. ASTM E 308 Standard Practice for Computing the Colors of Objects by Using the CIE System

h. ASTM E 330 Structural Performance of Exterior Windows, Curtain Walls and Doors

i. ASTM E 547 Test Method for Water Penetration of Exterior Windows, Skylights, Doors and Curtain walls by Cyclic Air Pressure Difference

j. ASTM E 1886 Standard Test Method for Performance of Exterior Windows, Curtain Walls, Doors, and Impact Protective Systems Impacted by Missile(s) and Exposed to Cyclic Pressure Differentials

k. ASTM E 1996 Standard Specification for Performance of Exterior Windows, Curtain Walls, Doors, and Impact Protective Systems Impacted by Windborne Debris in Hurricane

l. ASTM D 635 Test Method for Rate of Burning and/or Extent of Time of Burning of Self-Supporting Plastics in a Horizontal Position

m. ASTM D-1929 Test Method for Ignition Properties of Plastics

2. UNDERWRITERS' LABORATORIES (UL)

a. UL 181 Factory Made Air Ducts and Air Connectors

3. INTERNATIONAL CODE COUNCIL (ICC)

a. ICC AC-16 Acceptance Criteria for Plastic Skylights

4. FLORIDA BUILDING CODE

a. Florida Building Code TAS 201 Impact Test Procedures

b. Florida Building Code TAS 202 Criteria for Testing Impact and Non-Impact Resistant Building Envelope Components Using Uniform Static Air Pressure Loading

c. Florida Building Code TAS 203 Criteria for Testing Products Subject to Cyclic Wind Pressure Loading

B. Performance Requirements: Completed tubular daylighting device assemblies shall be capable of meeting the following performance requirements.

1. Air infiltration test: Air infiltration will not exceed 0.30 cubic feet per minute per square foot aperture with a pressure delta of 1.57 pounds per square foot across the tube when tested in accordance with ASTM E 283

2. Water resistance test: No uncontrolled water leakage at 10.5 pounds per square foot pressure differential with water rate of 5 gallons per hour per square foot when tested in accordance with ASTM E 547

3. Uniform Load Test

a. No breakage, permanent damage to fasteners, hardware parts, or damage to make daylighting system inoperable or cause excessive permanent deflection of any section when tested at a Positive Load

of 150 pounds per square foot 7.18 kPa or Negative Load of 70 pounds per square foot 3.35 kPa

b. All units shall be tested with a safety factor of 3 for positive pressure and 2 for negative pressure, acting normal to plane of roof in accordance with ASTM E 330

4. Hurricane Resistance

a. Meets Florida Building Code TAS, 201, TAS, 202 and TAS 203 for impact and non-impact components

b. Meets ASTM E 1886 and ASTM E1996 for missile and cyclic pressure differential testing

5. Fire Testing

a. When used with the Dome Edge Protection Band, all domes meet fire rating requirements as described in the 2006 International Building Code

b. Self-ignition temperature: Greater than 650 degrees F per ASTM D-1929

c. Smoke Density: Rating no greater than 450 per ASTM Standard E 84 in way intended for use. Classification C

d. Rate of burn and/or extent: Maximum Burning Rate: 2.5 inches per minute 62 millimeters per minute Classification CC-2 per ASTM D 635

e. Rate of burn and/or extent: Maximum Burn Extent: 1 inch (25 mm) Classification CC-1 per ASTM D 635

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination, Sequencing, and Scheduling: per Division 01 General Requirements.

1.05 SUBMITTALS

A. Submit in accordance with Division 01 General Requirements.

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: Showing layout, profiles and product components, including anchorage, flashings and accessories

D. Test Reports: Independent testing agency or evaluation service reports verifying compliance with specified performance requirements

E. Closeout and Maintenance Material Submittals: per Division 01 General Requirements.

1.06 QUALITY ASSURANCE

A. Provide in accordance with Division 01 General Requirements.

B. Qualifications: per Division 01 General Requirements for manufacturing and as follows.

1. Engaged in the manufacture of tubular daylighting devices for minimum of 15 years

1.07 DELIVERY, STORAGE, AND HANDLING

A. Provide in accordance with Division 01 General Requirements.

B. Unload and store products in manufacturer's unopened packaging until ready for installation. Store materials on substantial pallets, dunnage, or other supports and spacers, free from the earth and properly drained, preventing splattering with dirt and other foreign matter.

C. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

1.08 SITE CONDITIONS

A. Existing Conditions: per Division 01 General Requirements.

1.09 WARRANTY

A. Special Warranty/Extended Correction Period

1. Daylighting device: Manufacturer’s 10 year warranty

PART 2 – PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Solatube International, Inc.

B. Velux

C. Wasco

D. ODL

2.02 TUBULAR DAYLIGHTING DEVICES

A. Transparent roof-mounted skylight dome and self-flashing curb, reflective tube, and ceiling level diffuser assembly, transferring sunlight to interior spaces; complying with ICC AC-16

B. Solatube Model 330 DS-O Open Ceiling, 21 inch Daylighting System or equal

1. Roof dome assembly: Transparent, UV and impact resistant dome with flashing base supporting dome and top of tube

    a. Glazing: Type DA, 0.143 inch minimum thickness injection molded acrylic classified as CC2 material; UV inhibiting (100 percent UV C, 100 percent UV B and 98.5 percent UV A), impact modified acrylic blend.

2. LightTracker Reflector, made of aluminum sheet, thickness 0.015 inch with SpectraLight Infinity, positioned in the dome to capture low angle sunlight

3. Roof Flashing Base

    a. One-piece, seamless, leak-proof flashing functioning as base support for dome and top of tube. Sheet steel, corrosion resistant conforming to ASTM A 653or ASTM A 463, or ASTM A 792, 0.028 inch plus or minus .006 inch thick

        1) Base Style: Type F11, Self-mounted, 11 inches high

4. Flashing insulator: Type FI, thermal isolation material for use under flashing

5. Roof flashing turret extensions: Provide manufacturer's standard extensions for applications requiring Type T12, additional lengths of 12 inches extension

6. Tube ring: Attached to top of base section; 0.090 inch nominal thickness injection molded high impact PVC; to prevent thermal bridging between base flashing and tubing and channel condensed moisture out of tubing

7. Tube ring seal: Attached to the base of the dome ring; butyl glazing rope, 0.24 inch diameter; to minimize air infiltration

8. Dome seal: Adhesive backed weather strip, 0.63 inch tall by 0.28 inch.

9. Reflective tubes: Aluminum sheet, thickness 0.018 inch

    a. General

        1) Interior Finish: SpectraLight Infinity high reflectance specular finish on exposed reflective surface. Specular

reflectance for visible spectrum greater than 99 percent. Total solar spectrum reflectance less than 80.2 percent

b. Extension Tube

1) Reflective extension tube, Type EXX, notched for open ceiling diffuser attachment, 24 inches or 48 inches long

10. Diffuser assemblies for tubes not penetrating ceilings (open ceiling): Solatube Model 330 DS-O 21 inch diameter diffuser attached directly to bottom of tube

a. Lens: Type L1 OptiView Fresnel lens design to maximize light output and diffusion. Visible light transmission shall be greater than 90 percent at 0.022 inch thick. Classified as CC2

b. Diffuser Seal: Open cell foam, acrylic adhesive backed, 0.75 inch wide by 0.125 inch thick to minimize condensation and bug, dirt and air infiltration per ASTM E 283

c. Diffuser Trim Ring: Injection molded acrylic. Nominal wall thickness 0.172 inches

d. Secondary Diffuser: Type SS, Acrylic plastic classified as CC2 material. Thickness shall not be less than 0.100 inches

11. Accessories: Open ceiling trim ring Type R, ABS Plastic, White; nominal thickness of 0.04 inches

2.03 ACCESSORIES

A. Fasteners: Same material as metals being fastened, non-magnetic steel, non-corrosive metal of type recommended by manufacturer, or injection molded nylon

B. Suspension wire: Steel, annealed, galvanized finish, size and type for application and ceiling system requirement

C. Sealant: Polyurethane or copolymer based elastomeric sealant as provided or recommended by manufacturer

2.04 SOURCE QUALITY CONTROL

A. Provide in accordance with Division 01 General Requirements.

PART 3 – EXECUTION

3.01 EXAMINATION

A. Do not begin installation until substrates have been properly prepared

B. If substrate preparation is the responsibility of another installer, notify Engineer of unsatisfactory preparation before proceeding

3.02 PREPARATION

A. Clean surfaces thoroughly prior to installation

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the Project conditions

3.03 INSTALLATION

A. Install in accordance with manufacturer's printed instructions

B. 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

C. After installation of first unit, field test to determine adequacy of installation. Conduct water test in presence of Owner and Engineer. Correct if needed before proceeding with installation of subsequent units

3.04 PROTECTION

A. Protect installed products until completion of Project

B. Touch-up, repair or replace damaged products

3.05 FIELD QUALITY CONTROL

A. Provide in accordance with Division 01 General Requirements.

3.06 STARTUP & COMMISSIONING

A. Provide in accordance with Division 01 General Requirements.

3.07 CLOSEOUT ACTIVITIES

A. Provide in accordance with Division 01 General Requirements.

END OF SECTION

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SECTION 08 71 00

DOOR HARDWARE

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes

1. Provide finish hardware for doors to provide correct functions for intended use, provide related items and services, as indicated on Drawings and in accordance with this Section and applicable reference standards listed in Article 1.03.

2. Furnish hardware schedules and templates as required for fabrication of doors and frames under other Sections.

B. Related Requirements

1. Division 07, Section 07 92 00 JOINT SEALANTS

2. Division 08, Section 08 11 00 METAL DOORS AND FRAMES

3. Division 08, Section 08 16 15 FIBERGLASS DOORS AND FRAMES

1.02 PRICE AND PAYMENT PROCEDURES

A. Measurement and payment requirements: per Division 01 General Requirements.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Coordination, Sequencing, and Scheduling: per Division 01 General Requirements.

1.04 SUBMITTALS

A. Submit in accordance with Division 01 General Requirements.

B. Product Data: Manufacturer's product data, catalog cuts, descriptive data, UL listings, and other pertinent technical data for each of the products used

C. Certifications of fire-ratings for hardware items located in rated assemblies

D. Shop Drawings

1. Final hardware and keying schedule. Format schedule vertically. List each door opening using same designations indicated on Drawings.

E. Manufacturer Instructions

1. Installation Templates: For Work installed or prepared for installation by others

F. Closeout and Maintenance Material Submittals: per Division 01 General Requirements

1.05 QUALITY ASSURANCE

A. Provide in accordance with Division 01 General Requirements.

B. Provide the services of a certified hardware consultant to prepare hardware and keying schedules.

C. Fire-resistance ratings: When fire-resistance ratings are indicated or required by authorities having jurisdiction, provide hardware items identical to those which have been tested and labeled for fire-rated use by independent testing agencies acceptable to Engineer.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Provide in accordance with Division 01 General Requirements.

B. Package and label each hardware item separately with all screws, bolts, and accessories required for a complete and proper installation. Coordinate the labeling of packages with hardware set numbers.

C. Store hardware items in locked spaces. Replace all hardware items lost or damaged. Provide copies of Supplier receipts for hardware items delivered to the Project.

1.07 SITE CONDITIONS

A. Provide in accordance with Division 01 General Requirements.

1.08 MAINTENANCE

A. Provide services of hardware Supplier's representative to inspect hardware 6 months after completion of Project. Readjust and restore hardware.

PART 2 – PRODUCTS

2.01 FINISH HARDWARE - GENERAL REQUIREMENTS

A. One manufacturer and catalog number is listed for each type of hardware specified. Catalog numbers are listed to set the standard of quality required. Provide the specified hardware item, or an equal product from one of the following manufacturers.

1. Sargent
2. Hager Companies
3. McKinney
4. Soss
5. Stanley
6. PEMKO
7. Ives
8. Brookline
9. LCN
10. Yale
11. Reese
12. National Guard Products
13. Zero
14. Glynn-Johnson

B. For each type of hardware, provide products of a single manufacturer.

C. Manufacturer's names or trademarks displayed in a visible location will not be permitted on any piece of hardware.

D. Base metal: Provide hardware items of stainless steel.

E. Fasteners: Provide concealed fasteners to the greatest extent possible. Do not use through-bolts unless otherwise acceptable to the Engineer.

2.02 HARDWARE FINISHES

A. Submit Samples of each finish to be exposed. Show full range of color and finish variations expected.

1. Provide US 32D dull stainless for all hardware.
2. Provide painted plastic covers on closers.

2.03 LOCKSETS AND LATCHSETS

A. As manufactured by Sargent or approved equal.

B. Provide lock and latchset functions listed in the hardware schedule provided on Drawings.

C. Mortise locksets and latchsets: Except where scheduled otherwise, provide Sargent 7900 Mortise lock

D. Exit device: Sargent 30 Series where scheduled

E. US 32D dull stainless lever trim, ADA compliant

F. Provide 1/2 inch minimum throws. Comply with UL requirements for fire-rated hardware.

G. Provide manufacturer's standard box strike with extended curved lip. Finish strikes and lips to match lock or latch.

H. Provide rabbeted locks and latches where rabbeted door stiles are indicated or required.

2.04 KEYING AND LOCK CYLINDERS

A. Contractor shall utilize the services of a professional locksmith, as required to comply with Owner's instructions for keying of Project. Provide Grandmaster Key System, unless otherwise directed by Owner.

B. Provide interchangeable core cylinders, removable by use of special key, for all locking devices on this Project, unless otherwise directed by Owner.

C. Provide cylinders and keys from stainless steel, brass, or nickel silver.

D. Provide three keys for each lock, 5 Master keys, 5 Grandmaster keys. Provide one blank key for each lock, unless otherwise directed by Owner.

E. Provide 3 additional cores, keyed only into this system, unless otherwise directed by Owner.

2.05 KEY CONTROL SYSTEM

A. Provide key control system consisting of labels, tags, card index, and metal wall mounted cabinet. Set up control system, label and identify each key, type index cards, and deliver to Owner complete and ready for use.

B. Refer to Hardware Schedule provided on the Drawings for electrical lockset requirements and locations.

2.06 HINGES AND BUTTS

A. Provide stainless steel hinges template produced, full mortise, five knuckle-type, except as otherwise scheduled, and as follows:

1. For major corridor doors, entrance doors, lobby doors, and public toilet room doors, provide four-ball bearing hinges.

2. For all other doors not listed above, provide standard weight, 2 ball bearing hinges.

B. Hinge height: 4-1/2 inches

C. Consultant shall determine proper hinge width based upon door thickness and trim conditions. Provide minimum 4-1/2 inch wide hinges.

D. Provide 3 hinges for doors up to 7 feet 6 inches high, and 1 additional hinge for each additional 2 feet 6 inches of height. Provide one additional hinge for doors over 3 feet 6-inches wide.

E. Provide flat button pins matching hinges in finish and material. Provide non-removable pins on out-swinging exterior and corridor doors. Provide non-rising pins for all other hinges.

2.07 CLOSERS

A. Provide LNC 4010 Series

B. Provide closers with hold-open features where indicated. Provide closers with built-in door stop function at an adjustable angle where indicated. Hold-open door closers are not permitted to be used on fire door assemblies.

C. Mount closers on the least public side of doors to the greatest extent possible. Provide closers with parallel arms wherever closers are on the stop side of doors that swing out into corridors and public spaces. Where parallel arms are used, provide closers that are one size larger than manufacturer's recommendation.

D. Follow manufacturer's recommendations for size of closer based upon size and weight of door, exposure, and frequency of use.

E. Closer cylinders, arms, adapter plated, and metal covers shall have a powder coating finish with optimal special rust inhibitor (SRI) primer designed for installations in corrosive environments.

2.08 KICK PLATES

A. Provide Hager No. 194S kick plates, beveled on all four sides

B. Provide kick plates that are 1/2 inch less than door width when mounted on the pull side, and 1-1/2 inches less than door width when mounted on stop side.

C. Height: 10 inches high for kick plates

D. Material: 0.05-inch gauge solid metal closely matching lockset/latchset finish. Plated metal door trim units are not acceptable.

2.09 STOPS

A. Provide Ives wall stops #406 to suite wall condition. Where indicated, or where wall stop is not practical, provide Ives floor stops #436 or #438 to suit floor conditions and clearances.

2.10 WEATHERSTRIPPING, SOUNDSTRIPPING, AND THRESHOLDS

A. Thresholds: Provide Catalog # S256A for all thresholds, unless noted otherwise. Provide Catalog #S803A, for exterior wall man-doors. Where indicated on the Contract Drawings, provide ADA accessible thresholds.

B. Provide weather stripping for every exterior door, doors with unheated spaces on one side, and wherever scheduled. Weather stripped doors are required to provide a continuous seal at the entire perimeter of door with no cracks.

1. Drop seals: Provide Reese Automatic Door Bottom Catalog #372 for metal and Fiberglass Reinforced Polyester (FRP) doors.

2. Gaskets: Provide Reese Catalog #797B gaskets at door heads and jambs.

2.11 MISCELLANEOUS HARDWARE

A. Astragals: Provide Reese Catalog #87C.

B. Drip Caps: For doors that swing directly out into the rain, provide Reese Catalog #R199A drip cap.

C. Silencers: For steel doors, provide Hager Companies No. 308D grey resilient silencers. Provide 3 silencers for single doors, and 2 silencers for doors hinged in pairs.

D. Flushbolts: Provide top and bottom of inactive leaf in double doors.

2.12 SOURCE QUALITY CONTROL

A. Provide in accordance with Division 01 General Requirements.

PART 3 – EXECUTION

3.01 INSPECTION

A. Examine doors, frames, and conditions under which the Work of this Section will be performed. Notify Contractor in writing of conditions detrimental to the proper completion of the Work. Do not proceed with Work until unsatisfactory conditions are corrected. Commencing Work means Installer accepts substrates and conditions.

3.02 INSTALLATION

A. Hardware schedule: As shown on the Drawings

B. Provide installation templates for Work installed or prepared for installation by others.

C. Comply with manufacturers' instructions and recommendations, except where more restrictive requirements are specified in this Section.

D. Installation of hardware shall comply with NFPA 80 and NFPA 101 requirements.

E. Set hardware plumb, level, and in exact alignment and location. Conceal and countersink fasteners wherever possible.

F. Set exterior thresholds in bed of sealant provided in accordance with Section 07 92 00 JOINT SEALANTS.

3.03 ADJUSTING, CLEANING, AND PROTECTION

A. Adjust hardware items to work smoothly, easily, and correctly.

B. Clean exposed surfaces using non-abrasive materials and methods recommended by manufacturer of hardware being cleaned. Remove and replace Work which cannot be successfully cleaned, as judged solely by the Engineer.

C. Provide temporary protection to ensure Work being without damage or deterioration at time of final acceptance. Remove protections and re-clean as necessary immediately prior to final acceptance.

D. Cover knobs, levers, pulls, and push plates with heavy cloth to protect against damage until Final Acceptance of the Project.

3.04 FIELD QUALITY CONTROL

A. Provide in accordance with Division 01 General Requirements.

3.05 STARTUP & COMMISSIONING

A. Provide in accordance with Division 01 General Requirements.

3.06 CLOSEOUT ACTIVITIES

A. Provide in accordance with Division 01 General Requirements.

END OF SECTION

SECTION 09 22 16

NON-STRUCTURAL METAL FRAMING

PART 1 – GENERAL

1.01 1.01 SUMMARY

A. Section Includes

1. Provide non-structural metal framing in accordance with this Section and applicable reference standards listed in Article 1.03.

1.02 PRICE AND PAYMENT PROCEDURES

A. Measurement and payment requirements: per Division 01 General Requirements.

1.03 REFERENCES

A. Reference Standards

1. AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

   a. AISC 341 Seismic Provisions for Structural Steel Buildings

2. ASTM INTERNATIONAL (ASTM)

   a. ASTM A 653 Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process

3. NATIONAL ASSOCIATION OF ARCHITECTURAL METAL MANUFACTURERS (NAAMM)

   a. NAAMM ML/SFA 920 Metal Lathing and Furring

4. UNDERWRITERS LABORATORIES (UL)

   a. UL Fire Resistance Directory

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination, Sequencing, and Scheduling: per Division 01 General Requirements.

1.05 SUBMITTALS

A. Submit in accordance with the Division 01 General Requirements.

B. Shop Drawings: Submit for the erection of metal framing, furring, and girts. Indicate materials, sizes, thicknesses, and fastenings.

C. Closeout and Maintenance Material Submittals: per Division 01 General Requirements

1.06 QUALITY ASSURANCE

A. Provide in accordance with Division 01 General Requirements.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Provide in accordance with Division 01 General Requirements.

B. Deliver materials to the job Site and store in ventilated dry locations. Storage area shall permit easy access for inspection and handling. If materials are stored outdoors, stack materials off the ground, supported on a level platform, and fully protected from the weather. Handle materials carefully to prevent damage. Remove damaged items and provide new items.

1.08 SITE CONDITIONS

A. Existing Conditions: per Division 01 General Requirements.

PART 2 – PRODUCTS

2.01 MATERIALS

A. Provide steel materials for metal support systems with galvanized coating ASTM A 653, G-60.

B. Provide steel materials for metal support systems with galvanized coating ASTM A653, G-60.

C. J-Tracks, not lighter than 20 gauge galvanized steel, minimum 2-1/2 inches deep, and unequal legs of 1 inch and 2 inches.

D. C-H Studs, not lighter than 20 gauge galvanized steel, minimum 2-1/2 inches deep.

E. Wall studs shall be minimum 20 gage, 4" deep, with 1 3/8" wide flanges. Provide not less than two cutouts in web of each stud, approximately 12 inches from each end, and intermediate cutouts on approximately 24-inch centers. Studs shall be in one piece, full-height of wall.

F. Runners shall be minimum 18 gage.

2.02 SOURCE QUALITY CONTROL

A. Provide in accordance with Division 01 General Requirements.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Install framing for fired-rated ceiling assemblies in accordance with Design No. U415 and fire resistance rating UL 263.

B. J-Tracks: Attach tracks to walls with steel fasteners located not greater than 2 inches from the end and spaced no more than 24 inches on center.

C. C-H Studs: Cut 3/8 to 1/2 inch less than span length and space not more than 24 inches on center.

D. Wall Studs: Install in accordance with ASTM C754, except as otherwise shown or specified. Space wall studs not more than 16 inches on center.

3.02 ERECTION TOLERANCES

A. Provide framing members which will be covered by finish materials such as wallboard, within the following limits.

1. Layout of walls and partitions: 1/4 inch from intended position

2. Plates and runners: 1/4 inch in 8 feet from a straight line

3. Studs: 1/4 inch in 8 feet out of plumb, not cumulative

4. Face of framing members: 1/4 inch in 8 feet from a true plane

3.03 FIELD QUALITY CONTROL

A. Provide in accordance with Division 01 General Requirements.

3.04 STARTUP & COMMISSIONING

A. Provide in accordance with Division 01 General Requirements.

3.05 CLOSEOUT ACTIVITIES

A. Provide in accordance with Division 01 General Requirements.

END OF SECTION

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SECTION 09 29 00

GYPSUM BOARD

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes

1. Provide gypsum board in accordance with this Section and applicable reference standards listed in Article 1.03.

1.02 PRICE AND PAYMENT PROCEDURES

A. Measurement and payment requirements: per Division 01 General Requirements.

1.03 REFERENCES

A. Reference Standards

1. ASTM INTERNATIONAL (ASTM)

a. ASTM C 36 Gypsum Wallboard

b. ASTM C 475 Joint Compound and Joint Tape for Finishing Gypsum Board

c. ASTM C 514 Standard Specification for Nails for the Application of Gypsum Board

d. ASTM C 630/C 630M Water-Resistant Gypsum Backing Board

e. ASTM C 840 Application and Finishing of Gypsum Board

f. ASTM C 954 Steel Drill Screws for the Application of Gypsum Board or Metal Plaster Bases to Steel Studs from 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm) in Thickness

g. ASTM C 1002 Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs

h. ASTM C 1396/C 1396M Standard Specification for Gypsum Board

2. GYPSUM ASSOCIATION (GA)

a. GA 214 Recommended Levels of Gypsum Board Finish

b. GA 216 Application and Finishing of Gypsum Board

c. GA 600 Fire Resistance Design Manual

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination, Sequencing, and Scheduling: per Division 01 General Requirements.

1.05 SUBMITTALS

A. Submit in accordance with the Division 01 General Requirements.

1. Product Data

   a. Gypsum Board

   b. Joint Treatment Materials

2. Certificates

   a. Material Safety Data Sheets

   b. Manufacturer maintenance instructions

1.06 QUALITY ASSURANCE

A. Provide in accordance with Division 01 General Requirements.

B. Qualifications: per Division 01 General Requirements for gypsum board work and as follows.

1. Furnish type of gypsum board work specialized by the installer with a minimum of 3 years of documented experience.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Provide in accordance with Division 01 General Requirements.

B. Deliver materials in the original packages, containers, or bundles with each bearing the brand name, applicable standard designation, and name of manufacturer, or Supplier.

C. Keep materials dry by storing inside a sheltered building. Where necessary to store gypsum board and cementitious backer units outside, store off the ground, properly supported on a level platform, and protected from direct exposure to rain, snow, sunlight, and other extreme weather conditions. Provide adequate ventilation to prevent condensation. Store per manufacturer's recommendations for allowable temperature and humidity range. Gypsum wallboard shall not be stored with materials which have high emissions of volatile organic compounds (VOCs) or other contaminants. Do not store panels near materials that may give off gas or emit harmful fumes, such as kerosene heaters, fresh paint, or adhesives.

D. Neatly stack gypsum board and cementitious backer units flat to prevent sagging or damage to the edges, ends, and surfaces.

1.08 SITE CONDITIONS

A. Existing Conditions: per Division 01 General Requirements.

1.09 MAINTENANCE

A. Maintain a uniform temperature of not less than 50°F in the structure for at least 48 hours prior to, during, and following the application of gypsum board, cementitious backer units, and joint treatment materials, or the bonding of adhesives.

B. Protect gypsum board and cementitious backer unit products from direct exposure to rain, snow, sunlight, and other extreme weather conditions.

C. Provide temporary ventilation for Work of this section.

PART 2 – PART 2 - PRODUCTS

2.01 MATERIALS

A. Provide gypsum board types, gypsum backing board types, cementitious backing units, and joint treating materials manufactured from Asbestos free materials only. Submit Material Safety Data Sheets and manufacturer maintenance instructions for gypsum materials including adhesives.

B. Gypsum Board

1. Fire-resistance (Type X): 48-inch wide, 5/8-inch thick, tapered edges. Provide for 1-hour fire rated ceiling wherever indicated.

2. Regular: 48-inch wide, 5/8-inch thick, tapered edges. Provide for walls indicated.

C. Joint treatment materials: Use all-purpose joint and texturing compound containing inert fillers and natural binders, including lime compound. Pre-mixed compounds shall be free of antifreeze, vinyl adhesives, preservatives, biocides and other slow releasing compounds.

1. Embedding compound: Specifically formulated and manufactured for use in embedding tape at gypsum board joints and compatible with tape, substrate and fasteners.

2. Finishing or topping compound: Specifically formulated and manufactured for use as a finishing compound.

3. All-purpose compound: Specifically formulated and manufactured to serve as both a taping and a finishing compound and compatible with tape, substrate and fasteners.

4. Setting or hardening type compound: Specifically formulated and manufactured for use with fiberglass mesh tape.

5. Joint tape: Use cross-laminated or tapered edge tape recommended by the manufacturer. Paper and fiberglass joint tape are not permitted.

D. Fasteners

1. Screws: ASTM C 1002, Type G, Type S or Type W steel drill screws for fastening gypsum board to gypsum board, wood framing members and steel framing members less than 0.033 inch thick. ASTM C 954 steel drill screws for fastening gypsum board to steel framing members 0.033 to 0.112 inch thick. Provide cementitious backer unit screws with a polymer coating.

2. Do not use adhesive containing benzene, carbon tetrachloride, or trichloroethylene. Adhesive shall contain a maximum VOC content of 50 grams per liter.

2.02 SOURCE QUALITY CONTROL

A. Provide in accordance with Division 01 General Requirements.

PART 3 – EXECUTION

3.01 EXAMINATION

A. Verify that framing and furring are securely attached and of sizes and spacing to provide a suitable substrate to receive gypsum board. Verify that all blocking, headers and supports are in place to support plumbing fixtures and similar items. Do not proceed with Work until framing and furring are acceptable for application of gypsum board.

3.02 APPLICATION OF GYPSUM BOARD

A. Apply gypsum board to framing and furring members in accordance with ASTM C 840 or GA 216 and the requirements specified. Apply gypsum board with separate panels in moderate contact; do not force in place. Stagger end joints of adjoining panels. Neatly fit abutting end and edge joints. Use gypsum board of maximum practical length; select panel sizes to minimize waste. Cut out gypsum board to make neat, close, and tight joints around openings. In vertical application of gypsum board, provide panels in lengths required to reach full height of vertical surfaces in one continuous piece. Lay out panels to minimize waste; reuse cutoffs whenever feasible. Treat edges of cutouts for plumbing pipes, screw heads, and joints with water-resistant compound as recommended by the gypsum board manufacturer. Minimize framing by floating corners with single studs and drywall clips. Provide type of gypsum board for use in each system specified herein as indicated.

B. Application of single-ply gypsum board to wood framing: Apply in accordance with ASTM C 840, System I or GA 216.

C. Application of two-ply gypsum board to wood framing: Apply in accordance with ASTM C 840, System II of GA 216.

3.03 FINISHING OF GYPSUM BOARD

A. Tape and finish gypsum board in accordance with ASTM C 840, GA 214, and GA 216. Finish walls and ceilings without critical lighting to receive flat paints, light textures, or wall coverings to Level 4 in accordance with GA 214. Provide joint, fastener depression, and corner treatment. Tool joints as smoothly as possible to minimize sanding and dust. Do not use fiberglass mesh tape with conventional drying type joint compounds; use setting or hardening type compounds only. Provide treatment for water-resistant gypsum board as recommended by the gypsum board manufacturer. Protect workers, building occupants, and HVAC systems from gypsum dust.

3.04 SEALING

A. Seal openings around pipes, fixtures, and other items projecting through gypsum board and cementitious backer units as specified in Section 07 92 00 Joint Sealants. Apply material with exposed surface flush with gypsum board or cementitious backer units.

3.05 FIRE-RESISTANT ASSEMBLIES

A. Wherever fire-rated construction is indicated, provide materials and application methods, including types and spacing of fasteners, and ceiling framing in accordance with the Specifications contained in GA 600 for File Number RC 2601. Joints of fire-rated gypsum board enclosures shall be closed and sealed in accordance with GA requirements. Seal penetrations through rated partitions and ceilings tight in accordance with tested systems.

3.06 PATCHING

A. Patch surface defects in gypsum board to a smooth, uniform appearance, ready to receive finishes.

3.07 WASTE MANAGEMENT

A. Separate clean waste gypsum products from contaminants. Do not include wood, plastic, metal, asphalt-impregnated gypsum board, or any gypsum board coated with glass fiber, vinyl, decorative paper, or other finish. Place in designated area and protect from moisture and contamination.

3.08 FIELD QUALITY CONTROL

A. Provide in accordance with Division 01 General Requirements.

3.09 STARTUP & COMMISSIONING

A. Provide in accordance with Division 01 General Requirements.

3.10 CLOSEOUT ACTIVITIES

A. Provide in accordance with Division 01 General Requirements.

END OF SECTION

SECTION 09 90 00

PAINTING AND COATING

1.01 SUMMARY

A. Section Includes

1. Provide surface preparation and painting in accordance with this Section and applicable reference standards listed in Article 1.03.

2. Provide the following types of painting Work per the Paint Schedules attached and on Drawings.

a. Painting of exterior trim.

b. Painting of new doors and frames.

c. Painting of new and existing interior CMU masonry, concrete, miscellaneous metal, and gypsum wallboard surfaces as indicated

d. Painting and labeling of ductile iron pipes, PVC/CPVC pipes, and fittings.

e. Painting of equipment where indicated, and labeling of all equipment.

f. Painting of existing walls where existing equipment is demolished.

g. Painting of new concrete equipment bases.

h. Painting of the existing concrete equipment bases for the primary sludge pumps and grinders.

i. Touch-up painting of factory-coated equipment

j. Painting of HVAC equipment and ducts where indicated

1.02 PRICE AND PAYMENT PROCEDURES

A. Measurement and payment requirements: per Division 01 General Requirements.

1.03 REFERENCES

A. Reference Standards

1. SOCIETY FOR PROTECTIVE COATINGS (SSPC)

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination, Sequencing, and Scheduling: per Division 01 General Requirements.

1.05 SUBMITTALS

A. Submit in accordance with Division 01 General Requirements.

B. Product Data

1. Block Fillers

2. Primers

3. Manufacturer's technical information including label analysis and instructions for handling, storage, and application of each material proposed for use.

4. Manufacturer's material data and certificates of performance for proposed substitutions.

5. List each material and cross-reference the specific coating, finish system, and application. Identify each material by the manufacturer's catalog number and general classification.

C. Certificates: from manufacturer that products supplied comply with local regulations controlling use of volatile organic compounds (VOCs).

D. Closeout and Maintenance Material Submittals: per Division 01 General Requirements.

1.06 QUALITY ASSURANCE

A. Provide in accordance with Division 01 General Requirements.

B. Applicator Qualifications: Engage experienced applicators who have completed painting system applications similar in material and extent to those indicated for the Project that have resulted in a construction record of successful in-service performance.

C. Field Samples: On wall surfaces and other exterior and interior components, duplicate finishes of prepared samples. Provide full-coat finish samples on at least 100 square ft. of surface until required sheen, color, and texture are obtained; simulate finished lighting conditions for review of in-place Work.

1. Final acceptance of colors will be from Project-applied samples.

2. The Engineer will select one room or surface to represent surfaces and conditions for each type of coating and substrate to be painted. Apply coatings in this room or surface according to the Paint Schedules attached and on the Drawings or as specified.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Provide in accordance with Division 01 General Requirements.

B. Deliver materials to the Site in the manufacturer's original, unopened packages and containers bearing manufacturer's name and label, and the following information:

1. Product name or title of material

2. Product description (generic classification or binder type)

3. Manufacturer's stock number and date of manufacture

4. Contents by volume, for pigment and vehicle constituents

5. Thinning instructions

6. Application instructions

7. Color name and number

C. Store materials not in use in tightly covered containers in a well-ventilated area at a minimum ambient temperature of 45°F. Maintain containers used in storage in a clean condition, free of foreign materials and residue.

1. Protect from freezing. Keep storage area neat and orderly. Remove oily rags and waste daily. Take necessary measures to ensure that workers and Work areas are protected from fire and health hazards resulting from handling, mixing, and application.

1.08 SITE CONDITIONS

A. Existing Conditions: per Division 01 General Requirements.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. Tnemec, Sherwin Williams (S-W), PPG Coating, or Engineer Approved Equal per Paint Schedules attached and on the Drawings.

2.02 PAINT MATERIALS

A. Provide materials designated by item or area to be painted in Paint Schedules attached and on Drawings. Use of manufacturer's proprietary product names to designate colors or materials is not intended to imply that products named are required to be used to the exclusion of equivalent products of other manufacturers.

B. Provide primers and undercoat paint produced by the same manufacturer as the finish coats.

C. Material Compatibility: Provide block fillers, primers, finish coat materials, and related materials that are compatible with one another and the substrates indicated under conditions of service and application, as demonstrated by the manufacturer based on testing and field experience.

D. Material Quality: manufacturer's best-quality trade sale paint material of the various coating types specified. Ensure paint material containers display manufacturer's product identification.

E. Colors: from the manufacturer's full range of standard colors.

2.03 SOURCE QUALITY CONTROL

A. Provide in accordance with Division 01 General Requirements.

PART 3 – EXECUTION

3.01 EXAMINATION

A. Examine substrates and conditions under which painting will be performed for compliance with paint application requirements. Ensure surfaces receiving paint are thoroughly dry before paint is applied. Do not begin to apply paint until unsatisfactory conditions have been corrected.

B. Coordination of Work: Review other Specifications in which primers are provided to ensure compatibility of the total system for various substrates. On request, furnish information on characteristics of finish materials to ensure use of compatible primers. Notify the Engineer about anticipated problems using the materials specified over substrates primed by others.

3.02 PREPARATION

A. Remove hardware and hardware accessories, plates, machined surfaces, lighting fixtures, and similar items already installed that are not to be painted, or provide surface-applied protection prior to surface preparation and painting. Following completion of painting operations in each space or area, ensure workers skilled in the trades involved reinstall items.

B. Before applying paint or other surface treatments, clean the substrates of substances that could impair the bond of the various coatings. Remove oil and grease prior to cleaning. Schedule cleaning and painting so dust and other contaminants from the cleaning process will not fall on wet, newly painted surfaces.

C. Clean and prepare surfaces to be painted according to the manufacturer's instructions for each particular substrate condition and as specified.

1. Provide barrier coats over incompatible primers or remove and reprime. Notify Engineer in writing about anticipated problems using the specified finish-coat material with substrates primed by others.

2. Ensure existing painted surfaces are structurally sound, dry, clean, and free of oil, grease, dirt, mildew, form release agents, curing compounds, efflorescence, loose and flaking paint, or other foreign material. Engineer will approve condition of prepared substrate prior to application of coating system. Test old coatings for lifting per coating manufacturer's recommendations.

3. Cementitious Materials: Prepare concrete and concrete masonry block, to be painted. Remove efflorescence, chalk, dust, dirt, grease, oils, and release agents. Roughen, as required, to remove glaze. If hardeners or sealers have been used to improve curing, use mechanical methods of surface preparation.

   a. Use abrasive blast-cleaning methods if recommended by the paint manufacturer.

   b. Determine alkalinity and moisture content of surfaces by performing appropriate tests. If surfaces are sufficiently alkaline to cause the finish paint to blister and burn, correct this condition before application. Do not paint surfaces where moisture content exceeds that permitted in manufacturer's printed directions.

4. Ferrous Metals: Clean un-galvanized ferrous metal surfaces that have not been shop-coated; remove oil, grease, dirt, loose mill scale, and other foreign substances. Use solvent or mechanical cleaning methods that comply with recommendations of the Society for Protective Coatings (SSPC), as specified below:

   a. Non-submerged ferrous metal components scheduled for priming shall be sandblasted clean in accordance with SSPC-SP-6, Commercial Blast Cleaning, immediately prior to priming.

   b. Submerged components for priming shall be sandblasted clean in accordance with SSPC-SP-10, Near White Blast Cleaning, immediately prior to priming.

   c. Field applied touch ups for factory painted equipment shall be prepared in accordance with SSPC-SP-11, Power Tool Cleaning to Bare Metal.

5. Galvanized Surfaces: Clean galvanized surfaces with nonpetroleum-based solvents so that the surface is free of oil and surface contaminants.

Remove pretreatment from galvanized sheet metal fabricated from coil stock by mechanical methods.

6. Carefully mix and prepare paint materials according to manufacturer's directions.

7. Maintain containers used in mixing and applying paint in a clean condition, free of foreign materials and residue.

8. Stir material before application to produce a mixture of uniform density; stir as required during application. Do not stir surface film into material. Remove film and, if necessary, strain material before using.

9. Use only thinners approved by the paint manufacturer and only within recommended limits.

3.03 COLOR SELECTION

A. Colors of finish coats: as indicated or specified or as selected by Owner.

3.04 APPLICATION

A. General

1. Apply water-based paints only when the temperature of surfaces to be painted and surrounding air temperatures are between 50°F and 90°F.

2. Apply solvent-thinned paints only when the temperature of surfaces to be painted and surrounding air temperatures are between 45°F and 95°F.

3. Do not apply paint in snow, rain, fog, or mist; or when the relative humidity exceeds 85 percent; or to damp or wet surfaces. Painting may continue during inclement weather if surfaces and areas to be painted are enclosed and heated within temperature limits specified by the manufacturer during application and drying periods.

4. Apply paint according to manufacturer's directions. Use applicators and techniques best suited for substrate and type of material being applied.

   a. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions detrimental to formation of a durable paint film.

   b. Paint colors, surface treatments, and finishes: indicated in the Paint Schedules.

   c. Provide finish coats that are compatible with primers used.

   d. The number of coats and the film thickness required are the same regardless of the application method. Do not apply succeeding

coats until the previous coat has cured as recommended by the manufacturer. Sand between applications where sanding is required to produce a smooth even surface according to the manufacturer's directions.

e. Apply additional coats if undercoats, stains, or other conditions show through final coat of paint until paint film is of uniform finish, color, and appearance. Give special attention to ensure that surfaces, including edges, corners, crevices, welds, and exposed surfaces/fasteners, receive a dry film thickness equivalent to that of flat surfaces.

f. The term “exposed surfaces” includes areas visible when permanent or built-in fixtures, convector covers, covers for finned tube radiation, grilles, and similar components are in place. Extend coatings in these areas, as required, to maintain the system integrity and provide desired protection.

g. Paint surfaces behind movable equipment and furniture the same as similar exposed surfaces. Before the final installation of equipment, paint surfaces behind permanently fixed equipment or furniture with prime coat only.

h. Paint interior surfaces of ducts, where visible through registers or grilles, with a flat, non-specular black paint.

i. Paint back sides of access panels and removable or hinged covers to match exposed surfaces.

j. Finish exterior doors on tops, bottoms, and side edges same as exterior faces.

k. Sand lightly between each succeeding enamel or varnish coat.

l. Omit primer on metal surfaces that have been shop-primed and touch-up painted.

m. Prime CMU walls and apply 1 finish coat prior to installation of any wall mounted equipment, piping, conduits, or fixed objects that would limit access for application of coating system and/or conceal portions of the wall surface. Apply second finish coat after all Work of other trades is completed.

B. Apply first coat to surfaces that have been cleaned, pretreated, or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.

1. Allow sufficient time between successive coats to permit proper drying. Do not recoat until paint has dried to where it feels firm, does not deform or feel sticky under moderate thumb pressure, and where application of another coat of paint does not cause the undercoat to lift or lose adhesion.

C. Apply paints and coatings by brush, roller, spray, or other applicators according to the manufacturer's directions.

1. Brushes: Use brushes best suited for the material applied.

2. Rollers: Use rollers of carpet, velvet back, or high-pile sheep's wool as recommended by the manufacturer for the material and texture required.

3. Spray Equipment: Use airless spray equipment with orifice size as recommended by the manufacturer for the material and texture required.

D. Apply materials no thinner than the manufacturer's recommended spreading rate. Provide the total dry film thickness of the entire system as recommended by the manufacturer.

E. Paint only mechanical and electrical Work exposed in mechanical equipment rooms and in occupied spaces and paint mechanical, electrical, HVAC, process equipment, and other utility items as indicated on the Drawings. Do not paint items that are factory painted. Factory applied coating systems are specified in the Specification where the product or item is specified. Items to be painted include:

1. Piping

2. Pumps

3. Heat exchangers

4. Tanks

5. HVAC ductwork

6. Insulation

7. Supports

8. Motors and mechanical equipment

9. Accessory items

F. Ferrous metals indicated on the Drawings to be painted will be provided with a shop primer compatible with the coatings specified herein. Paint ferrous metals specified in Section 05 50 00 METAL FABRICATIONS that are not galvanized and indicated to be painted on the Drawings.

G. Block Fillers: Apply block fillers to concrete masonry block at a rate to ensure complete coverage with pores filled.

3.05 PRIME COATS

A. Before applying finish coats, apply a prime coat of material as recommended by the manufacturer, to material that is required to be painted or finished and that has not been prime-coated by others. Recoat primed and sealed surfaces where evidence of suction spots or unsealed areas in first coat appears, to ensure a finish coat with no burn-through or other defects due to insufficient sealing. Apply prime coat to previously painted surfaces if finish coats are not compatible with existing coating.

3.06 PIGMENTED (OPAQUE) FINISHES

A. Completely cover to provide a smooth, opaque surface of uniform finish, color, appearance, and coverage. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections will not be acceptable.

3.07 PIPE, VALVE/EQUIPMENT IDENTIFICATION AND COLOR CODING

A. Provide identification of pipes, valves and pumps by color as specified in the Section 22 00 00 PLUMBING, 23 05 15 for HVAC Piping and Equipment, and 40 05 13.1 Process Piping.

3.08 COMPLETED WORK

A. Match approved samples for color, texture, and coverage. Remove, refinish, or repaint Work not complying with specified requirements.

3.09 FIELD QUALITY CONTROL

A. Provide in accordance with Division 01 General Requirements.

B. Site/Field Tests and Inspections: may be required by Owner up to four times during the period when paint is being applied.

1. Engage the services of an independent testing agency with minimum 5 years of experience to sample the paint material used. Provide that samples of material delivered to the Project are taken, identified, sealed, and certified in the presence of the Contractor.

2. The independent testing agency shall perform appropriate tests at no additional cost to the Owner for the following characteristics.

    a. Quantitative materials analysis

    b. Abrasion resistance

    c. Apparent reflectivity

    d. Flexibility

    e. Washability

f. Absorption

g. Accelerated weathering

h. Dry opacity

i. Accelerated yellowness

j. Recoating

k. Skinning

l. Color retention

m. Alkali and mildew resistance

3. If test results show material being used does not comply with specified requirements, stop painting, remove noncomplying paint, repaint surfaces coated with rejected paint, and remove rejected paint from previously painted surfaces if, upon repainting with specified paint, the two coatings are incompatible.

3.10 CLEANING

A. At the end of each Work day, remove empty cans, rags, rubbish, and other discarded paint materials from the Site. Clean up debris resulting from Work and dispose in Project on-Site trash receptacles.

B. After completing painting, clean glass and paint-spattered surfaces. Remove spattered paint by washing and scraping. Be careful not to scratch or damage adjacent finished surfaces.

3.11 PROTECTION

A. Protect Work of other trades, whether being painted or not, against damage by painting. Correct damage by cleaning, repairing or replacing, and repainting, as acceptable to Engineer.

B. Provide "Wet Paint" signs to protect newly painted finishes. Remove temporary protective wrappings provided by others to protect their Work after completing painting operations.

C. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.12 ATTACHMENTS

A. Paint Schedule

END OF SECTION

PAINT SCHEDULE

Number of coats scheduled is as a minimum. Painting and finishing shall conform to applicable Laws and building code regarding fire hazard classifications and volatile organic content of finish materials. Provide products by the manufacturers named or approved equal.

Refer to "Room Finish Schedule" on the Drawings for building areas to be painted.

Provide paint and coating systems listed below where the Drawings refer to this Specification section or reference any item to be painted or coated, unless a specific paint or coating system is specified elsewhere.

This list is intended to cover all potential conditions that may require painting and not all paint and coating systems listed below may not be included in the Work.

Equipment: Exterior Non-Submerged Ferrous Metals

Factory Applied Primer	1. Tnemec “Series 1 Omnithane” DFT 2.5-3.5 mils 2. S-W “Corothane I Galvapac Zinc Primer” DFT 3-4 mils 3. PPG “Amercoat 68HS” DFT 2-5 mils
Factory Applied Prime Coat	1. Tnemec "Series 66HS Hi-Build Epoxoline" DFT 3-5 mils 2. S-W “Macropoxy 646” DFT 3-5 mils 3. PPG “Amercoat 370” DFT 4-6 mils
Factory Applied Finish Coat	1. Tnemec “Series 73-color Endura-Shield” DFT 2.5-5 mils 2. S-W “Hi-Solids Polyurethane” DFT 3-5 mils 3. PPG “Amercoat 450H Shield” DFT 2-5 mils

Equipment: Interior Non-Submerged Ferrous Metals

Factory Applied Primer	1. Tnemec “Series 1 Omnithane” DFT 2.5-3.5 mils 2. S-W "Recoatable Epoxy Primer" DFT 4-6 mils 3. PPG “Amerlock2/400” DFT 4-8 mils
Factory Applied Prime Coat	1. Tnemec "Series 66HS Hi-Build Epoxoline" DFT 3-5 mils 2. S-W “Macropoxy 646” DFT 3-4 mils 3. PPG “Amerlock2/400” DFT 4-8 mils
Factory Applied Finish Coat	1. Tnemec “Series 66HS Hi-Build Epoxoline” DFT 3-5 mils 2. S-W – “Macropoxy 646” DFT 3-4 mils 3. PPG – “Amerlock2/400” DFT 4-8 mils

Equipment: Exterior or Interior Submerged Ferrous Metals

Factory Applied Primer	1. Tnemec “Series 1 Omnithane” DFT 2.5-3.5 mils 2. S-W “Dura-Plate 235” DFT 4-6 mils 3. PPG “Amercoat 68HS” DFT 2-5 mils
Factory Applied Prime Coat	1. Tnemec "Series 66HS Hi-Build Epoxoline" DFT 6-8 mils 2. S-W “Dura-Plate 235” DFT 3-4 mils 3. PPG “Amercoat 370” DFT 4-6 mils
Factory Applied Finish Coat	1. Tnemec "Series 66HS Hi-Build Epoxoline" DFT 6-8 mils 2. S-W “Dura-Plate 235” DFT 4-6 mils 3. PPG “Amerlock/2400” DFT 4-8 mils

Factory Coated Equipment Touch Up

Touch Up	1. Touch up paint shall match product recommendations found in each individual equipment specification from Division 43

Galvanized Repair Paint

Galvanizing Repair	1. Tnemec "Series 90-97 Tneme-Zinc" 2. S-W "Corothane I Galvapac 1K Zinc Primer" DFT 3-4 mils 3. PPG "Amercoat 68HS” DFT 2-5 mils
Finish Coat	2. S-W “Fast Clad Urethane” DFT 6-9 mils

Ferrous metals listed in Section 05 50 00 Metal Fabrications Interior Exposure for Epoxy Coating

Shop Applied Prime Coat	1. Tnemec "Series 27 Typoxy" DFT 2-3 mils 2. S-W "Recoatable Epoxy Primer" DFT 4-6 mils 3. PPG "Amerlock 370” DFT 4-6 mils
Field Applied Two Finish Coats	1. Tnemec "Series 66HS Hi-Build Epoxoline" DFT 2-3 mils 2. S-W "Macropoxy 646" DFT 3-5 mils 3. PPG "Amerlock 2” DFT 4-8 mils/ct

Ferrous metals listed in Section 05 50 00 Metals Fabrication Exterior Exposure for Epoxy Coating

Shop Applied Prime Coat	1. Tnemec "Series 66HS Hi-Build Epoxoline" DFT 2-3 mils 2. S-W "Macropoxy 646" DFT 4-6 mils 3. PPG "Amercoat 385" DFT 4-8 mils
Field Applied Two Finish Coats	1. Tnemec "Series 175 Endura-Shield" DFT 2-5 mils/ct 2. S-W "High Solids Polyurethane" DFT 3-4 mils/ct 3. PPG "Amercoat 450H" DFT 2-3 mils/ct

Ductile, Cast Iron, Copper, Aluminum or PVC - Interior or Exterior Exposure for Epoxy/Polyurethane Coating

PVC Surface Preparation	Scarify
Field Applied Prime Coat	1. Tnemec "Series 66HS Hi-Build Epoxoline" DFT 2-3 mils 2. S-W "Macropoxy 646" DFT 3-5 mils 3. PPG "Amerlock 2" DFT 4-8 mils
Field Applied Intermediate Coat	1. Tnemec "Series 66HS Hi-Build Epoxoline" DFT 4-6 mils 2. S-W "Macropoxy 646" DFT 3-5 mils 3. PPG "Amerlock 2" DFT 4-8 mils
Field Applied Finish Coat	1. Tnemec Series 175 Endura-Shield" @ DFT 2-5 mils 2. S-W "High Solids Polyurethane" DFT 4-5 mils 3. PPG "Amercoat 250H 2-3" DFT 4-6 mils

Ductile Iron Pipe - Submerged

Field Applied Prime Coat	1. Tnemec "Series N140 Pota-Pox-Plus" DFT 2-3 mils 2. S-W "Dura-Plate 235" DFT 4-6 mils 3. PPG "Amerlock 2" DFT 4-8 mils
Field Applied Intermediate Coat	1. Tnemec "Series 66HS Hi-Build Epoxoline" DFT 4-6 mils 2. S-W "Dura-Plate 235" DFT 3-4 mils 3. PPG "Amerlock 2/400" DFT 4-8 mils
Field Applied Finish Coat	1. Tnemec "Series N140 Pota-Pox-Plus" DFT 2-3 mils 2. S-W "Dura-Plate 235" DFT 4-6 mils 3. PPG "Amerlock 2/400" DFT 4-8 mils

Insulated Pipe Interior or Exterior Exposure for Acrylic Coating

Field Applied	1. Tnemec "Series 151-1051 Elasto- Grip Primer" @ DFT 1.0-1.5 mils 2. S-W "DTM Acrylic/Primer" DFT 2.5-4.0 mils 3. PPG "Pitt Tech Plus Primer" DFT 2-4 mils
Field Applied Two Finish Coat	1. Tnemec "Series 1029 Enduratone" @ DFT 2.0-3.0 mils/ct 2. S-W "Sher-Cryl HPA" DFT 2.5-4.0 mils/ct 3. PPG "Pitt Tech Plus 90-131" DFT 2-4 mils/ct

Interior CMU walls for Waterborne Epoxy Coating

Field Applied Prime Coat	1. Tnemec "Series 130 Envirofill" 60-80 sf/gal 2. S-W "Cement-Plex 875" DFT 50-100 SF/GAL 3. PPG "Amerlock 400BF" DFT 10-20 mils
Field Applied Two Finish Coats	1. Tnemec "Series 113 Tufcoat" DFT 4-6 mils/ct 2. S-W "Waterbased Catalyzed Epoxy" DFT 2.5-3 mils/ct 3. PPG "Aquapon WB Water Base Epoxy" DFT 2-3 mils/ct

Exterior Trim for Acrylic Coating, Eggshell

Field Applied Prime Coat	1. Tnemec "Series 10-99W" DFT 2-3 mils 2. S-W "Exterior Latex Wood Primer" DFT 2-3 mils 3. PPG "17-921 Seal grip Primer" DFT 2-3 mils/ct
Field Applied Two Finish Coats	1. Tnemec "Tneme-Cryl Series 6" DFT 2-3 mils/ct 2. S-W "A-100 Exterior Acrylic Latex" DFT 1.5-2 mils/ct 3. PPG "Sun Proof Exterior House Paint" DFT 1-2 mils/ct

Interior Gypsum Drywall and Plaster for Waterborne Epoxy Coating

Field Applied Prime Coat	1. Tnemec "Series 151-1051 Elasto- Grip FC" @ DFT 1.0-2.0 mils 2. S-W "PrepRite ProBlock" DFT 1.0-2.0 mils 3. PPG "Seal Grip Primer 17-931" DFT 1-2 mils
Field Applied Two Finish Coats	1. Tnemec "Series 113 Tufcoat" DFT 2-3 mils/ct 2. S-W "Waterbased Catalyzed Epoxy" DFT 2.5-3.0 mils/ct 3. PPG "Aquapon WB Water Base Epoxy" DFT 2-3 mils/ct

Interior Galvanized Steel (where listed on Drawings to be field painted) for Epoxy Coating

Galvanizing Repair at Field Welds	1. Tnemec "Series 90-97 Tneme-Zinc" 2. S-W "Corothane I Galvapac Zinc Primer" 3. PPG "Amercoat 68HS" DFT 2-5 mils
Field Applied Prime Coat	1. Tnemec "Series N69 Hi-Build Epoxoline" DFT 2-3 mils 2. S-W "Macropoxy 646" DFT 3-5 mils 3. PPG "Amerlock 2" DFT 4-8 mils
Field Applied Finish Coat	1. Tnemec "Series N69 Hi-Build Epoxoline" DFT 2-3 mils 2. S-W "Macropoxy 646" DFT 3-5 mils 3. PPG "Amerlock 2" DFT 4-8 mils

Exterior Galvanized Steel (where listed on Drawings to be field painted) for Epoxy / Polyurethane Coating

Galvanizing Repair at Field Welds	1. Tnemec "Series 90-97 Tneme-zinc" 2. S-W "Corothane I Galvapac Zinc Primer" 3. PPG "Amercoat 68HS" DFT 2-5 mils
Field Applied Prime Coat	1. Tnemec "Series 27 Typoxy" DFT 2-3 mils 2. S-W "Macropoxy 646" DFT 3-5 mils 3. PPG "Amercoat 385" DFT 4-8 mils
Field Applied Two Finish Coats	1. Tnemec "Series 175 Endura-Shield" DFT 2-5 mils/ct 2. S-W "High-Solids Polyurethane" DFT 3-4 mils/ct 3. PPG "Amercoat 450" DFT 2-3 mils/ct

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SECTION 09 96 50

SPECIALTY H2S COATING FOR CONCRETE

1.01 SUMMARY

A. Section Includes

1. Provide all labor, materials, equipment and incidentals as specified, shown, and required to furnish, install, and place into satisfactory service the protective liner including surface preparation and painting in accordance with this Section and applicable reference standards listed in Article 1.03 for the following existing and proposed concrete surfaces:

    a. All existing exposed Wet Well surfaces below grating level.

    b. Proposed Wet Well Baffle Wall.

    c. Existing Influent Channel horizontal and vertical surfaces as shown on the drawings.

2. Where not otherwise shown, extent of the protective lining shall be located as shown on the Drawings.

3. Types of protective lining for concrete Work required include, but are not necessarily limited to, the following:

    a. Trowelable, rapid-setting, cementitious repair mortar

    b. Trowelable, fast-setting, epoxy- modified cementitious thin overlay (resurfacer)

    c. Corrosion-resistant, spray-applied, fiber-reinforced high-build epoxy lining (basecoat)

    d. Corrosion-resistant, high-build epoxy glaze coat (topcoat)

    e. Miscellaneous materials

4. Cleaning, surface preparation, lining application, and thicknesses shall be as specified herein and shall meet or exceed the lining manufacturer's recommendations. When the manufacturer's minimum recommendations exceed the specified requirements, Contractor shall comply with the Manufacturer's minimum recommendations.

B. Payment for this work shall be in accordance with additive alternate bid item.

C. Related Sections

1. Section 03 30 00 CAST-IN-PLACE CONCRETE

2. Section 07 92 00 JOINT SEALANTS

3. Section 09 90 00 PAINTING AND COATING

1.02 PRICE AND PAYMENT PROCEDURES

A. Measurement and payment requirements: per Division 01.

1.03 REFERENCES

A. This Section contains references to the governing standards and documents listed below. They are a part of this Section as specified and modified; the current version shall apply unless otherwise noted. In case of conflict between the requirements of this section and those of the listed documents, the more stringent of the requirements shall prevail.

1. AMERICAN CONCRETE INSTITUTE (ACI)
   a. ACI 301 Specifications for Structural Concrete
   b. ACI 308R Guide to Curing Concrete
   c. ACI 350 Code Requirements for Environmental Engineering Concrete Structures and Commentary
   d. ACI 515 A Guide to the use of Waterproofing, Damproofing, Protective, and Decorative Barrier Systems for Concrete
   e. ACI 546.R Concrete Repair Guide
   f. ACI 546.3R Guide for the Selection of Materials for the Repair of Concrete
2. ASTM INTERNATIONAL (ASTM)
   a. ASTM C 868 Standard Test Method for Chemical Resistance of Protective Linings
   b. ASTM C 1583/1583M Standard Test Method for Tensile Strength of Concrete Surfaces and the Bond Strength or Tensile Strength of Concrete Repair and Overlay Materials by Direct Tension (Pull-off Method)
   c. ASTM D 2794 Standard Test Method for Resistance of Organic Linings to the Effects of Rapid Deformation (Impact)
   d. ASTM D 4060 Standard Test Method for Abrasion Resistance of Organic Linings by the Taber Abraser
   e. ASTM D 4285 Standard Test Method for Indicating Water or Oil in Compressed Air
   f. ASTM D 4263 Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method

g. ASTM D 4414 Standard Practice for Measurement of Wet Film Thickness by Notch Gages

h. ASTM D 6944 Standard Test Method for Measuring Humidity with a Physchrometer

i. ASTM F 1869 Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride

j. ASTM F 2414 Standard Practice for Sealing Sewer Manholes Using Chemical Grouting

3. INTERNATIONAL CONCRETE REPAIR INSTITUTE (ICRI)

a. Guideline No. 310.1R Guide for Surface Preparation for the Repair of Deteriorated Concrete Resulting from Reinforcing Steel Corrosion

b. Guideline No. 310.2 Selecting and Specifying Concrete Surface Preparation for Sealer, Linings, and Polymer Overlays

4. NACE INTERNATIONAL (NACE)

a. NACE Publication 6D-173 – A Manual for Painter Safety

b. NACE SP0188 Standard Practice for Discontinuity (Holiday) Testing of Protective Linings

c. NACE SP0892 Standard Practice for Coatings and Linings over Concrete for Chemical Immersion and Containment Service

d. NACE No. 6/SSPC-SP13 Surface Preparation of Concrete

5. OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION (OSHA)

a. Safety and health Standards (29 CFR 1910/1926)

6. THE SOCIETY FOR PROTECTIVE LININGS (SSPC)

a. SSPC-SP13/NACE No. 6 Surface Preparation of Concrete

b. SSPC-Guide 12 Guide for Illumination of Industrial Painting Projects

7. STANDARD PRACTICE FOR THE RAPID EVALUATION OF COATINGS AND LININGS BY SEVERE WASTEWATER ANALYSIS TEST (S.W.A.T.)

B. Unless otherwise specified, references to documents shall mean the documents in effect at the time of receipt of Bids. If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents, the last version of the document before it was discontinued.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination, Sequencing, and Scheduling: per Division 01 General Requirements.

1.05 SUBMITTALS

A. Submit in accordance with Division 01 General Requirements.

B. Shop Drawings: Submit for approval prior to commencing any Work:

1. Product Data Sheets: Copies of current technical data for each component specified and applied as outlined in this Section.
2. Material Safety Data Sheets: Copies of current MSDS for any materials brought on-site including all clean-up solvents and lining materials.
3. Qualification Data: Approved Installer Training Certificates from manufacturer.
4. Performance Testing Reports: Copies of test data for the entire physical, chemical, and permeation properties listed herein and as outlined within this Section.
5. Installation Instructions: Manufacturer's written installation instructions for the materials specified in this Section.
6. Construction Details: Copies of manufacturer's computer generated standard lining details for specified materials, including: leading edge termination, metal embedment in concrete, joint detail, wall-to-slab detail, pipe termination detail, and any other detail at the request of the Engineer.
7. Maintenance Manual: Upon completion of the Work, submit five copies of corrosion protection lining manufacturer's written instructions for recommended maintenance practices. Include the following information:
    a. Product name and number
    b. Name, address, e-mail address and telephone number of manufacturer and local representative
    c. Detailed procedures for routine maintenance and cleaning
    d. Detailed procedures for repairs
8. Product Substitution: The specified corrosion protection lining is the minimum standard of quality for this project. Equivalent materials of other manufacturers may be substituted only by approval of Engineer. Requests for material substitutions shall be in accordance with requirements of the project specification.
    a. Manufacturers of "or equal" products shall provide direct property comparison with the materials specified in addition to complying with all other requirements of these Specifications. "Or equal"

products shall employ the same generic materials and system components as the corrosion protection lining specified. "Or equal" products shall provide equivalent performance as the corrosion protection lining specified.

C. Jobsite Reports: Submit at the completion of Work

1. Daily Reports: Include surface preparation, substrate conditions, ambient conditions application procedures, lining materials applied, material quantities, material batch number(s), description of work completed and location thereof.

1.06 QUALITY ASSURANCE

A. Applicator Qualifications

1. Contractor shall be a qualified Applicator by the corrosion protection lining manufacturer prior to bid date. Only applicators that are approved by the coating manufacturer may perform coating work for this Project. Submit proof of acceptability of Applicator by manufacturer to Engineer.
2. Applicator shall have a minimum of 10 years of experience with completing painting system applications similar in material and extent to those indicated for the Project that have resulted in a construction record of successful in-service performance. A minimum of five (5) references shall be provided for similar coating projects.
3. Installation equipment shall be acceptable to the protective lining manufacturer.
4. Applicator to establish quality control procedures and practices to monitor phases of surface preparation, storage, mixing, application, and inspection throughout the duration of the project. Contractor to provide a fulltime, on-site person whose dedicated responsibilities will include quality control of the corrosion protection linings.
5. Quality control procedures and practices must include the following items:
6. Training of personnel in the proper surface preparation requirements.
7. Training of personnel in the proper storing, mixing, application, and inspection of the linings.

B. Mock-Ups

1. Prior to the installation of the corrosion protection lining and auxiliary system components, but after Engineer's approval of the Samples and Shop Drawings, install 25 square foot stepped-back mock-ups of the systems showing each system component, in area selected by Engineer, to show representative installation of the Work.

2. Obtain Engineer's acceptance of visual qualities of the mock-ups before start of Work. Retain and protect mock-ups during construction as one standard for judging completed corrosion protection lining Work. Do not alter mock-ups after approval by Engineer.

    a. Finished Work, in compliance with visual qualities of mock-ups, that fails other on-site quality control testing procedures shall be replaced by Contractor with new materials.

3. Build as many mock-ups as required to achieve Engineer's acceptance of the corrosion protection lining.

4. Accepted mock-up shall be considered the acceptable minimum standard of quality.

5. Corrosion protection lining Work that proceeds without approved mock-ups shall be stopped, and mock-ups prepared for approval.

C. Pre-Installation Conference

1. Before erecting mock-ups, Contractor, Installer and technical representative of the corrosion protection lining manufacturer shall meet on-site with Engineer to discuss approved products and workmanship to ensure proper application of the corrosion protection lining components and substrate preparation requirements.

2. Review foreseeable methods and procedures related to the corrosion protection lining of coating Work, including but not necessarily limited to, the following:

    a. Review Project requirements and the Contract Documents.

    b. Review required submittals, both completed and yet to be completed.

    c. Review status of substrate Work, including approval of surface preparations and similar considerations.

    d. Review requirements of on-site quality control testing and requirements for preparing Site Quality Control Report as specified herein.

    e. Review availability of materials, tradesmen, equipment and facilities needed to make progress and avoid delays.

    f. Review required inspection and testing.

    g. Review environmental conditions, other Project conditions, and procedures for coping with unfavorable conditions.

    h. Review regulations concerning code compliance, environmental protection, health, safety, fire and similar considerations.

    i. Review procedures required for the protection of the corrosion protection lining during the remainder of the construction period.

3. Record the discussions of the Pre-Installation Conference and the decisions and agreements or disagreements reached, and furnish a copy for the record to each party attending. Record any revision or changes agreed upon, reasons therefore, and parties agreeing or disagreeing with them.

4. Reconvene the conference at the earliest opportunity if additional information must be developed in order to conclude the subjects under consideration.

D. Performance Criteria

1. The surfaces to receive the protective lining shall be capable of withstanding, under constant exposure to, raw wastewater, permeation from hydrogen sulfide and other sewer gases, and attack from organic acids generated by microbial sources, with no adverse effects. Products must have sufficient field history and accelerated laboratory testing to substantiate product viability for these exposures.

2. The finished coating shall be uniform in color, texture and appearance. All edges that have discontinuities and other embedded items shall be sharp, uniform and cosmetically acceptable with no thick or ragged edge. The Contractor shall work out an acceptable masking technique to ensure the acceptable finish of all coated surfaces.

E. Source Quality Control: Provide each component of protective lining produced by a single manufacturer, including recommended repair mortar, repair overlay (resurfacers), base coat and top coat materials.

F. Reference Standards: Comply with applicable provisions and recommendations of all standards listed herein, except as otherwise shown or specified.

G. Protective Linings system specified are as manufactured by Tnemec Company, Inc., Kansas City, MO (816) 483-3400. Specified system is the minimum standard of quality for this project. Request for material substitutions shall be in accordance with requirements of the project specifications.

1.07 COORDINATION

A. Coordinate surface preparation of substrates to avoid later difficulty or delay in performing the Work of this Section.

B. Review installation procedures under other Sections and coordinate the instillation of items that must be installed prior to application of the protective lining.

C. All substrate surface preparation and lining application, including concrete resurfacing, to be completed by manufacturer’s approved Applicator.

D. The Contractor shall coordinate with Engineer regarding the availability of work areas, completion times, safety, access and other factors which can impact plant operations.

1.08 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Delivery of Materials

1. Deliver material in manufacturer's original, unopened and undamaged packages.
2. Clearly identify manufacturer's, brand name, contents, color, batch number, and any personal safety hazards associated with the use of or exposure to the materials on each package.
3. Packages showing indications of damage that may affect condition of contents are not acceptable.

B. Storage of Materials

1. Materials shall be stored in accordance with manufacturer's recommendations in enclosed structures and shall be protected from weather and adverse temperature conditions. Flammable materials shall be stored in accordance with state and local codes. Materials exceeding storage life as defined by the manufacturer shall be removed promptly from the site. Store all materials only in area or areas designated by the Engineer solely for this purpose.
2. Store in original packaging under protective cover and protect from damage.
3. Stack containers in accordance with manufacturer's recommendations.

C. Handling of Materials: Handle materials in such a manner as to prevent damage to products or finishes.

D. Follow all manufacturer's specific instructions and prudent safety practices for delivery, storage and handling.

1.09 SITE CONDITIONS

A. Existing Conditions: per Division 01 General Requirements.

B. Environmental Requirements

1. Proceed with corrosion protection lining Work only when temperature and moisture conditions of substrates, air temperature, relative humidity, dew point and other conditions comply with the corrosion protection lining manufacturer's written recommendations and when no damaging environmental conditions are forecasted for the time when the material will

be vulnerable to such environmental damage. Record all such conditions and include in final Site Quality Control Report.

2. Maintain substrate temperature and ambient temperature before, during and after installation above 50°F (10°C) and rising in accordance with protective lining material manufacturer's instructions.

3. Provide adequate ventilation during instillation and full curing periods of the protective lining.

4. Protective Lining shall not be applied when ambient air temperature is within 5°F (3°C) of the dew point and falling.

5. Protective Lining shall not be applied when relative humidity is outside of material manufacturer's recommendations. Do not prepare surfaces or apply materials in rain, snow, fog, mist, or otherwise inclement weather as per material manufacturer's instructions.

C. Dust and Contaminants: Protect work and adjacent areas from excessive dust and airborne contaminates during protective lining application and curing. Schedule Work to avoid excessive dust and airborne contaminants.

D. Protect all adjacent surfaces not to be coated with masking and covers.

1.10 WARRANTY

A. Protective Lining Manufacturer shall warranty its products as free from material defects for a minimum period of three (3) years. Provide associated Warranty Certificate.

B. Contractor shall warranty the installed protective lining system as free from workmanship defects for a minimum period of three (3) years.

C. Written warranty shall cover full labor and materials during the warranty period, as required to repair and/or replace any defects or failures observed relative to all lining and repair items included in this specification. Defects include, but are not limited to, cracking, spalling, delamination, disbonding, peeling, bubbling, flaking, rust bleeding through coating, etc.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. TNEMEC Company, Inc

B. Carboline

C. Dupont

D. Approved Equal

E. Requests for submission will be reviewed and shall include the respective manufacturer's technical literature for each product giving the name, generic type, descriptive information, recommended dry film thickness, certified test reports showing results to equal the performance criteria as specified herein and the Manufacturer's Safety Data Sheets (MSDS) for each product. No request for substitution shall be considered that would change the generic type of coating system specified.

F. Manufacturers of Approved System shall be of single source and made in the USA.

2.02 MATERIALS

A. Protective Lining shall be comprised of 1) concrete repair mortar or epoxy resurfacer, 2) spray-applied, fiber-reinforced epoxy liner (basecoat), and 3) epoxy glaze (topcoat).

1. Cementitious Repair Mortar: Trowelable grade rapid-setting cementitious repair mortar when concrete is deteriorated greater than a depth of 1/4-inch and when recommended by the Manufacturer to restore concrete and provide level substrate for application of the protective lining; or
2. Epoxy Resurfacer: Epoxy-polymer modified cementitious resurfacer (thin overlay) applied to new or existing concrete to a depth up to 1/2-inch. Repair new or existing concrete and provide a uniform, level substrate for application of the protective lining; and
3. Spray-applied, fiber-reinforced high-build epoxy liner (basecoat) to provide a chemical, permeation, and abrasion resistant protective lining against physical and chemical attack phenomena typically associated with municipal wastewater headspace conditions; and
4. Epoxy glaze coat (topcoat) to provide enhanced chemical, permeation, and abrasion resistance.

B. Contractor shall provide all accessory components such as polysulfide sealants, and curing compounds, as recommended by the manufacturer for maximum protective lining adhesion to substrate, and long-term service performance.

C. Cementitious Shallow-Depth Repair Mortar

1. Properties for Tnemec Series 217 MortarCrete
   a. Minimum Thickness = 1/4 inches
   b. Maximum Thickness = 4.0 inches
   c. Application Time: Initial set at 75°F = 60 min; Final set at 75°F = 90 min
   d. Bond Strength (ASTM C 1583)
      1) Applied at ¼” to Concrete --> Concrete Failure

2) Applied at 2.0" to Concrete --> Concrete Failure

e. Compressive Strength (ASTM C 579)

1) 16 hours --> 8,670 psi

2) 28 days --> 10,650 psi

f. Curing Requirements (ACI 308R)

1) Method --> Wet- or Membrane-cure

2) Duration --> Manufacturer Recommended

g. Drying Shrinkage (ASTM C 596) = 0.0%

h. Linear Shrinkage (ASTM C 531) = 0.022%

i. Thermal Expansion (ASTM C 531) = 7.46 x 10-6 in/in/°F

2. Shallow-depth cementitious repair mortar shall be a rapid-setting, non-shrinking resurfacing material. Material shall have similar CLTE properties as concrete.

3. Material shall have a minimum 12-month shelf life.

D. Epoxy modified Cementitious Resurfacer

1. Properties for Tnemec Series 218-1000 MortarClad

a. Minimum thickness = 1/16 inch

b. Maximum thickness = 1/2 inch

c. Application Working Time at 75°F = 60 min

d. Bond Strength (ASTM D 7234)

1) Applied at 1/16" to Concrete --> Concrete Failure

e. Compressive Strength (ASTM C 579) = 7,100 psi

f. Curing Requirements (ACI 308)

1) Method --> Ambient Cure

2) Duration --> 15 hours

g. Flexural Strength (ASTM C580) = 1,290 psi

h. Slant Shear (ASTM C882) = 1,040 psi

i. Splitting Tensile (ASTM C496) = 640 psi

E. Epoxy Lining, Fiber-Reinforced Protective Lining (basecoat)

1. Properties for Tnemec Series 436 Perma-Shield FR

a. Application Time at 75°F = 30 min

b. Color = Gray

c. Maximum Dry Film Thickness (DFT) = 125 mils

d. Severe Wastewater Analysis Test (S.W.A.T.)

1) Initial EIS Impedance (Log $Z_{0.01\ Hz}$ Ω cm^2) = 10.4

2) Final EIS Impedance (Log $Z_{0.01\ Hz}$ Ω cm^2) = 10.2

e. Bond Strength (ASTM D 7234)

1) Bare Concrete/Series 436 --> Concrete Failure

2) Bare Concrete/Series 217/Series 436 --> Concrete Failure

3) Bare Concrete/Series 218/Series 436 --> Concrete Failure

f. Chemical Resistance (ASTM C 686)

1) 25% H_2SO_4, 100 days, 100°F --> No effect

g. Compressive Strength (ASTM D 695) = 8,866 psi

h. Elongation (ASTM D 638) = 7.65%

i. Flexural (ASTM D 790)

1) Strength = 8,148 psi

2) Modulus of Elasticity = 5.4 x 10^5 psi

j. Shrinkage (ASTM C 531) = 0.06%

k. Tensile Strength (ASTM D 2370) = 2,940 psi

l. Thermal Expansion

1) Linear Coefficient (ASTM C 531) = 5.68 x 10^{-5} in/in/°F

2) Thermal Cycling (ASTM D 6944) --> No effect

m. Water Absorption (ASTM C 413) = 0.4%

n. Water Vapor Transmission (ASTM D 1653) = 0.43 perms

F. Epoxy Lining, Glaze Protective Lining (topcoat)

1. Properties for Tnemec Series 435 Perma-Glaze

a. Application Time at 75°F = 30 min

b. Color = Gray

c. Minimum Dry Film Thickness (DFT) = 15 mils

d. Maximum Dry Film Thickness (DFT) = 20 mils

e. Severe Wastewater Analysis Test (S.W.A.T.)

1) Initial EIS Impedance (Log $Z_{0.01\ Hz}$ Ω cm^2) = 11.3

2) Final EIS Impedance (Log $Z_{0.01\ Hz}$ Ω cm^2) = 11.1

3) Optical Microscopy = No more than 9%

4) Δ Tensile Strength = No more than 19%

5) Δ Flexural Strength = No more than 6%

f. Bond Strength (ASTM D7234)

1) Bare Concrete/Series 436 --> Concrete Failure

2) Bare Concrete/Series 217/Series 436 --> Concrete Failure

3) Bare Concrete/Series 218/Series 436 --> Concrete Failure

g. Chemical Resistance (ASTM C686)

1) 25% H_2SO_4, 100 days, 100°F --> No effect

h. Compressive Strength (ASTM D695) = 9,427 psi

i. Elongation (ASTM D638) = 14.1%

j. Flexural (ASTM D790)

1) Strength = 3,289 psi

2) Modulus of Elasticity = 3.0×10^5 psi

k. Tensile Strength (ASTM D2370) = 2,053 psi

l. Water Absorption (ASTM C413) = 0.07%

m. Water Vapor Transmission (ASTM D1653) = 0.243 perms

G. Product and Manufacturer

1. Materials specified are those that have been evaluated for the specific service. Products of Tnemec Company, Inc. (816-483-3400) are listed to establish a standard of performance and quality. Equivalent materials from Carboline or Sauereisen may be submitted on written approval of the Engineer. As part of the proof of equality, the Engineer will require at the cost of the Contractor, comparative laboratory tests as directed by the Engineer between the product specified and the requested substitution.

2. Requests for substitution shall include manufacturer's literature for each product giving name, product number, generic type, descriptive information, laboratory testing showing results to equal the performance criteria of the products specified herein. In addition, a list of ten projects shall be submitted in which each product has been used and rendered satisfactory service.

3. Requests for product substitution shall be made at least 10 days prior to the bid date.

4. Any material savings shall be passed to the Owner in the form of a contract dollar reduction.

PART 3 – EXECUTION

3.01 GENERAL

A. Contractor shall provide, erect, and maintain all required hoists, scaffolding, staging and planking, and perform all access related hoisting work required to complete the Work of this Section as specified.

B. Contractor shall cover or otherwise protect finish work or other surfaces not being coated within the scope of this Section. Contractor shall erect and maintain protective tarps, enclosures and/or masking to contain debris, including dust or other airborne particles from surface preparation or application activities. This may include the use of dust or debris collection apparatus as required at no additional cost to Owner.

3.02 PRE-CONSTRUCTION INSPECTION

A. Contractor shall examine the areas and conditions under which the protective coating Work is to be performed in accordance with SSPC-SP13/NACE No. 6 and notify Engineer in writing of conditions detrimental to the proper and timely completion of the Work.

B. Contractor shall examine and report the presence of a positive side waterproofing on the exterior of the concrete structure.

C. Commencement of the Work of this Section shall indicate that the substrate and other conditions of installation are acceptable to the Contractor and his Applicator, and will produce a finished product meeting the requirements of the Specifications. All defects resulting from accepted conditions shall be corrected by Contractor at his own expense.

D. Stopping Active Leaks: After surface cleaning, any visible leaks or other water ingress shall be reported to the Engineer. Any water infiltration through minor leaks must be stopped using a polyurethane grout manufactured by Avanti International, Webster, TX (281-486-5600), or approved equal. Surface and grouting material may require additional surface preparation prior to application of protective coating.

3.03 SUBSTRATE PREPARATION

A. Concrete surfaces to receive protective coating shall be cast with smooth form finish, including the leveling or grinding of form fins in accordance with ACI 301. Surfaces shall not be rubbed, sacked, troweled or otherwise finished in any manner that will obscure or cover the parent concrete surface with materials other than as specified in this Section.

B. Allow concrete to cure for a minimum of 28 days before installing the corrosion protection lining system.

C. All surface washing, abrasive blasting, water-jetting, grinding, patching, filling and preparation shall be completed by the Applicator in accordance with the Protective Coating Manufacturer's recommendations.

D. Substrate: Concrete surfaces to be coated shall be free of curing compounds and form release agents, laitance and foreign particles that my inhibit bonding. Prior to start of protective coating systems application, high-pressure water clean or waterjet to be covered as required, and inspect the substrate in accordance with SSPC-SP13/NACE No. 6. Surface preparation procedures shall be in accordance with SSPC-SP13/NACE No. 6 and ICRI Guideline No. 03732. Surface preparation requirement is to expose aggregate and obtain a uniform surface texture resembling an ICRI-CSP5-6.

E. New Concrete Application: New Concrete voids, bugholes, and other surface depressions shall be filled with thin overlay material, re-establishing plan finished grades and concrete planes. The thin overlay shall be applied as a continuous parge coat at a minimum 1/16" thickness to the entire concrete surface.

1. All new cast-in-place concrete shall cure for a period of 28 days in accordance with ACI 308 before protective coating system is installed, unless otherwise recommended by the Protective Coating manufacturer.

2. Moisture Testing

   a. Floor – as per the manufacturer's recommendations.

F. Existing Concrete Application: Existing concrete structures to receive protective coating system must be capable of withstanding imposed loads. All oil, grease and chemical contaminants must be removed from the surface of concrete by chemical cleaning prior to preparation in accordance with SSPC-SP13/NACE No. 6. Surfaces must be firm, free of standing water, laitance, form release agents, and be structurally sound as determined by the Engineer. Surface preparation requirement is to expose a sound, uniform surface texture resembling an ICRI-CSP 5-6. The appropriate replacement/overlay material must be applied to the prepared surface to level surface suitable for coating.

1. All existing concrete surfaces shall be decontaminated to remove all microorganisms, acid constituents, grease, oil, and other contaminants prior to commencement of surface preparation in accordance with SSPC-SP13/NACE No. 6.

2. Verify acceptable surface pH of the decontaminated concrete within.

G. Metal Application: Remove all visible contaminants per SSPC-SP1. All ferrous metals shall be blast cleaned in the field conforming to SSPC-SP-5 standards. A minimum 3.0 mil anchor pattern is required.

3.04 APPLICATION

A. Protective coating systems shall be installed when ambient air and surface temperature is above 50°F. The substrate temperature shall be at least 5°F above the dew point. Condition the material between 70°-80°F for 24 hours prior to use. Application when temperatures outside of this range will require written instruction from the manufacturer and approval of the Engineer.

B. Application in direct sunlight and/or with rising surface temperatures is not allowed, as this may result in blistering of the materials due to expansion of entrapped air or moisture in the concrete. In such cases, it will be necessary to postpone the application until later in the day when the temperature of the substrate is falling.

C. New Concrete Application

1. 1st Coat: Apply a parge coat of Series 218 @ 1/16th of an inch, filling all bug holes in the concrete.
2. 2nd Coat: Apply one coat of Tnemec Series 436FR @ 80.0-100.0 mils dry.
3. 3rd Coat: Apply one coat of Tnemec Series 435 @ 15.0-20.0 mils dry.

D. Ferrous Metals within the Tank

1. All ferrous metals shall be blast cleaned in the field conforming to SSPC-SP5 standards. A minimum 3.0 mil anchor pattern is required.
2. Apply TWO coats of Tnemec 435 @ 15.0-20.0 mils dry per coat.

E. Areas not to receive Protective Lining system shall be masked or otherwise protected to prevent the surfaces being coated.

F. Ensure straight, even termination of protective lining system on wall edges and flush with the embedded steel.

3.05 FIELD QUALITY CONTROL, INSPECTION AND TESTING

A. CONTRACTOR to perform the quality control procedures listed below in conjunction with the requirements of this Section.

B. Inspect all materials upon receipt to ensure that all are supplied by the approved Manufacturer.

C. Inspect and record findings for the degree of cleanliness of substrates used. The pH of the concrete substrate will be measured using pH indicating papers. The pH testing is to be performed once every 50 sq. ft. Acceptable pH values shall be between 9.0 and 11.0 as measured by a full-range (1-12) color indicating pH paper with readable color calibrations and a scale at whole numbers (minimum). Use Hydrion Insta-Check Jumbo 0-13 or 1-12 or equal. The paper shall be touched to the surface once using moderate gloved finger pressure. The surface shall not be

wiped or moved laterally to disturb the surface during pH testing. Following the one touch, lift the paper vertically to not "wipe" the surface. Compare the color indicated with the scale provided and record the pH. Spot check any areas that may be questionable with phenolphthalein.

D. Inspect and record substrate profile (anchor pattern). Surfaces shall be abraded, at a minimum, equal to the roughness of CSP5 in accordance with ICRI Guideline 03732 and SSPC-SP13/NACE No. 6.

E. Measure and record ambient air temperature once every two hours of each shift, use a thermometer and measure and record substrate temperature once every two hours using an infrared or other surface thermometer.

F. Measure and record relative humidity and dew point temperature every two hours of each shift using a sling psychrometer in accordance with ASTM E337.

G. Provide correct mixing of coating materials in accordance with the Manufacturer's instructions.

H. Inspect and record that the "pot life" of coating materials is not exceeded during installation.

I. Verify curing of the coating materials in accordance with the Manufacturer's instructions.

J. Upon full cure, the installed lining system shall be checked by high voltage spark detection in accordance with NACE SP0188, and the Manufacturer's printed application guide to verify a pinhole-free surface. Areas which do not pass the spark detection test shall be corrected at no cost to the Owner and rechecked upon cure.

K. Contractor is responsible for keeping the Engineer informed of all progress so that Engineer may provide additional quality control at his discretion.

L. Inspection by the Engineer or others does not absolve the Contractor from his responsibilities for quality control inspection and testing as specified herein or as required by the Manufacturer's instructions.

M. Independent Coating Inspector

1. The services of an independent coating inspector may be retained and paid for by the Owner to inspect the surface preparation and application of the specified coatings.
2. Contractor shall cooperate with inspector to provide safe access for inspection and shall conduct thorough inspection of substrates or linings to ensure that work is done in accordance with the contract documents.

3. Applicator and Contractor shall be responsible to provide a minimum of 48 hours of notice to inspector for inspection points identified at the start of the lining work.

4. Should the Contractor not be ready for a mutually-agreed upon date for an inspection and the inspector shows up on site, the Contractor shall be responsible to pay for the inspector's time for any wasted inspection trips.

N. Manufacturer's Representative: Provide site inspection by manufacturer's field representative before and during application (minimum of 2 days per individual tank structure).

3.06 ACCEPTANCE CRITERIA

A. All surfaces shall be prepared in accordance with the specification and referenced standards herein.

B. Finish Criteria for Coated Surfaces

1. Finished, coated surface shall have uniform color and shall be smooth, monolithic, and free of holidays, pits, drips, runs, trowel licks, cracks, blisters, bubbles, off-gassing pinholes, and other marks or defects;

2. Finish shall be equivalent to a "smooth form finish" for new concrete and as defined by Mock-Up Panel outlined in Part 1 of this specification.

3.07 ADJUSTMENT AND CLEANING

A. At the completion of the Work, Contractor shall remove all materials and debris associated with the Work of this Section.

B. Clean all surfaces not designated to receive protective lining. Restore all other wok in a manner acceptable to Engineer.

1. All finished protective lining shall be protected from damage until Final Acceptance of the Work. Protective lining damaged in any manner shall be repaired or replaced at the discretion of Engineer, at no additional cost to Owner.

2. Clean all protective lining as recommended by the manufacturer to provide finished Work acceptable to Owner, just prior to Final Acceptance.

END OF SECTION

SECTION 10 44 16

FIRE EXTINGUISHERS

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes

1. Provide fire extinguishers in accordance with this Section and applicable reference standards listed in Article 1.03.

1.02 PRICE AND PAYMENT PROCEDURES

A. Measurement and payment requirements: per Division 01 General Requirements.

1.03 REFERENCES

A. Reference Standards

1. INTERNATIONAL CODE COUNCIL (ICC)

2. NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

3. U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

4. UNDERWRITERS LABORATORIES (UL)

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination, Sequencing, and Scheduling: per Division 01 General Requirements.

1.05 SUBMITTALS

A. Submit in accordance with Division 01 General Requirements.

B. Product Data

1. Fire Extinguisher

2. Accessories

3. Wall Brackets

4. Replacement Parts

C. Shop Drawings

1. Fire Extinguisher

2. Accessories

3. Wall Brackets

D. Certificates

1. Certification that fire extinguishers comply with local codes and Regulations.

2. Certification that fire extinguishers comply with OSHA, NFPA, and UL requirements.

E. Closeout and Maintenance Material Submittals: per Division 01 General Requirements

1.06 QUALITY ASSURANCE

A. Provide in accordance with Division 01 General Requirements.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Provide in accordance with Division 01 General Requirements.

B. Protect materials from weather, soil, and damage during delivery, storage, and construction.

C. Deliver materials in their original packages, containers, or bundles bearing the brand name and the name and type of the material.

1.08 SITE CONDITIONS

A. Existing Conditions: per Division 01 General Requirements

PART 2 – PRODUCTS

2.01 TYPE

A. Must conform to NFPA 10. Quantity and placement must comply with the applicable sections of IFC 1414, IFC 906, NFPA 1, NFPA 101, and 29 CFR 1910.157.

B. Provide dry chemical type fire extinguishers compliant with UL 299, rated A:B:C for all extinguishers, unless noted otherwise.

C. Submit manufacturer's data for each type of fire extinguisher required, detailing all related wall mounting and accessories information, complete with manufacturer's warranty with inspection tag.

2.02 MATERIAL

A. Fire extinguisher shall be red enameled steel.

2.03 SIZE

A. Fire extinguisher shall be 10 pounds.

2.04 ACCESSORIES

A. Provide pressure gage on each fire extinguisher.

2.05 WALL BRACKETS

A. Provide wall-hook fire extinguisher wall brackets.

B. Wall bracket and accessories must be as approved.

C. Mounting Height: Top of fire extinguishers shall not be more than 5 feet above the floor.

2.06 SOURCE OF QUALITY CONTROL

A. Provide in accordance with Division 01 General Requirements.

B. Provide manufacturer's warranty with inspection tag on each extinguisher.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Class A light-hazard occupancies such as office buildings must have a Class A extinguisher within a 75-foot travel distance with 1 unit of 1A rating for every 3,000 square feet of floor area; ordinary hazard occupancies such as warehouses and department stores: 75-foot travel distance with one unit of 2A rating for every 3,000 square feet; and extra hazard occupancies such as woodworking and spray painting locations: 75-foot travel distance with one unit of 3A rating for every 3,000 square feet.

B. Class B light-hazard occupancies must have a Class B extinguisher within a 50-foot travel distance with one unit of 4B rating; ordinary hazard occupancies: 50-foot travel distance with one unit of 8B rating; extra hazard occupancies: 50-foot travel distance with one unit of 12B rating. For deep-layer flammable-liquid fire hazards such as dip tanks, one unit of Class B extinguishing potential is

required for each square foot of the largest individual hazard unless an approved automatic system is installed.

C. Class C extinguishers, where there are electrical hazards, are distributed on the same basis as Class B extinguishers.

D. Install fire extinguishers where indicated on the Drawings. Verify exact locations prior to installation.

E. Comply with the manufacturer's recommendations for all installations.

F. Provide fire extinguishers that are fully charged and ready for operation upon installation. Provide extinguishers complete with manufacturer's warranty with inspection tag attached.

3.02 FIELD QUALITY CONTROL

A. Provide in accordance with Division 01 General Requirements.

3.03 STARTUP & COMMISSIONING

A. Provide in accordance with Division 01 General Requirements.

3.04 CLOSEOUT ACTIVITIES

A. Provide in accordance with Division 01 General Requirements.

END OF SECTION

SECTION 22 00 00

PLUMBING

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes

1. Demolishing existing plumbing fixtures and systems in accordance with this Section.

    a. All fixtures with the exception of the - sink, piping, fittings, etc., currently installed. and applicable references listed in Article 1.03.

    b. A new water service entrance is to be constructed. The existing water meter shall be reused.

2. Furnishing and installing plumbing fixtures and systems in accordance with this Section and applicable references listed in Article 1.03.

    a. Plumbing fixtures, trim and ancillary devices shown on the Drawings or specified herein

    b. Cold water system

    c. Pipe insulation

    d. Backflow preventer, valves and piping to accommodate the water service as required meeting local water department requirements

    e. Temporary water construction if needed

    f. Securing of all permits and testing for backflow devices

    g. Testing of drainage

    h. Pipe hangers, clamps, rods, and sway bracing

    i. Pipe penetrations through floors, walls, and partitions

3. The Drawings are diagrammatic and do not indicate or allow for offsets, fittings, valves, vents, etc., which may be required to complete the Work. The Contractor shall study the Drawings showing the structural and finish design of the building and shall furnish and install all fittings, valves, fixtures, trim, traps, vents, etc., necessary to fully complete the plumbing Work to give a fully operational, trouble free system.

4. Give notices, file plans and obtain permits and licenses, and obtain necessary approvals from authorities having jurisdiction.

B. Related Requirements

1. Division 09, Section 09 90 00 PAINTING AND COATING

2. Division 23 – HVAC

3. Division 26 – Electrical

4. Division 40, Section 40 05 13.03 PROCESS PIPE SUPPORTS

1.02 PRICE AND PAYMENT PROCEDURES

A. Measurement and payment requirements: per Division 01 General Requirements.

1.03 REFERENCES

A. Local and State Building, Plumbing, Mechanical, Electrical, Fire and Health Department Codes

B. Standards

1. AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI) A117.1 ACCESSIBLE AND USABLE BUILDINGS AND FACILITIES

2. AMERICAN SOCIETY OF SANITARY ENGINEERING FOR PLUMBING AND SANITARY RESEARCH (ASSE INTERNATIONAL)

3. AMERICAN WATER WORKS ASSOCIATION (AWWA)

4. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM INTERNATIONAL OR ASTM)

5. CSA GROUP (CSA)

6. FACTORY MUTUAL (FM)

7. OCCUPATIONAL SAFETY AND HEALTH ACT (OSHA)

8. PLUMBING AND DRAINAGE INSTITUTE

9. UNIVERSITY OF SOUTHERN CALIFORNIA FOUNDATION FOR CROSS-CONNECTION CONTROL AND HYDRAULIC RESEARCH MANUAL (USC MANUAL)

C. Provide listed codes and standards on Site for reference during construction, held by the Contractor or Subcontractor so designated.

1.04 SUBMITTALS

A. Submit in accordance with Division 01 General Requirements.

B. Submit prior to placing orders including equipment submittals listing corresponding mark and pertinent data, highlighted and checked for the following fixtures and equipment included under this Section denoting name of manufacturer, model #, composition, finish, grade, size, capacity, etc.:

1. Ball valves, backflow preventers, wall hydrants and hose bibs, and shock absorbers.

2. All pipe insulation, PVC covers, tape, metal and/or rewettable cloth coverings, mastic coating (cold water above and below slab).

3. Pipe, pipe hangers, rods, clamps, pipe insulation shields, fittings, insulation and access panels.

4. Piping materials and certificates

5. All plumbing fixtures, and trim

6. Floor Drains

7. Traps

8. Trap Primers

9. Escutcheons

10. Pipe labels

C. Certifications

1. Submit a certificate of inspection from authorities having jurisdiction showing that the Work has been properly inspected and approved.

   a. That all piping systems above and below ground specified herein has been tested, flushed and approved by the local plumbing Inspector.

   b. That all water piping systems specified above and below ground herein has been sterilized, flushed and approved by the local plumbing inspector.

   c. Test certificates, registration forms, diagrams, plans, details, permits, etc. for all backflow devices, as specified herein.

D. Closeout and Maintenance Material Submittals: per Division 01 General Requirements.

1. Complete list of valve tags

2. Written instructions (by trained personnel) in the care, use, maintenance and operation of each product.

3. Maintenance Manual and written operating instructions

4. Up-to-date mark-up set of Record Drawings to show as-built conditions.

a. Record principal dimensions of concealed Work. Valve tags shall be recorded as they are installed. All buried piping shall be dimensioned from the nearest column or masonry wall line.

1.05 QUALITY ASSURANCE

A. Provide in accordance with Division 01 General Requirements.

B. All respective materials and equipment specified herein shall be of the same manufacturer, identified by maker's name, mark, rating and approved standards where applicable.

PART 2 – PRODUCTS

2.01 GENERAL

A. All plumbing materials and equipment shall be selected and designed so as to conform to applicable state codes, local ordinances and energy codes.

B. Provide mixing valves, backflow preventers, vacuum breakers, shock absorbers, check valves, etc., to provide a complete plumbing system as approved by the Engineer. A careful study of all Drawings shall be made in order to determine all of the plumbing items required to make a complete system.

C. All underground soil, waste, vent and storm drain piping shall have a factory applied bituminous coating.

2.02 BURIED WATER SERVICE

A. HDPE DR 11 as shown on drawings and specified under type PE/4 in Section 40 05 13.01 unless otherwise specified by City of Portsmouth Standards.

B. Provide transition fittings for connection to existing water service as required.

2.03 COPPER TUBING AND FITTING

A. Copper tube shall be Type "L" hard drawn, hard temper copper conforming to ASTM B-88 for all above ground hot water, tempered hot water and cold-water piping.

B. Fittings shall be wrought copper or cast bronze fittings, conforming to ASTM B-42 Standards. Pro-press fittings shall be Viega or approved equal.

C. Above ground shall be sweat type with 95/5 solder (95% tin, 5% antimony), conforming to ASTM B-32.89 Standards. Viega Pro-press or equal mechanical joint valves and fittings may be used at contractors option.

2.04 PIPING SPECIALTIES AND ACCESSORIES

A. Pipe Insulators: Non-metallic pipe insulators shall by Dielectric couplings with Plaskon bushings or Mica insulators, as manufactured by the Thermo Dynamics Corporation, Koppers, Anchor or approved equal.

B. Shock Absorbers: Stainless steel as manufactured by Smith, Zurn, Josam or approved equal, sized and installed in accordance with Plumbing and Drainage Institute "Standard PD1 WH201."

C. Escutcheons: Split ring, chrome plated brass, Beaton & Corbin, Frost Co. or approved equal and shall have locking device to hold escutcheon firmly in place.

D. Gauges: Dial type, 4½" diameter; chrome plated, brass case, bronze movement, pulsation dampener and stop, Therice 800, Ashcroft, Crosby, Ametek U.S. Gauge or approved equal. Dial range shall be 0–160 psi for water service.

E. Hose Bibbs

1. Hose bibs located indoors, provide Nibco Model C56-VB ¾ inch, brass body, Heavy Pattern. Provide metal handle and vacuum breaker. Nibco, Watts or approved equal.

F. Camlock Fittings

1. Camlock fittings located indoors, provide Camlock Type B – Aluminum Fitting.

2.05 SUMP PUMPS

A. Provide submersible centrifugal sewage grinder pump(s) as specified herein. The pumps furnished for this application shall be Model X160 as manufactured by Zoeller Pump Company or approved equal by Gould, Liberty or approved equal.

B. Rating: 1/2 H.P., 115 Volts, 1 phase, 60 hertz, 15.5 FLA.

C. Construction: Each pump shall be of the sealed submersible type incorporating features normally found in pumps furnished for the heavy duty industrial or municipal markets. These features include:

1. The pump volute, motor, and seal housing shall be high quality gray cast iron, ASTM A-48, Class 30.

2. The pump shall feature a multiple strainer inlet that prevents clogging from foreign objects and provides optimum operation and reduced maintenance.

3. All external mating parts shall be machined and Buna N, O-Ring sealed.

4. All fasteners exposed to the pumped liquid shall be 300 series stainless steel.

5. All power cords shall be water resistant UL or CSA approved with double insulation and sized as a function of amperes draw.

D. Motor and Shaft: The stator, rotor and bearings shall be mounted in a sealed submersible type housing. Single phase motors shall be Shaded Pole, with automatic reset thermal overload protection. Full Load and, Locked Rotor Amps as well as Run winding resistance shall be tabulated for each pump.

E. Bearings, shaft and mechanical seal: An upper radial and lower thrust bearing shall be required. The upper bearing shall be bronze while the lower bearing is heavy duty single row ball. They are both permanently, continuously lubricated and cooled by the dielectric oil, which fills the motor housing. The motor shaft shall be corrosion resistant steel and sealed from the pumped liquid with a carbon ceramic mechanical seal.

F. Impeller: A thermoplastic, eight vane, non-clog design with three pump out vanes on the backside. These vanes wash out grit and stringy material that will damage the shaft and mechanical seal.

G. All pumps should be capable of automatic operation.

H. Provide all pumps with a tilt-sensitive wide-angle float switch which is sealed in a non-corrosive PVC enclosure. The switch is UL listed for water and sewage and QSA certified. The float switch shall also be fitted with a piggy-back plug that allows the pump to be operated manually without removal from the sump.

I. All cast iron parts shall be painted before assembly with a water reducible alkyd air dried enamel. The paint shall be applied in one coat with a minimum thickness of 3 to 4 mils.

J. All pumps shall be individually tested to include the following:

1. The pump and power cord shall be visually inspected for imperfections, cuts or nicks.

2. The pump shall have a ground continuity check and the motor chamber shall be Hi-potted to test for moisture content and/or insulation defects.

3. The motor and volute housing shall be pressurized and a 10 second air leak decay test run.

4. A specific amount of oil is now added. The pump is run in a fully automated, sequenced, control console, which monitors voltage, current and watts visually and electronically. The tester listens for any noise or malfunction.

2.06 BACK FLOW PREVENTERS

A. Provide a Reduced Pressure Zone Back Flow Preventer (RPZ-BFP) where shown on the Drawings or where required by code.

B. RPZ-BFP shall be of Lead Free design.

C. A Reduced Pressure Zone Assembly shall be installed at each potential health hazard location to prevent backflow due to back-siphonage and/or backpressure.

D. The assembly shall consist of an internal pressure differential relief valve located in a zone between two positive seating check modules with captured springs and silicone seat discs. Seats and seat discs shall be replaceable in both check modules and the relief valve. There shall be no threads or screws in the waterway exposed to line fluids. Service of all internal components shall be through a single access cover secured with stainless steel bolts. The assembly shall also include two resilient seated isolation valves, four resilient seated test cocks and an air gap drain fitting. The assembly shall meet the requirements of: USC Manual; ASSE International Std. 1013; AWWA Std. C511; CSA B64.4.

E. Watts Regulator Co. Series 009LF is the basis of design. Provide PRZ-BFP by Watts, Apollo, Wilkins or approved equivalent. BALL VALVES

2.07 FLOOR DRAINS

A. Setting Grades: Before setting any drains, Plumbing Contractor shall obtain from the general Contractor the exact information relative to finish grade at top of drains.

B. Drain Types: Floor drain outlets shall be of size noted on Drawings. Drains shall be as manufactured by J.R. Smith Co., Zurn Co., Josam or approved equal. Drains shall be acid resistant where indicated. Floor drains shall be Zurn model Z415, round top no-hub with adjustable strainer heads.

2.08 TRAPS

A. Traps shall be provided on all sanitary branch waste connections from fixtures or equipment not provided with traps.

B. Unless otherwise specified, traps shall be plastic per ASTM F 409 or copper-alloy adjustable tube type with slip joint inlet and swivel.

C. Enclosed traps shall be with a cleanout. Provide traps with removable access panels for easy clean-out at sinks and lavatories.

D. Inlets shall have rubber washer and copper alloy nuts for slip joints above the discharge level. Swivel joints shall be below the discharge level and shall be of metal-to-metal or metal-to-plastic type as required for the application. Nuts shall have flats for wrench grip.

E. Outlets shall have internal pipe thread, except that when required for the application, the outlets shall have sockets for solder-joint connections.

F. The depth of the water seal shall be not less than 2 inches. The interior diameter shall be not more than 1/8 inch over or under the nominal size, and interior surfaces shall be reasonably smooth throughout.

G. Slip joints are not permitted on sewer side of trap.

2.09 TRAP SEAL PRIMER SYSTEMS

A. The trap seal primer system shall conform to ASSE 1018 and UPC standards. Provide automatic trap primers for each trap.

B. System shall include atmospheric vacuum breaker, internal back-flow protection, and calibrated manifold for equal water distribution.

C. System shall be designed to provide a minimum of 1 oz of potable water at 20 psig.

D. Provide a trap primer distribution unit to allow distribution to multiple traps from one priming system.

E. Provide trap primer assemblies and distribution systems in accordance with the following criteria:

1. Inlet: ½ Inch NPT(F), ANSI/ASME BI.20.1. Include inlet shutoff valve.

2. Outlet: ½ Inch NPT(F), ANSI/ASME BI.20.1.

3. Backflow Prevention: Anti-siphon atmospheric vacuum breaker

4. Inlet Service Valve: Yes, bronze solder ball valve

F. Manufacturers

1. Precision Plumbing Products (PPP) – Prime-Pro Model

2. Engineer Approved Equal

2.10 BALL VALVES

A. Ball valves 1-1/2 inch and smaller: rated for 150 psi saturated steam pressure, 600 psi Water Oil Gas (WOG) pressure, 2-piece adaptor load construction with bronze body conforming to ASTM B62, single reduced port, chrome-plated brass ball, glass reinforced Teflon or tetrafluoroethylene (TFE) seats and seals, blowout proof stem, soldered, screwed or flanged ends, and vinyl-covered steel handle. Provide stainless steel ball and stem with screwed or flanged ends for air service.

B. Ball valves 2-inch and larger: rated for 150 psi saturated steam pressure, 600 psi WOG pressure, 3-piece construction with bronze body conforming to ASTM B62, single reduced port, chrome-plated brass ball, glass reinforced Teflon or TFE seats and seals, blowout proof stem, soldered, screwed or flanged ends, and vinyl-covered steel handle.

C. Apollo or approved equal. If mechanical joint is selected contractor shall provide valves approved by the mechanical joint vendor.

2.11 CHECK VALVES

A. Swing check valves 2-inches and smaller: MSS SP-80, Class 125, cast-bronze body and cap conforming to ASTM B62, horizontal swing and bronze disc, with threaded or solder ends. Provide Class 150 valves with threaded end connections, as specified, where system pressure requires or where Class 125 valves are not available.

2.12 GLOBE VALVES

A. Globe valves 2-inch and smaller: MSS SP-80, Class 125, body and screwed bonnet of ASTM B62 cast bronze with threaded or solder ends, bronze or replaceable composition disc, copper-silicon alloy stem, bronze packing gland, non-asbestos packing, and malleable iron hand wheel. Provide Class 150 valves, as specified, where system pressure requires.

2.13 DIELECTRIC PIPE COUPLINGS

A. Install where copper connects to steel or cast iron pipe appurtenances with steel bodies with non-conducting bushing on each threaded end. Couplings: rated at 200 psi.

2.14 PIPE SUPPORTS AND HANGERS

A. Pipe supports and hangers are specified in Section 40 05 13.03 Process Pipe Supports.

2.15 EQUIPMENT AND MATERIALS IDENTIFICATION

A. Use symbols, nomenclature and equipment numbers specified, shown on the drawings, or shown in the maintenance manuals.

B. Interior (Indoor) Equipment: Engraved nameplates, with letters not less than 48 mm (3/16-inch) high of brass with black-filled letters, or rigid black plastic with white letters, shall be permanently fastened to the equipment. Unit components such as water heaters, tanks, coils, filters, fans, etc. shall be identified.

C. Exterior (Outdoor) Equipment: Brass nameplates, with engraved black filled letters, not less than 48 mm (3/16-inch) high riveted or bolted to the equipment.

D. Control Items: All temperature, pressure, and controllers shall be labeled and the component's function identified. Identify and label each item as they appear on the control diagrams.

E. Valve Tags and Lists

1. Plumbing: All valves shall be provided with valve tags and listed on a valve list (Fixture stops not included). The Contractor shall provide a tagging list of all valves.

2. Valve tags: Engraved black filled numbers and letters not less than 13 mm (1/2-inch) high for number designation, and not less than 6.4 mm(1/4-inch) for service designation on 19 gauge, 38 mm (1-1/2 inches) round brass disc, attached with brass "S" hook or brass chain.

3. Valve lists: Valve lists shall be created using a word processing program and printed on plastic coated cards. The plastic coated valve list card(s), sized 216 mm (8-1/2 inches) by 280 mm (11 inches) shall show valve tag number, valve function and area of control for each service or system. The valve list shall be in a punched 3-ring binder notebook. A copy of the valve list shall be mounted in picture frames for mounting to a wall.

4. A detailed plan for each floor of the building indicating the location and valve number for each valve shall be provided. Each valve location shall be identified with a color coded sticker or thumb tack in ceiling.

PART 3 – EXECUTION

3.01 GENERAL

A. Work shall be executed in strict conformity with the latest edition of the plumbing and building codes and all local Regulations that may apply. In case of conflict between the Contract Documents and a governing code or ordinance, the more stringent standard shall apply. If any Work is performed and subsequent changes

are necessary to conform to local ordinances, these changes shall be made at no additional cost to the Owner.

B. All Work, fixtures, and materials shall be protected at all times. The Contractor shall make good all damage caused by his workmen either directly or indirectly. All pipe openings shall be closed with caps and/or plugs during installation. Fixtures and equipment shall be tightly covered and protected against dirt, water, chemical or mechanical injury.

C. Duct tape shall be applied to the openings and finished surfaces of all floor drains, floor cleanouts, to protect against dirt, water, chemical or mechanical injury and shall be removed prior to completion of Work. Plywood covers may be secured to floor drain grates with coated wire in lieu of duct tape.

D. Coordinate with all trades in executing the Work of this Section as described hereunder.

1. Perform all Work such as the progress of the entire Project including the Work of all other trades whether involved in the Work of this or other Sections shall not be interfered with or deleted.

2. Observe all concrete pours in areas associated with Work performed under this Section.

E. Obtain detailed information from the manufacturers of equipment to be provided under this Section as to the proper methods of installation.

F. Keep fully informed as to the shape, size and position of all openings required for material or equipment and give full information so that such openings may be provided for in advance.

1. Where valves cannot be placed in an accessible area, covers and frames shall be provided under this Section and built into the Work. Access doors are not indicated on the Drawings but are required.

G. Cutting Holes

1. Holes through concrete and masonry shall be cut by rotary core drill. Pneumatic hammer, impact electric, and hand or manual hammer type drill will not be allowed, except as permitted by the Engineer where working area space is limited.

2. Holes shall be located to avoid interference with structural members such as beams or grade beams. Holes shall be laid out in advance and drilling done only after approval by the Engineer. If the Contractor considers it necessary to drill through structural members, this matter shall be referred to the Engineer for approval.

3. Waterproof membrane shall not be penetrated. Pipe floor penetration block outs shall be provided outside the extents of the waterproof membrane.

H. All piping in finished areas shall be run concealed unless directed otherwise by the Owner.

I. Provide maintenance for all plumbing equipment and systems until final acceptance by the Owner, and take such measures as necessary to ensure adequate protection of all equipment and material during delivery, storage, installation and shutdown conditions. This responsibility shall include all provisions required to meet conditions incidental to delays pending final test of systems and equipment.

J. Excavation and Backfill is provided by the general Contractor.

1. Pipe bedding shall be in accordance with provisions of Division 31. Work under this Section shall commence only after proper bedding material has been provided, graded and properly compacted. Excavation shall be kept open until system has been inspected, tested and approved.

2. All piping left exposed subsequent to backfilling shall be identified with flagged stakes and spray painted with fluorescent paint to guard against mechanical damage.

3. Observe all backfilling and compaction of all underground piping associated with the Work of this section.

K. All non-insulated, non-chrome plated water piping shall be painted in accordance with Section 09 90 00 PAINTING AND COATING by the Painting Subcontractor.

L. After installation, clean and touch up damaged spots on equipment and accessories with factory primed or finished surfaces with the same paint as applied at the factory.

3.02 STERILIZATION AND ACCEPTANCE TESTING

A. All water piping shall be filled with a solution of chlorine and water [fifty (50) ppm free chlorine] and allowed to stand for at least twenty-four (24) hours or a 200-ppm solution for at least six (6) hours. After the system has been flushed, drained and refilled, a sample of the water will be taken by the local health department for a test. If it has been found that all impurities have not been removed, the above shall be repeated. Testing shall be continued until testing verifies that all impurities have been removed and the water meets current standards for potable water.

B. Plumbing Work shall be inspected and tested according to state and local codes and as follows:

1. The Contractor shall provide all necessary labor and materials to accomplish tests as part of this Contract.

2. All soil, storm drain and vent piping shall be given a hydrostatic test equivalent to filling stacks with water for a 15-minute period after which time the systems shall prove tight at all points. Test pressure shall be at least equal to the building height with a minimum of 10'0".

3. Water piping shall be given a hydrostatic test of 100 lbs. per square inch pressure for a three-hour period with a pressure drop of not greater than two pounds.

C. Following the final slab pour within the building, the Contractor shall perform additional testing and flushing of each underground sanitary line to detect any obstructions and/or damage to pipe following backfilling, compacting and final slab pours.

3.03 BACKFLOW PREVENTION

A. Furnish and install backflow devices as specified herein and/or shown, and where required by and in accordance with applicable state Codes, Local codes, and/or authorities having jurisdiction.

B. All backflow devices and associated trim (valves) shall be FM and USC approved.

C. Test all backflow devices (reduced pressure backflow preventer) prior to completion of Work. The tests shall be conducted by a state certified backflow prevention device tester, and recorded on the proper registration test, inspection, and/or maintenance forms and submitted with all necessary diagrams, plans, details, etc., to the state and/or local authorities having jurisdiction. All devices failing a test or found defective shall be overhauled, repaired or replaced and retested. Submit three (3) complete sets of all said materials, including copies of final test certificates issued by state and/or local authorities having jurisdiction.

D. Backflow preventers shall be located so as to permit easy access and provide adequate and convenient space for maintenance, inspection and testing. The backflow preventer and shut-off valves shall be installed horizontally between 3 and 4 feet from the floor and a minimum of 6 inches from any wall.

E. All reduced pressure backflow preventers specified herein shall be furnished and installed with left or right hand relief ports to allow for ease of maintenance and air gap fitting as supplied by the manufacturer, substitutions fabricated from fittings or pipe shall not be permitted in lieu thereof.

F. The spare parts kits associated with each backflow device shall be securely fastened to the body of said device with nylon tie straps.

G. Provide a drain line full size from all backflow preventers with relief ports and/or vents to the nearest floor drain, Increaser drain, case drain condensate drain or waste receptacle, unless specified otherwise herein.

3.04 CLEANING AND ADJUSTING

A. At the completion of the Work all fixtures, equipment, specialties, components, and exposed trim shall be cleaned and, where required, polished ready for use. Faucet washers, which have been damaged during construction, shall be replaced. All drains, sediment buckets and traps shall be thoroughly cleaned.

B. At the completion of the Work all valves and automatic control devices shall be adjusted for proper and quiet operation of all plumbing systems specified herein under this Section. Hot water system shall be adjusted for proper operation.

3.05 PLUMBING SYSTEMS DEMOLITION

A. Rigging access, other than indicated on the drawings, shall be provided after approval for structural integrity by the Engineer. Such access shall be provided without additional cost or time to the Owner. Where work is in an operating building, approved protection from dust and debris shall be provided at all times for the safety of building personnel and maintenance of building operation and environment of the building.

B. Unless specified otherwise, all piping, wiring, conduit, and other devices associated with the equipment up to the water meter shall be completely removed from the Owner's property. This includes all concrete equipment pads, pipe, valves, fittings, insulation, and all hangers including the top connection and any fastenings to building structural systems. All openings shall be sealed after removal of equipment, pipes, ducts, and other penetrations in roof, walls, floors, in an approved manner and in accordance with plans and specifications where specifically covered. Structural integrity of the building system shall be maintained. Reference shall also be made to the drawings and specifications of the other disciplines in the project for additional facilities to be demolished or handled.

C. All valves including gate, globe, ball, butterfly, and check, and all pressure gauges and thermometers with wells shall remain Owner property and shall be removed and delivered to the Engineer and stored as directed. The Contractor shall remove all other material and equipment, devices and demolition debris under these plans and specifications. Such material shall be removed from Owner property expeditiously and shall not be allowed to accumulate.

3.06 PAINTING

A. Prior to final inspection and acceptance of the plant and facilities for beneficial use by the Owner, the plant facilities, equipment and systems shall be thoroughly cleaned and painted. Painting of pipes, hangers, supports, and other iron work, either in concealed spaces or exposed spaces, is specified in Section 09 90 00 PAINTING & COATING.

B. The following material and equipment shall NOT be painted:

1. Motors, controllers, control switches, and safety switches

2. Control and interlock devices

3. Regulators

4. Pressure reducing valves

5. Control valves and thermostatic elements

6. Lubrication devices and grease fittings

7. Copper, brass, aluminum, stainless steel, and bronze surfaces. Surfaces shall be painted or finished if specifically indicated on the Drawings.

8. Valve stems and rotating shafts

9. Pressure gauges and thermometers

10. Glass

11. Name plates

3.07 OPERATION AND MAINTENANCE MANUALS

A. Provide four bound copies. The Operations and Maintenance Manuals shall be delivered to the Engineer not less than 30 days prior to completion of a phase or final inspection.

B. All new and temporary equipment and all elements of each assembly shall be included.

C. Data sheet on each device listing model, size, capacity, pressure, speed, horsepower, impeller size, and other information shall be included.

D. Manufacturer's installation, maintenance, repair, and operation instructions for each device shall be included. Assembly drawings and parts lists shall also be included. A summary of operating precautions and reasons for precautions shall be included in the Operations and Maintenance Manual.

E. Lubrication instructions, type, and quantity of lubricant shall be included.

F. Schematic diagrams and wiring diagrams of all control systems corrected to include all field modifications shall be included.

G. Set points of all interlock devices shall be listed.

H. Trouble-shooting guide for the control system troubleshooting guide shall be inserted into the Operations and Maintenance Manual.

I. The combustion control system sequence of operation corrected with submittal review comments shall be inserted into the Operations and Maintenance Manual.

J. Emergency procedures.

3.08 POSTED INSTRUCTIONS

A. Framed instructions under glass or in laminated plastic, including wiring and control diagrams showing the complete layout of the entire system, shall be posted where directed. Condensed operating instructions explaining preventive maintenance procedures, methods of checking the system for normal safe operation, and procedures for safely starting and stopping the system shall be prepared in typed form, framed as specified above for the wiring and control diagrams and posted beside the diagrams. The framed instructions shall be posted before acceptance testing of the systems.

3.09 DEFECTIVE WORK

A. If inspection or test shows defects, such defective work or material shall be replaced or repaired as necessary and inspection and tests shall be repeated. Repairs to piping shall be made with new materials. Caulking of screwed joints or holes will not be acceptable.

END OF SECTION

SECTION 23 05 00

COMMON WORK RESULTS FOR HVAC

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes

1. Overall requirements for mechanical installations common to Specifications in Division 23 Heating, Ventilating and Air Conditioning (HVAC).

2. Ensure each mechanical trade is sufficiently familiar with and responsible for electrical operation and wiring of the mechanical system for which they are responsible. Electrical tradesmen may be used by each mechanical trade for the associated portion of wiring, however, require that responsibility for repair and maintenance of each mechanical system is provided by each mechanical trade.

B. Related Requirements

1. Division 23 - HVAC

1.02 PRICE AND PAYMENT PROCEDURES

A. Measurement and payment requirements: per Division 01 General Requirements.

1.03 REFERENCES

A. Reference Standards

1. AIR MOVEMENT AND CONTROL ASSOCIATION (AMCA)

2. AIR CONDITIONING, HEATING AND REFRIGERATION INSTITUTE (AHRI)

3. AIR DIFFUSION COUNCIL (ADC)

4. AMERICAN CONFERENCE OF GOVERNMENTAL INDUSTRIAL HYGIENISTS (ACGIH)

5. AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

a. ANSI/ASHRAE/IES Standard 90.1 Energy Standard for Buildings Except Low-Rise Residential Buildings

b. Other applicable standards

6. AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR CONDITIONING ENGINEERS (ASHRAE)

7. AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

8. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

9. FACTORY MUTUAL (FM)

10. HYDRAULIC INSTITUTE STANDARDS (HI) STANDARDS

11. INSTRUMENTAL SOCIETY OF AMERICA (SA) STANDARDS

12. MANUFACTURER'S STANDARDIZATION SOCIETY (MSS) STANDARDS

13. NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA) STANDARDS

14. NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY (NBS)

15. NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

16. SHEET METAL AND AIR CONDITIONING CONTRACTORS NATIONAL ASSOCIATION (SMACNA)

17. UNDERWRITERS LABORATORY (UL) standards

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination, Sequencing, and Scheduling: per Division 01 General Requirements.

1.05 SUBMITTALS

A. Submit in accordance with Division 01 General Requirements and as specified in individual Specification sections.

B. Closeout and Maintenance Material Submittals: per Division 01 General Requirements.

1. Mark Drawings to indicate revisions to piping and ductwork, size and exterior and interior locations; locations of coils, dampers and other control devices, filters, boxes and similar units requiring periodic maintenance or repair; actual equipment locations dimensioned to column lines; actual inverts and locations of underground piping; concealed equipment and control system devices dimensioned to column lines; mains and branches of

piping systems, with valves and control devices located and numbered, concealed unions located, and items requiring maintenance located (such as traps, strainers, expansion compensators, tanks).

1.06 QUALITY ASSURANCE

A. Provide in accordance with Division 01 General Requirements.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Provide in accordance with Division 01 General Requirements.

B. Packing, Shipping, Handling, and Unloading

1. Identify products with names, model numbers, types, grades, compliance labels, and similar information needed for distinct identifications; adequately packaged and protected to prevent damage during shipment, storage, and handling.

C. Acceptance at Site

1. Coordinate deliveries of mechanical materials and equipment to minimize construction Site congestion. Limit each shipment to the items and quantities needed for the smooth and efficient flow of installations.

1.08 SITE CONDITIONS

A. Existing Conditions: per Division 01 General Requirements.

PART 2 – PRODUCTS

2.01 NAMEPLATES

A. Provide permanent operational data nameplate on each item of power operated mechanical equipment, indicating manufacturer, product name, model number, serial number, capacity, operating and power characteristics, labels of tested compliances, and similar necessary data. Locate nameplates in accessible location.

2.02 EQUIPMENT

A. Provide equipment meeting ANSI/ASHRAE/IES Standard 90.1.

2.03 COMPONENTS

A. System components are identified throughout the Drawings for proper system operation.

2.04 SOURCE QUALITY CONTROL

A. Provide in accordance with Division 01 General Requirements.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Install equipment and materials to allow required access for servicing and maintenance. Coordinate final location of concealed equipment and devices requiring access with final location of required access panels and doors. Allow ample space for removal of parts that require replacement or servicing. Extend grease fittings to accessible location.

B. Coordinate equipment and materials for installation with other building components.

C. Verify dimensions by field measurements.

D. Arrange for chases, slots, and openings in other building components to allow for mechanical installations.

E. Sequence, coordinate and integrate installation of mechanical materials and equipment for efficient flow of Work. Give particular attention to large equipment requiring positioning prior to closing in the building.

F. Coordinate cutting and patching of building components to accommodate installation of mechanical equipment and materials.

G. Coordinate installation of mechanical materials and equipment above ceilings with suspension system, lighting fixtures, and other installations.

H. 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. Provide required connection for each service.

I. Coordinate installation of identifying devices after completing coverage and painting where devices are applied to surfaces. Install identifying devices prior to installing acoustical ceilings and similar concealment.

3.02 EQUIPMENT CONNECTIONS

A. Drawings schematically show the order of connection of various terminal units, louvers, valves, and other mechanical equipment but do not show every detail of piping and ductwork. Connect fixtures in accordance with standard details, accepted trade practice, and the intent of the Specifications and Drawings. Coordinate with other trades.

3.03 FIELD QUALITY CONTROL

A. Provide in accordance with Division 01 General Requirements.

3.04 STARTUP & COMMISSIONING

A. Provide in accordance with Division 01 General Requirements.

3.05 CLEANING

A. Cap ductwork during construction to protect from dust and debris. Thoroughly clean interior of ductwork and air systems.

B. Cleaning filters, strainers, and mechanical systems prior to final acceptance.

3.06 CLOSEOUT ACTIVITIES

A. Provide in accordance with Division 01 General Requirements.

END OF SECTION

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SECTION 23 05 10

HVAC DEMOLITION

PART 1 – GENERAL

1.01 SCOPE OF WORK

A. Provide all labor, materials, equipment and incidentals required to remove and dispose of the HVAC equipment, ductwork, piping, etc., in the existing building as indicated on the Drawings and as specified herein.

B. Provide all HVAC demolition Work associated with the removal of equipment from the existing facilities, including disconnecting piping, ductwork, temperature controls and electrical connections to equipment being removed under other related Sections.

1.02 RELATED WORK

A. The demolition and removal of all existing louvers, fans, and HVAC ductwork.

B. The demolition and removal of all gas unit heaters and gas piping back to meter.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.01 GENERAL

A. The demolition and removal Work shall be coordinated with the construction schedule for new Work and the demolition Work of other Contracts.

B. In general, the Work includes removal and disposal of:

1. Ventilation system, gas fired heating system.

2. All ductwork, controls and electrical connections that are to be removed shall be removed to a point below the roof and prepared for future fit-up whether or not indicated on the Drawings.

3.02 DEMOLITION AND REMOVAL

A. Disconnect all HVAC Work associated with equipment scheduled for demolition except portions indicated to remain.

3.03 DISPOSITION OF MATERIALS AND EQUIPMENT

A. Except as indicated herein or otherwise directed by the Owner, all material and equipment removed under this Section shall become the property of the Contractor and shall be removed from the Site and disposed of by the Contractor. Provide the Owner with receipts verifying acceptable disposal of any legally regulated materials and equipment.

END OF SECTION

SECTION 23 05 15

HVAC IDENTIFICATION

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:

1. Painted Identification Materials
2. Plastic Pipe Markers
3. Valve Tags
4. Plastic Equipment Markers
5. Plasticized Tags

B. Related Sections

1. Division 22 and 23 Sections which specify Pipe and Valve marking and identification.

1.02 REFERENCES

A. ANSI Standards - Comply with ANSI A13.1 for lettering size, length of color field, colors, and viewing angles of identification devices.

1.03 SUBMITTALS

A. Manufacturer's technical product data and installation instructions for each identification material and device required.

B. Samples of each color, lettering style and other graphic representation required for each identification material or system.

C. Valve schedule for each piping system, typewritten and reproduced on 8½" x 11" 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 that are intended for emergency shut-off and similar special uses, by special "flags", in margin of schedule.

1.04 QUALITY ASSURANCE

A. Mechanical identification materials shall be provided by firms regularly engaged in manufacture of identification devices of types and sizes required and whose products have been in satisfactory use in similar service for not less than 5 years.

1.05 MAINTENANCE

A. Extra Materials

B. Furnish minimum of 5% extra stock of each mechanical identification material required, including additional numbered valve tags (not less than 3) for each piping system, additional piping system identification markers, and additional plastic laminate engraving blanks of assorted sizes.

C. Where stenciled markers are provided, clean and retain stencils after completion of stenciling and include used stencils in extra stock, along with required stock of stenciling paints and applicators.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. Subject to compliance with requirements, provide mechanical identification materials of one of the following or an approved equal:

1. Allen Systems, Inc.

2. Brady (W.H.) Co.; Signmark Div.

3. Seton Name Plate Corp.

2.02 MATERIALS

A. Mechanical Identification Materials

1. Provide manufacturer's standard products of categories and types required for each application as referenced in other Division 23 sections. Where more than single type is specified for application, selections is Installer’s option, but provide single selection for each product category.

B. Painted Identification Materials

1. Provide 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 ¾ inch high letters for access door signs and similar operational instructions. Provide 1-inch high letters for labeling tanks between 0-20 gallons.

2. Utilize standard exterior type stenciling enamel; black, except as otherwise indicated; either brushing grade or pressurized spray-can form and grade.

3. Utilize standard identification enamel of colors indicated or, if not otherwise indicated for piping systems, comply with ANSI A13.1 for colors.

C. Plastic Pipe Markers

1. Provide manufacturer's standard pre-printed, semi-rigid snap-on, color-coded pipe markers, complying with ANSI A13.1.

2. Furnish 1-inch thick molded fiberglass insulation with jacket for each plastic pipe marker to be installed on uninsulated pipes subjected to fluid temperatures of 125°F (52°C) or greater. Cut length to extend 2 inches beyond each end of plastic pipe marker.

3. For external diameters less than 6 inch (including insulation if any), provide full-band pipe markers, extending 360□ around pipe at each location, fastened by one of the following methods:

   a. Snap-on application of pre-tensioned semi-rigid plastic pipe marker.

4. For external diameters of 6 inch and larger (including insulation if any), provide either full-band or strip-type pipe markers, but not narrower than 3 times letter height (and of required length), fastened by one of the following methods:

   a. Strapped-to-pipe (or insulation) application of semi-rigid type, with manufacturer's standard stainless steel bands.

5. Manufacturer's standard pre-printed nomenclature that best describes piping system in each instance, as selected by the Engineer in cases of variance with names as shown or specified. Custom wording shall be provided when no standard nomenclature is available.

6. Print each pipe marker with arrows indicating direction of flow, either integrally with piping system service lettering (to accommodate both directions), or as a separate unit of plastic.

D. Valve Tags

1. Provide 19-gauge polished brass valve tags with stamp-engraved piping system abbreviation in ¼ inch high letters and sequenced valve numbers ½ inch high and with 5/32-inch hole for fastener.

   a. Provide 1-1/2-inch diameter tags, except as otherwise indicated.

   b. Provide size and shape as specified or scheduled for each piping system.

c. Fill tag engraving with black enamel.

2. Provide manufacturer's standard solid brass chain (wire link or beaded type), or solid brass S-hooks of the sizes required for proper attachment of tags to valves, and manufactured specifically for that purpose.

3. Provide manufacturer's standard 1/16-inch thick engraved plastic laminate access panel markers, with abbreviations and numbers corresponding to concealed valve. Include 1/8-inch center hole to allow attachment.

E. Plastic Equipment Markers

1. Provide manufacturer's standard laminated plastic, color coded equipment markers. Conform to the following color code:

a. Yellow - Heating equipment and components.

b. Blue - Equipment and components that do not meet any of the above criteria.

c. For hazardous equipment, use colors and designs recommended by ANSI A13.1.

2. Include the following, matching terminology on schedules as closely as possible:

a. Name and plan number

b. Equipment service

c. Design capacity

d. Other design parameters such as pressure drop, entering and leaving conditions, rpm, etc.

3. Provide approximate 2-1/2 inch by 4 inch markers for control devices, dampers, and valves; and 4-1/2 inch by 6 inch for equipment.

F. Plasticized Tags

1. Manufacturer's standard pre-printed or partially pre-printed accident-prevention tags, of plasticized card stock with matt finish suitable for writing approximately 3-1/4 inch by 5-5/8 inch, with brass grommets and wire fasteners and with appropriate pre-printed wording including large-size primary wording (as examples; DANGER, CAUTION, DO NOT OPERATE).

G. Lettering and Graphics

1. Coordinate names, abbreviations and other designations used in mechanical identification Work, with corresponding designations shown, specified, or scheduled. Provide numbers, lettering and wording indicated or, if not

otherwise indicated, as recommended by manufacturers or as required for proper identification and operation/maintenance of mechanical systems and equipment.

2. 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

3.01 INSTALLATION

A. 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 removable concealment, if any.

B. Piping System Identification

1. Install pipe markers of one of the following types on each system indicated to receive identification, and include arrows to show normal direction of flow:

a. Plastic pipe markers, with application system as indicated under "Materials" in this section. Install on pipe insulation segment where required for hot non-insulated pipes.

2. Locate pipe markers and color bands as follows wherever piping is exposed to view in occupied spaces, machine rooms, accessible maintenance spaces (shafts, tunnels, plenums), and exterior non-concealed locations.

a. Near each valve and control device.

b. Near each branch, excluding short take-offs for fixtures and terminal units; mark each pipe at branch, where there could be question of flow pattern.

c. Near locations where pipes pass through walls or floors/ceilings, or enter non-accessible enclosures.

d. At access doors, manholes and similar access points that permit view of concealed piping.

e. Near major equipment items and other points of origination and termination.

f. Spaced intermediately at maximum spacing of 50 feet along each piping run, except reduce spacing to 25 feet in congested areas of piping and equipment.

C. Valve Identification

1. Provide valve tag on every valve, cock and control device in each piping system; exclude check valves, valves within factory-fabricated equipment units, plumbing fixture faucets, convenience and lawn-watering hose bibs, and shut-off valves at plumbing fixtures, HVAC terminal devices and similar rough-in connections of end-use fixtures and units. List each tagged valve in valve schedule for each piping system.

D. Mechanical Equipment Identification

1. Install engraved plastic laminate sign or plastic equipment marker on or near each major item of mechanical 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:

   a. Main control and operating valves, including safety devices and hazardous units.

   b. Meters, gauges, thermometers and similar units.

   c. Pumps, compressors, condensers and similar motor-driven units.

   d. Fans, blowers, primary balancing dampers and mixing boxes.

   e. Tanks and pressure vessels.

   f. Strainers, filters, water treatment systems and similar equipment.

2. 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.

3. Minimum ¼ inch high lettering for name of unit where viewing distance is less than 2 feet, ½ inch high for distances up to 6 feet and proportionately larger lettering for greater distances. Provide secondary lettering of 67% to 75% of size of the principal lettering.

4. 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.

5. At Installer's option, where equipment to be identified is concealed, plasticized tags may be installed within concealed space to reduce amount of text in exposed sign (outside concealment).

   a. Operational valves and similar minor equipment items located in non-occupied spaces (including machine rooms) may, at Installer's

option, be identified by installation of plasticized tags in lieu of engraved plastic signs.

3.02 ADJUSTING

A. Relocate any mechanical identification device which has become visually blocked by Work of this division or other divisions.

3.03 CLEANING

A. Clean face of identification devices.

END OF SECTION

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SECTION 23 05 93

TESTING, ADJUSTING AND BALANCING FOR HVAC

PART 1 – GENERAL

1.01 SUMMARY

A. Furnish the necessary labor, materials, instruments, transportation and devices required to test, adjust and balance the total heating and ventilating systems, both water and air systems. Each system as specified and detailed herein, shall perform in accordance with the intent of the Drawings and this Section. Systems to be tested, adjusted, and balanced include air and hydronic systems installed by the HVAC Contractor.

B. Testing, balancing and operation of the systems shall be performed by competent and experienced personnel, having formerly done similar Work and whose qualifications and performance shall be subject to the approval of the Engineer. Test and balance air and water system and submit testing and balancing reports to the Engineer for review and approval. Rebalance when required by the Engineer, incorporating all changes and certify the systems have been tested and balanced to meet specified requirements.

C. The tests shall demonstrate the specified capacities and operation of equipment and materials comprising the systems. Such tests other than as described herein, which are deemed necessary by the Engineer to indicate the fulfillment of the Contract, shall be made.

D. Data required by this Section shall receive complete approval before final payment is made.

E. If, in the opinion of the Engineer, the Contractor has not, will not, or cannot comply with the testing, balancing and adjusting requirements of this Section, he may advise the Owner to employ a qualified firm to perform such Work at Contractor's sole expense.

1.02 SUBMITTALS

A. Submit, in accordance with the following:

1. Qualifications and experience information and data as detailed under Paragraph 1.03 below.

2. Proposed testing schedules and procedures.

3. Results of periodic field inspections as specified under Paragraph 3.01 below.

4. Preliminary draft "system" balancing reports as systems are completed and tested.

5. Final systems and Project balancing reports as final system adjustments are made as systems are accepted by the Owner.

6. All submittals shall contain a statement that Section 23 05 93 TESTING, ADJUSTING AND BALANCING FOR HVAC and all other referenced Sections have been read and complied with. The certification statement shall be made by all of the following that are applicable; the Contractor, Subcontractor and the vendor. The statement shall be an individual statement for each party involved, and shall be included with every submittal and resubmittal.

B. In general, corrections, comments, or lack thereof, made relative to submittals during review shall not relieve the Contractor from compliance with the requirements of the Drawings and Specifications. Submittals are for review of general conformance with the design concepts of the Project and general compliance with the Contract Documents. The Contractor is Responsible for the final design conforming and correlating all quantities and dimensions, selecting fabrication processes and techniques of construction, coordinating the Work of all trades, and performing the Work in a safe and satisfactory manner.

1.03 QUALITY ASSURANCE

A. Qualifications standards for this Work - Affiliation with manufacturers, installing Contractors, or engineering firms will not preclude acceptability. Submit qualifications within 60 days after Contract award. Membership in the AABC or NEBB for air and water testing is required. The testing balancing Contractor shall not be affiliated with the on Site Contractors.

B. The balancing Contractor shall be prepared to submit credentials and other evidence of qualifications, and Work experience.

C. To perform required professional services, the balancing agency shall have a minimum of two test-and-balance Engineers certified by the AABC or NEBB.

D. This certified test-and-balance Engineer shall be Responsible for supervision and certification for the total Work specified herein.

E. The balancing agency shall submit records of experience in the field of air and hydronic system balancing or any other data as requested by the Engineer. The supervisory personnel for the firm shall have at least five years' experience and all the employees used in this Project shall be qualified technicians in this specific field.

F. The balancing agency shall furnish all necessary calibrated instrumentation to adequately perform the specified services. An inventory of all instruments and

devices in possession of the balancing agency may be required by the Engineer to determine the balancing agency's performance capability.

1.04 ENGINEERING SERVICES

A. When engineering services are specified to be provided by the Contractor, the Contractor shall retain a licensed professional Engineer to perform the services. The Engineer shall be licensed at the time the Work is done and in the State of New Hampshire. If the State issues discipline specific licenses, the Engineer shall be licensed in the applicable discipline. In addition, the Engineer shall be experienced in the type of Work being provided.

B. All Work is to be done according to the applicable regulations for professional Engineers, to include signing, sealing and dating documents. When submittals are required by a professional Engineer, in addition to state required signing and sealing, a copy of the current wallet card or wall certificate indicating the date of expiration shall be included with the submittal.

1.05 SCHEDULE AND PROCEDURES

A. A complete schedule of balancing procedures for each of the buildings or systems shall be submitted in sufficient time in advance so that the Engineer might arrange to observe these procedures as they progress. Before commencing with the balancing of the systems, submit the methods and instruments proposed to be used to adjust and balance the air and water systems.

B. Submit proposed testing programs at least 2 weeks prior to the scheduled test to assure agreement as to personnel and instrumentation required and scope of each testing program.

1.06 DRAWING REVIEW

A. The balancing organization shall thoroughly review the location of all fresh air dampers, return dampers, spill dampers, quadrant dampers, splitter dampers, bypass dampers, face dampers, fire dampers, registers, grilles, diffusers, etc. The purpose of the review is to finalize the optimum locations for dampers, test ports, and balancing valves shown on the Drawings.

1.07 EQUIPMENT CURVES

A. Fan Characteristics Charts: The HVAC and general Contractors shall provide to the Balancing Organization any required characteristic curve charts for all fans to include air conditioning units and air handling units. Characteristic curve charts shall be not less than 8-1/2-in by 11-in and shall show the static pressure, capacity horsepower, and overall efficiency for operating conditions from no load to 130 percent of specified load. The minimum size of the actual fan curve shall be no less than 6-in by 8-in. The use of faxed copies of curves is not acceptable.

1.08 GUARANTEE

A. The balancing Work shall be guaranteed to be accurate and factual data, based on readings in the field. All typewritten data shall be submitted within 14 working days of the performance of the test. Test data shall not be held until completion, but shall be submitted on an interim basis as soon as the test or appropriate groups of tests are finished.

PART 2 – PRODUCTS

2.01 MATERIALS

A. Furnish gaskets, lubricants and other expendable materials required to be replaced during the execution of this Work.

B. Fixed-pitched pulleys required for fan adjustments shall be furnished on an exchange basis by the party Responsible for the fan installation.

C. Where test results indicate that air quantities at any system fan are below or in excess of the specified amount, the HVAC and general Contractor's, at their own expense, shall change driving pulley ratio or shall make approved changes to obtain the specified or scheduled air quantities.

D. Testing apparatus: Furnish plugs, caps, stops, valves, pumps, compressors, blowers, and similar devices required to perform this Work.

1. Furnish anemometers, thermometers, gauges, voltmeters, ammeters, tachometers and similar instruments, not part of the permanent installation, but required to record the performance of the equipment and systems.

2. Testing apparatus, not part of the permanent installation, shall remain the property of the Contractor, but made available to the Engineer.

3. Instruments used for testing shall be certified accurate to within plus or minus 0.10°F for temperature or plus or minus 0.10-in w.c. for pressure. Calibration of the instruments shall be done within 7 days of testing for this Project and henceforth every 30 days thereafter for the duration of the testing period. Certification of calibration shall be submitted to the Engineer prior to starting the Work.

2.02 TESTING REPORTS

A. Forms: Furnish test report data on 8-1/2-in by 11-in bond AABC or NEBB form paper. Submit format for recording data and receive approval prior to use. Electronic submission shall be in Adobe pdf format.

B. Reports shall be Excel spreadsheets format and shall be submitted in both hard copy and as a data file.

C. The report shall contain the following general data in a format selected by the balancing agency:

1. Project number
2. Contract number
3. Project title
4. Project location
5. Project architect
6. Project mechanical Engineer
7. Test and balance agency
8. Test and balance Engineer
9. General Contractor
10. Mechanical Subcontractor
11. Dates tests were performed
12. Certification

D. At a minimum, the report shall include:

1. Preface. A general discussion of the systems, any abnormalities, and problems encountered.
2. Instrumentation list. The list of instruments including type, model, manufacturer, serial number, and calibration dates.
3. System Identification. In each report, the VAV boxes, zones, supply, return and exhaust openings and traverse points shall be numbered and/or lettered to correspond to the numbers and letters used on the report data sheets and on the report diagrams.

E. Prepare 11-in by 17-in single line diagrams or 12-in by 18-in half size Drawings showing all duct systems indicating all terminal air outlets including diffusers, grilles and registers, perforated plates, nozzles and other types of air supply, exhaust or return outlets. The minimum scale for diagrams showing the measurement points shall be 1/8-in=1-ft-0-in in the final form as submitted. The use of faxed copies of diagrams is not acceptable. Location of test points shown on the diagrams shall be clear and easy to locate on the diagram. The identification mark of the test points shall be the same as is shown on the test report showing the test data. The identification for test points shall include indication of the units served, and shall

not have a duplicate in the Project. All supply outlets shall be adjusted so that there are no drafts. Grille and register readings may be made by a vane anemometer, but diffuser readings shall be made by a flow hood or a velometer, using the tip recommended by the diffuser manufacturer. Each test sheet shall include the following data:

1. Job name and address
2. Name of HVAC Contractor
3. Name of balancing organization
4. Instruments used to perform the test
5. Name of test technician or test Engineer
6. Fan system and/or zone number
7. Room number or area name
8. Size of outlet
9. Type outlet
10. Manufacturer of outlet
11. The cfm at each outlet on system and corresponding cfm at each outlet as noted on the plans.
12. Percent deviation of the measured flow versus the design flow.
13. Indication of the branch and terminal that are the open/low that are the basis for balancing the remainder of the system.

PART 3 – EXECUTION

3.01 INSPECTIONS

A. During construction, the balancing agency shall inspect the installation of pipe systems, sheet metal Work, temperature controls, and other component parts of the heating, ventilating, and air conditioning systems. The inspections shall be performed periodically as the Work progresses. A minimum of two inspections are required as follows: (1) when 60 percent of the ductwork is installed: (2) when 90 percent of the equipment is installed. The Balancing Agency shall submit a brief written report of each inspection to the Engineer.

3.02 START OF BALANCING

A. The general Contractor shall notify the Balancing Organization and Engineer when systems become operational and ready for preliminary and final testing, adjusting, and balancing.

B. Final balancing shall not begin until system has been installed complete and is capable of normal operation. Provide personnel to assist in rough balance and calibration.

C. All grilles, dampers, fans, coils, pumps, valves, and linkages shall be verified to be installed and operating.

D. System shall be capable of operating under control as specified on Drawings and/or contained herein.

E. Verify with straight edge that fan/pump and motor shafts are parallel and that sheaves are in proper alignment.

F. Verify that belts are properly tensioned when unit is operating with no excessive squeal at startup. If not correct, adjust sheaves or motor base accordingly.

G. Start fans and pumps, verify that rotation is correct. If rotation is incorrect, coordinate with electrical Contractor to switch power leads such that the motor rotates correctly.

H. Check nameplate voltage on motor, compare to scheduled voltage. Notify the Engineer immediately of any discrepancies. Measure and record actual voltage across all power leads. Notify the Engineer of discrepancies immediately.

I. Check motor nameplates full load amps, measure and record amperage across all power leads. If there are marked discrepancies in amperage draws between legs, notify the Engineer immediately.

J. Measure and record fan/pump and motor rpm. Check, that motor rpm agrees with nameplate and scheduled rpm.

K. If, upon commencing the Work, the Balancing Contractor finds that the systems are not ready, or if a dispute occurs as to the readiness of the systems, the balancing agency shall request an inspection to be made by the Engineer. This inspection shall establish to the satisfaction of the represented parties whether or not the systems meet the basic requirements for testing and balancing. Should the inspection reveal the notification to have been premature, all costs for the inspection and Work previously accomplished by the balancing agency shall be paid for by the general Contractor. Furthermore, such items that are not ready for testing and balancing shall be completed and placed in operational readiness before testing and balancing services shall be recommenced.

L. Leaks, damage and defects discovered or resulting from startup, testing and balancing shall be repaired or replaced to like-new condition with acceptable materials. Tests shall be continued until system operates without adjustments or repairs.

3.03 REQUIRED ACCURACY

A. Systems shall be balanced to be within the following limits of the capacity shown on the Drawings. Limits shall be applied to both individual components and to the system totals.

B. General Systems (plus/minus 10 percent)

3.04 TESTING

A. HVAC Air Systems

1. Balance the supply return and exhaust air systems in accordance with AABC or NEBB Standards by the use of direct reading instruments such as an "AnemoTherm" or velometer, which has been properly calibrated.

2. Temporarily add static pressure to the system, to simulate the effect of dirty filters, by blanking off portions of the filter section, covering filter section with cheesecloth or other suitable means. Confirm static has been added with new static pressure reading across fan. Remove cheesecloth, etcetera, after traverses are complete.

3. If so instructed by the Engineer, further balancing of temperature shall be made either by thermometer or by temperature recorder.

4. The sequence of air balancing shall be as follows:

a. First, establish airflow quantity at supply fan by main duct traverse.

b. Next, establish airflow quantities in main ducts and branches.

c. Finally, establish airflow quantities at outlets, using proportional balancing among branch outlets. All multiple opening systems shall be left with at least one "open low" inlet or outlet, to which all other system openings shall be proportionally balanced. The "open low(s)" on each system shall be indicated in the report.

d. After all outlets are adjusted to within the tolerances specified elsewhere in this Section, re-measure all system outlets, and re-traverse all branch and main ducts to establish final "as balanced" flows.

e. All main air ducts shall be traversed, using a Pitot tube and manometer. The manometer shall be calibrated to read two significant figures in all velocity pressure ranges. The static pressure

reading at the traverse point shall be recorded for each successive traverse.

1) A main duct is defined as either of the following:

a) A duct emanating from a fan or plenum

b) All other ducts are branch ducts

2) The intent of this operation is to measure by traverse, the total air quantity handled by the fan and to verify the distribution of air to zones and to adjust system pressure to minimum level required to satisfy the farthest air outlet.

f. Adjust fan speeds if results of system capacity tests are not within tolerances specified and repeat Paragraphs 3.04A4c, d and e above, as required.

g. Mark all final balancing damper positions with a permanent marker.

h. For systems which modulate between different flow modes (e.g. minimum outside air to 100 percent outdoor air or 100 percent return air to 100 percent exhaust) measure and report system flow under both extremes of modulation and check for excessive system flow deviation above design, when system is modulating between its end points.

5. Furnish data in excel spreadsheet format tabulating the following:

a. Opening number, type, size, and design flow rate

b. Quantity of air in cfm at each air outlet and inlet

c. Dry bulb temperature in each room

d. Dry bulb temperature of the supply air

e. Outdoor dry and wet bulb temperature at the time the above tests are conducted. (Wet bulb temperature only required for AC systems)

6. Adjust belts, sheaves and the alignment of air handling equipment.

7. Where various combinations of sheaves must be installed on fan systems to achieve the correct air delivery, change the sheaves, and continue to take successive readings until the correct combinations are installed.

8. Furnish data in excel spread sheet format taken at each air moving device, to include fans, packaged units and air handling units, tabulating the following:

a. Manufacturers, model number and serial number of units

b. All design and manufacturer's rated data

c. Total quantity of supply air in cfm

d. Total quantity of return air in cfm

e. Total quantity of exhaust or relief air in cfm

f. Total quantity of outside air in cfm

g. Outlet velocity - fpm

h. The rpm of each fan or blower

i. Maximum tip speed - fpm

j. The rpm of each motor

k. Voltage and ampere input of each motor (one reading for each phase leg on 3 phase motors).

l. Pressure in inches w.g. at inlet of each fan or blower.

m. Pressure in inches w.g. at discharge of each fan or blower.

n. Pressure drops across system components such as louvers, filters, coils, and mixing boxes.

o. Submit the actual fan operating point on a copy of the fan Shop Drawing showing operating curve.

p. List the following data from all fan motors installed.

1) Manufacturer model and size

2) Motor horsepower, service factor, and rpm

3) Volts, phases, cycles and full load amps

4) Equipment locations

3.05 FINAL ACCEPTANCE

A. At the time of final inspection, the balancing agency shall recheck, in the presence of the Engineer, specific and random selections of data recorded in the certified test-and-balance report.

B. Points and areas for recheck shall be selected by the Engineer.

C. Measurements and test procedures shall be the same as the original test and balance.

D. Selections for recheck, specific plus random, shall not normally exceed 15 percent of the total number tabulated in the report, except where special air systems require a complete recheck for safety reasons.

E. If the specific rechecks are more than 5 percent deviation from the report or specified flows, all of the systems, that require specific recheck, shall be rebalanced. If 5 percent or five of the random checks, whichever is less, exceeds a

10 percent deviation from the specified flows, the report shall be rejected. In the event the report is rejected, all systems shall be readjusted and tested, new data recorded, a new certified test-and-balance report submitted, and a new inspection test made, all at no additional cost to the Owner.

END OF SECTION

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SECTION 23 07 00

HVAC INSULATION

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes

1. Piping Systems Insulation:

a. Fiberglass for all copper pipes.

2. Protective saddles, shields, and thermal hanger shields.

B. Related Sections

1. Division 23, Section 23 05 00 COMMON WORK RESULTS FOR HVAC

2. Division 22 - Plumbing

1.02 REFERENCES

A. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

1. ASTM C 547 Specification for Mineral Fiber Preformed Pipe Insulation

2. ASTM C 553 Specification for Mineral Fiber Blanket and Felt Insulation (Industrial Type)

3. ASTM C 612 Specification for Mineral Fiber Block and Board Thermal Insulation

4. ASTM C 921 Practice for Determining the Properties of Jacketing Materials for Thermal Insulation

5. ASTM E 84 Test Method for Surface Burning Characteristics of Building Materials

1.03 SUBMITTALS

A. Submit in accordance with Division 01 General Requirements.

B. Manufacturer's technical product data and installation instructions for each type of mechanical insulation. Submit schedule showing manufacturer's product number, K-value, thickness, and furnished accessories for each mechanical system requiring insulation.

C. Manufacturer's sample of each piping insulation type required, and of each duct and equipment insulation type required. Affix label to sample completely describing product.

1.04 QUALITY ASSURANCE

A. Manufacturer's Qualifications - Firms regularly engaged in manufacture of mechanical insulation products, of types and sizes required, whose products have been in satisfactory use in similar services for not less than 3 years.

B. Installers' Qualifications - Firm with at least 5 years successful installation experience on Projects with mechanical insulations similar to that required for the Project.

C. 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 E 84 (NFPA 255) method.

1. Exception - Industrial mechanical insulation that will not affect life safety egress of building may have flame spread index of 75 and smoke developed index of 150.

1.05 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, chemical and mechanical damage. Do not install damaged or wet insulation; remove from Project Site.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. Manufacturer - Subject to compliance with requirements, provide products of one of the following or an approved equal:

1. Knauf Fiber Glass GmbH.

2. Manville Products Corp.

3. Owens-Corning Fiberglass Corp.

4. Childers Products Co.

5. Specialty Products and Insulation Co.

2.02 MATERIALS

A. Piping Insulation

B. Fiberglass Piping Insulation - ASTM C 547, Class 1 for all metallic piping.

C. Jackets for Piping Insulation - ASTM C921, Type I for piping with temperatures below ambient, Type II for piping with temperatures above ambient. Type I may be used for all piping at Installers option.

a. Encase pipe fittings insulation with one-piece premolded PVC fitting covers, fastened as per manufacturer's recommendations.

b. Encase exterior piping insulation with aluminum jacket with weather-proof construction.

2. Piping Insulation Accessories - Provide staples, bands, wires, and cement as recommended by insulation manufacturer for applications indicated.

D. Piping Insulation Compounds - Provide adhesives, sealers, and protective finishes as recommended by insulation manufacturer for applications indicated.

E. Equipment Insulation Materials

1. Jacketing Material for Equipment Insulation – Provide pre-sized glass cloth jacketing material, not less than 7.8 ounces per square yard, or metal jacket at Installer’s option, except as otherwise indicated.

2. Equipment Insulation Compounds – Provide adhesives, cements, sealers, mastics and protective finishes as recommended by insulation manufacturer for applications indicated.

3. Equipment Insulation Accessories – Provide staples, bands, wire, wire netting, tape, corner angles, anchors and stud pins as recommended by insulation manufacturer for applications indicated.

PART 3 – EXECUTION

3.01 EXAMINATION

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.

3.02 APPLICATION

A. HVAC Piping

1. Omit insulation on chrome-plated exposed piping (except for handicapped fixtures), air chambers, unions, strainers, check valves, balance cocks, flow

regulators, drain lines from water coolers, drainage piping located in crawl spaces or tunnels, buried piping, fire protection piping, and pre-insulated equipment.

2. Cold Piping

a. Application Requirements - Insulate the following cold plumbing piping systems:

1) Potable cold water piping including boiler make-up water pipe

b. Insulate each piping system specified above with one of the following types and thicknesses of insulation:

1) Fiberglass – 1 inch thickness

2) Expanded Foam – 1 inch thickness

3.03 INSTALLATION

A. General

1. 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. Piping Insulation

1. Install insulation on pipe systems subsequent to installation of heat tracing, painting, testing, and acceptance of tests.

2. Install insulation materials with smooth and even surfaces. Insulate each continuous run of piping with full-length units of insulation, with a single cut piece to complete run. Do not use cut pieces or scraps abutting each other.

3. Clean and dry pipe surfaces prior to insulating. Butt insulation joints firmly together to ensure a complete and tight fit over surfaces to be covered.

4. Maintain integrity of vapor-barrier jackets on pipe insulation, and protect to prevent puncture or other damage.

5. Cover valves, fittings and similar items in each piping system with equivalent thickness and composition of insulation applied to adjoining pipe run. Install factory molded, precut or job fabricated units (at Installer's option) except where specific form or type is indicated.

6. Extend piping insulation without interruption through walls, floors and similar piping penetrations, except where otherwise indicated.

7. Butt pipe insulation against pipe hanger insulation inserts. For hot pipes, apply 3-inch wide vapor barrier tape or bank over the butt joints. For cold piping apply wet coat of vapor barrier lap cement on butt joints and seal joints with 3-inch wide vapor barrier tape or band.

3.04 REPAIR/RESTORATION

A. Replace damaged insulation which cannot be repaired satisfactorily, including units with vapor barrier damage and moisture saturated units, at no additional cost to the Owner.

3.05 PROTECTION

A. The Contractor shall provide the required protection for insulation Work during remainder of construction period, to avoid damage and deterioration.

END OF SECTION

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SECTION 23 30 00

HVAC AIR DISTRIBUTION

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes

1. Ceiling Air Diffusers and Grilles

2. Wall Registers and Grilles

3. Other air devices indicated on Drawings and schedules.

1.02 RELATED SECTIONS

A. Division 23, Section 23 05 00 COMMON WORK RESULTS FOR HVAC

B. Division 23, Section 23 31 13 METAL DUCTS

C. Division 23, Section 23 05 93 TESTING, ADJUSTING AND BALANCING FOR HVAC

1.03 QUALITY ASSURANCE

A. Manufacturer's Qualifications - Firms regularly engaged in manufacture of air outlets and inlets 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 outlets and inlets 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".

3. ADC Compliance - Test and rate air outlets and inlets in certified laboratories under requirements of ADC 1062 "Certification, Rating and Test Manual".

4. ADC Seal - Provide air outlets and inlets bearing ADC Certified Rating Seal.

5. AMCA Compliance - Test and rate louvers in accordance with AMCA 500 "Test Method for Louvers, Dampers and Shutters".

6. AMCA Seal - Provide louvers bearing AMCA Certified Rating Seal.

7. NDPA Compliance - Install air outlets and inlets in accordance with NFPA 90A "Standard for the Installation of Air Conditioning and Ventilating Systems".

1.04 SUBMITTALS

A. Schedule of air outlets and inlets indicating drawing designation, room location, number furnished, model number, size, and accessories furnished.

B. Data sheets for each type of air outlet and inlet, and accessory furnished; indicating construction, finish, and mounting details.

C. Performance data for each type of air outlet and inlet furnished, including aspiration ability, temperature and velocity traverses; throw and drop; and noise criteria ratings. Indicate selections on data.

D. Manufacturer's assembly-type shop drawing for each type of air outlet and inlet, indicating materials and methods of assembly of components.

E. Maintenance data, including cleaning instructions for finishes, and spare parts lists. Include this data, product data, and Shop Drawings in maintenance manuals.

1.05 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Deliver air outlets and inlets wrapped in factory-fabricated fiber-board type containers. Identify on outside of container type of outlet or inlet and location to be installed. Avoid crushing or bending and prevent dirt and debris from entering and settling in devices.

B. Store air outlets and inlets 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

2.01 ACCEPTABLE MANUFACTURER'S

A. Titus Company

B. MetalAire Industries, Inc.

C. Nailor Industries

D. Krueger

E. Or Engineer's Approved Equal

2.02 GENERAL DESCRIPTION

A. Unless otherwise indicated, provide manufacturer's standard air devices of size, shape, capacity, type and accessories as indicated on Drawings and schedules, constructed of materials and components as indicated and as required for complete installation and proper air distribution.

B. Provide air devices that have, as minimum, temperature and velocity traverses, throw and drop, and noise criteria ratings for each size device and listed in manufacturer's current data.

C. Unless noted otherwise on Drawings, the finish shall be grey. The finish shall be an anodic acrylic paint, baked at 315˚F for 30 minutes. The pencil hardness must be HB to H. The paint must pass a 100 hour ASTM D117 Corrosive Environments Salt Spray Test without creepage, blistering, or deterioration of film. The paint must pass a 250 hour ASTM-870 Water Immersion Test. The paint must also pass the ASTM D-2794 Reverse Impact Cracking Test with a 50 inch pound force applied.

D. Provide air device with border styles that are compatible with adjacent ceiling or wall system, and that are specially manufactured to fit into the wall construction or ceiling module with accurate fit and adequate support. Refer to architectural Drawings and Specifications for types of wall construction and ceiling systems.

E. Provide integral volume damper with roll formed steel blades where indicated on the Drawings or schedules. Dampers shall be opposed blade design with a screw driver slot or a concealed lever operator for adjustment through the face of the air device.

F. Air devices designated for fire rated systems shall be pre-assembled with UL classified radiation damper and thermal blanket. Fire rated air devices shall be shipped completely assembled; one assembly per carton. Each assembly shall be enclosed in plastic shrink wrap with installation instructions.

PART 3 – EXECUTION

3.01 INSPECTION

A. Examine areas and conditions under which air outlets and inlets are to be installed. Do not proceed with Work until unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. General - Install air outlets and inlets in accordance with manufacturer's written instructions and in accordance with recognized industry practices to ensure that products serve intended function.

B. Coordinate with other Work, including ductwork and duct accessories, as necessary to interface installation of air outlets and inlets with other Work.

END OF SECTION

SECTION 23 31 13

HVAC DUCTS

PART 1 – GENERAL

1.01 SCOPE OF WORK

A. Furnish, fabricate and install all ductwork, including fittings, accessories, dampers, hangers and any incidental Work or components required to provide complete air supply, return and exhaust ductwork systems as shown on the Drawings and as specified herein.

B. Design, furnish and install seismic restraints and braces for all ductwork and accessories.

C. In general, ductwork shall consist of any passageway made of sheet metal or other material substantially air tight, used for the conveying of air, gas or materials. Included are fittings, transitions, bracing, fasteners, sealers, supports and accessories such as access panels, access doors, turning vanes and manual air balancing dampers. All ductwork shall be of size and material as specified herein and as shown on the Drawings. All duct sizes indicated on the Drawings are clear, inside dimensions. Where ductwork is lined with fiberglass, duct sizes shown on the Drawings are clear, inside dimensions to the duct liner material.

D. Any change in duct sizes, offsets, transitions and fittings required to accommodate job conditions shall be submitted to the Engineer for approval.

E. The following Work descriptions are not intended to in any way limit the above broad statement, but are intended as a more specific mention of the most important items included therein.

F. All ductwork, piping, and equipment shown on the Drawings is intended to be approximately correct to scale, but figured dimensions and detailed Drawings of the actual equipment furnished shall be followed in every case. The Drawings shall be taken in a sense as diagrammatic. Size of ductwork and piping are shown, but it is not the intent to show every offset or fitting, nor every hanger or support, or structural difficulty that may be encountered. To carry out the intent and purpose of the Drawings all necessary parts to make a complete working system ready for use shall be furnished without extra charge. The Contractor shall be Responsible to coordinate the system installation and routing with the Work of all trades.

1.02 RELATED WORK

A. Cutting, coring and patching for all HVAC Work in accordance with Division 01 General Requirements and Section 23 05 00 COMMON WORK RESULTS FOR HVAC.

B. Trenching, excavation and backfill is included in Division 31 except for items specified herein.

C. Concrete Work is included in Division 03 except for required HVAC anchor bolts, sleeves and templates, which shall be furnished under this Section.

D. Structural steel and miscellaneous metal is included in Division 05 except for supplementary steel required for HVAC hangers, equipment supports, anchors and guides, which shall be furnished under this Section.

E. Flashing and counterflashing is included in Division 07 except for items specified herein.

F. Painting is included in Division 09 except for factory finished HVAC equipment, HVAC shop painting and HVAC identification labeling and as required in Paragraph 3.14 below.

1.03 SUBMITTALS

A. Submit, in accordance with Division 01 General Requirements the following Drawings and data.

1. Detailed equipment and ductwork Drawings at a minimum scale of 1/4 in = 1-ft-0-in. Site layout Drawings and roof plans may be submitted at scales smaller than 1/4 in = 1-ft-0-in, subject to Engineer's prior approval. Drawings shall locate ductwork accessories including manual, automatic and fire dampers. Ratings of fire dampers shall be shown. Drawings shall also show and dimension maintenance clear spaces for motors, drives, coils, filters and access doors or panels. Indicate ductwork pressure class used for fabrication.

2. Standard shop and field installation details for transitions, elbows, takeoffs, discharge nozzles, turning vanes, access panels and doors, volume control and splitter dampers, hangers and volume extractors. When SMACNA references are used, the specific methods for the Project shall be clearly defined. Where SMACNA has more than one option, the option to be used shall be indicated.

3. Ductwork materials, joining methods, reinforcing and material gauges. Where options are allowed by SMACNA, the proposed option shall be clearly defined. Indicate proposed materials and methods for ductwork and equipment hangers.

4. For units that will be shipped exposed, provide a description of the protective packaging that will be used during transit.

5. All submittals shall contain a statement that Sections 23 05 00 COMMON WORK RESULTS FOR HVAC and all other referenced Sections have been

read and complied with. The certification statement shall be made by all of the following that are applicable; the Contractor, Subcontractor and the vendor. The statement shall be an individual statement for each party involved, and shall be included with every submittal and resubmittal.

B. In general, corrections or comments or lack thereof, made relative to submittals during review shall not relieve the Contractor from compliance with the requirements of the Drawings and Specifications. Submittals are for review of general conformance with the design concepts of the Project and general compliance with the Contract Documents. The Contractor is Responsible for the final design conforming and correlating all quantities and dimensions, selecting fabrication processes and techniques of construction, coordinating the Work of all trades, and performing the Work in a safe and satisfactory manner.

1.04 REFERENCE STANDARDS

A. These standards shall be considered as minimum requirements. This is a general list and not all standards listed are necessarily referenced elsewhere in this Section. Specific requirements of this Section and/or Drawings shall have precedence. The Engineer shall resolve conflicts between published requirements.

B. Titles and abbreviations of Federal, State and industry standards, technical societies, associations and institutes and other organizations which may be used are as follows:

1. AMERICAN CONFERENCE OF GOVERNMENTAL INDUSTRIAL HYGIENISTS (ACGIH)

2. AIR MOVEMENT AND CONTROL ASSOCIATION (AMCA)

3. AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

4. AIR CONDITIONING AND REFRIGERATION INSTITUTE (ARI)

5. AIR DIFFUSION COUNCIL (ADC)

   a. ADC 1062 R4 Certification, Rating and Testing Manual

6. AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR CONDITIONING ENGINEERS (ASHRAE)

   a. ASHRAE 68 Laboratory Method of Testing In Duct Sound Power Measurement Procedure for Fans.

7. AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

8. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

   a. ASTM A65 Standard Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc-Iron, Alloy-Coated (Galvannealed) by the Hot Dip Process

   b. ASTM D1784 Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds

   c. ASTM E84 Standard Test Method for Surface Burning Characteristics of Building Materials

9. FACTORY MUTUAL (FM)

10. NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY (NBS)

11. NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

   a. NFPA 90A Standard for the Installation of Air Conditioning and Ventilating Systems

   b. NFPA 255 Standard Method of Test of Surface Burning Characteristics of Building Materials

12. OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION (OSHA)

13. SHEET METAL AND AIR CONDITIONING CONTRACTORS NATIONAL ASSOCIATION (SMACNA)

14. UNDERWRITERS LABORATORIES (UL)

   a. UL 723 UL Standard for Safety Test for Surface Burning Characteristics of Building Materials

C. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.05 QUALITY ASSURANCE

A. Inspection by the Engineer's representative or failure to inspect shall not relieve the Contractor of responsibility to provide materials and perform the Work in accordance with the Contract Documents.

B. The Owner and Engineer reserve the right to sample and test any materials after delivery and to reject all components represented by a sample that fails to comply with the specified requirements.

1.06 DELIVERY, STORAGE AND HANDLING

A. All materials shall be inspected for size, quality and quantity against approved Shop Drawings upon delivery.

B. Delivery schedule of all equipment shall be coordinated with the Contractor. Equipment ready for shipment prior to the agreed on shipping date shall be stored without cost to the Owner by the manufacturer.

C. All materials shall be suitably packed for shipment and long term storage. Each package shall be labeled to indicate the Project and the contents of each package. Where applicable, equipment numbers shall be marked on the container.

D. All equipment shipped that is exposed such as on a flat-bed truck shall be protected during transit. The equipment shall be protected from moisture, road salt, dirt and stones or other materials thrown up from other vehicles. Electrical components shall be protected as above, but with special attention to moisture. The method of shipment protection shall be defined in the submittals.

E. All materials shall be stored in a covered dry location off of the ground. When required to protect the materials they shall be stored in a temperature-controlled location.

1.07 SPARE PARTS

A. Spare parts shall include all special items on the manufacturer's standard list of spare parts

B. In addition to special items, the following spare parts shall be provided:

1. Furnish all special tools required for normal operation and proper servicing of the equipment.

2. Provide a minimum of 1 or 5 percent of the total units rounded to the next full unit whichever is greater for each size and rating of the following components.

a. Thermostats

b. Control relays

c. Damper operators

C. Pack spare parts in containers suitable for extended storage without deterioration of the parts. Containers shall be clearly labeled designating contents, pieces of equipment for which intended and equipment identification numbers.

1.08 DEFINITIONS

A. Particular terminology used under this Section is defined as follows:

1. Traffic Level and Personnel Level: Areas, including process areas, equipment rooms, boiler rooms and other areas where insulation may be damaged by normal activity and local personnel traffic. Area extends vertically to 8-ft above floor, walkways, platforms and stairs, and horizontally 3-ft beyond the edge of walkways, platforms, and stairs.

2. Exposed Piping and Ductwork: Piping and ductwork visible from the floor level and includes all piping and ductwork in equipment rooms, boiler rooms, etc.

3. Supply Air Ductwork: Ductwork carrying air from a fan or air handling unit to the space or spaces to which it will be introduced. This air may have been heated or cooled or in the case of ventilation system the air would be neither heated nor cooled. Supply air ductwork extends from the fan or air handling unit to the registers, grills or diffusers at the end of the ductwork.

4. Exhaust Air Ductwork: Ductwork carrying air from a space to a fan and then to be discharged to the outdoors. Exhaust air ductwork extends from the registers or grills at the end of the ductwork to the fan. From the fan the exhaust ductwork extends to the discharge point, exhaust air damper, or exhaust air plenum, whichever comes first.

5. Outdoor Air Ductwork: Ductwork carrying untreated air from the outside to a fan or air handling unit. Outdoor air ductwork starts at the intake point, outdoor air damper, or outdoor air plenum, whichever comes last. The outdoor air ductwork extends to the fan, air handling unit, or connection with a return air duct, whichever comes first.

6. Outdoor Air Plenum: A plenum that extends from the opening in the skin of the structure to the outdoor air duct. If the outdoor air damper is directly at the intake or there is no outdoor air damper, the plenum will extend to the first size reduction. If the outdoor air damper is not at the intake, the plenum will extend to the outdoor air damper.

7. Ventilated Spaces: Areas supplied with outdoor air on a continuous or intermittent basis. The outdoor air may be heated and/or cooled or untreated.

8. Heated Spaces: Areas where heat is supplied to maintain a minimum temperature during the heating season.

9. Non Conditioned Spaces: Areas that are not provided with mechanical cooling.

10. Thermal Conductivity: The rate of heat flow through unit area of a homogeneous substance under the influence of unit temperature gradient in the direction perpendicular to the area. Units BTU per (hour) (sq ft) (degrees F temperature difference) (per inch thickness).

11. Indoor Ductwork: Ductwork within a building that is not exposed to the weather.

12. Outdoor Ductwork: Ductwork that is not within a building and is exposed to the weather.

13. Flues/Stacks/Breeching: Ductwork carrying products of combustion to atmosphere.

1.09 COORDINATION

A. The Drawings indicate the extent and general arrangement of the systems. If any departures from the Drawings or Specifications are deemed necessary, details of such departures and the reasons therefore shall be submitted as soon as practical for review. No such departures shall be made without the prior written concurrence of the Engineer.

B. The Contractor shall coordinate the location and placement of all concrete inserts and welding attachments with the structural Engineer.

C. The Contractor shall assume full responsibility for coordination of the HVAC systems, including; scheduling, and verification that all structures, ducts, piping and the mounting of equipment are compatible.

D. The Contractor shall not install any equipment or materials until the Owner and Engineer have approved all submittals. If any equipment or materials are installed prior to approval of the submittals, it shall be at the Contractor's risk.

PART 2 – PRODUCTS

2.01 VIBRATION ISOLATION FOR DUCTWORK

A. Flexible fabric connectors for vibration isolation shall be airtight, watertight, fire retardant, 6 in wide with 3-in metal edges. Metal edges and fasteners shall be the same material or greater corrosion resistance as the duct.

1. Flexible connections for conventional indoor HVAC systems shall be glass fabric coated with polychloroprene. Fabric must comply with Underwriters Laboratories Standard UL214 and NFPA Bulletin 90A. Connections shall be Ventglas by Ventfabrics or equal.

2. Flexible connection for outdoor conventional HVAC systems ductwork shall be glass fabric coated with DuPont Hypalon Fabric and must be

resistant to sunlight, ozone and weather. Fabric must comply with Underwriters Laboratories Standard UL214 and NFPA Bulletin 90A. Connection shall be Ventlon by Ventfabric or equal.

B. Furnish flexible connectors at each inlet and outlet of fan where called for on the Drawings. Flexible connections shall be integrally flange molded arch type units constructed of EPDM rubber 1/4-in thick, reinforced with a strong synthetic asbestos-free fabric suitable for corrosive service. The flexible connections shall be designed to minimize the transmission of vibration from the fans to the ductwork at the suction and discharge connections. Expansion or Contractor flexible connections shall be designed to allow 1-in movement. Working length or "live" length shall be as designed by the manufacturer to allow up to 1-in of movement. Ends shall be flanged, with flanges matching duct connection flanges. Corners on rectangular expansion joints shall be molded and free of patches or splices. The flexible connections shall be suitable for outdoor service and temperature ranges from minus 10 up to 125°F, and pressure to 5 psig. Specially fabricated split Type 316 stainless steel retaining back-up bars shall be supplied to prevent damage to the EPDM rubber flanged with Type 316 stainless steel bolts are tightened.

C. Manufacturer

1. Holz Rubber Company

2. Mercer Rubber Company

3. Proco Products Incorporated

2.02 FLAME AND SMOKE RATINGS

A. All materials, including adhesives, surface coatings, sealers, assemblies of several materials, insulation, jacketing, finish, etc, shall have flame spread ratings not over 25 (fire resistive) and smoke development ratings not over 50 and fuel contributed rating not over 50, as established by tests conducted in accordance with the Federal Standard 00136B, National Bureau of Standards Radiant Energy Fire Test and the National Fire Code of the NFPA.

B. These requirements apply to all circumstances whether the materials are field applied or applied by a manufacturer in his/her shop, or elsewhere, prior to delivery to the Project.

2.03 SOUND CONTROL

A. The selection of ductwork and accessories shall be such as not to create noise that will exceed the levels of permissible noise exposures for occupational areas as established by the OSHA and other Federal, State and local safety and health standards, codes and ordinances.

2.04 HANGERS, SUPPORTS AND ANCHORS

A. Furnish supports, hangers and other devices necessary to support firmly and substantially the equipment and ductwork described in this Section. Ductwork support systems shall include restrains as required by the applicable building codes to withstand seismic loading. All equipment, ductwork, and supports that are installed outdoors shall be designed and installed to meet wind loadings as required as required by the International Mechanical Code, the New Hampshire Building Code, all other applicable codes, and the requirements specified herein.

B. Rectangular, Round and Flat Oval Ductwork Spacing and size of hangers shall be as called for in the SMACNA standards, except as limited below.

1. Rectangular ductwork 48-in wide and larger shall be supported by adjustable threaded rod hangers.

2. Round ductwork 37-in and larger shall be supported by two adjustable threaded rods at each support.

C. All hangers shall be hot dip galvanized or stainless steel to match duct material.

D. All hanger hardware and fasteners shall be hot dip galvanized or stainless steel to match duct material.

E. Perforated band iron or wire for supporting ducts shall not be permitted.

F. Where C clamp type hangers are used, furnish with a retainer strap.

G. The following methods of hanger attachment to the building structure are NOT allowed. The numbers and letters refer to hanger methods shown in Figure 4-1, 4-2 and 4-3 of the 1985 edition of the HVAC Duct Construction Standards Metal and Flexible as published by SMACNA.

1. "T"- wrap around strap on open web joist

2. "W" - bent over band on open web joist

3. "14" - friction clamps

4. "17" - bent wire in metal deck

H. Design of hangers shall include the effect of all loads applied to the duct as well as the load of the duct. These loads include, but are not limited to wind, snow and internal dirt or liquid buildup.

I. Hangers shall not be supported from roof decking or bulb tees. Where required, provide supplemental steel to span between the building structures.

2.05 DUCTWORK MATERIAL

A. Ductwork shall be constructed of the materials indicated on the Drawings using the gauges or thicknesses, reinforcing and construction methods in accordance with SMACNA standards. Unless otherwise specified, all components of the duct systems shall be constructed of the same material as the ductwork. This is to include braces and turning vanes.

1. Galvanized steel ductwork shall be constructed of hot dip galvanized sheet steel, per ASTM A653.

2. Stainless steel ductwork shall be constructed of Type 316 stainless steel.

3. PVC Ductwork shall be type 4 x 4. Gauges shall be standard SMACNA gauges for low pressure systems. Round ducts shall be roll-formed spiral pipes. Fittings shall be factory fabricated with stainless steel rivets. All fitting seams shall be caulked on the inside with PVC No. 8 duct sealer. All connecting joints are slip-fit. Apply No. 8 sealer to all raw edges and male ends. Secure joint connection by installing sheet metal screws with a minimum spacing around of 6 inches. Apply No. 8 sealer over screws and seam of joint and wrap with PVC tape. Repair any damage to the coating with PVC touch-up paint.

4. PVC ductwork and fittings shall conform to the PVC materials standard ASTM D1784 for Type I, Grade I PVC (cell classification 12454 B).

2.06 DUCTWORK CONSTRUCTION

A. All ductwork shall be substantially built with joints and seams smooth on the inside and given a neat appearance on the outside. Inside surfaces and joints shall be smooth and free from pockets, burrs and projections. All joints shall be substantially airtight with laps made in the direction of air flow and no flanges projecting into the air stream.

B. Pressure Classes

1. Pressure classes for determination of sheet metal gauge and reinforcing shall be as defined by the latest issue of the SMACNA - Industrial Duct Construction Standards.

2. For systems with fans with a shut off static pressure higher than 2 in w.g., design pressure shall be as listed in Paragraph 2.06 above. For systems with fans a shut off static pressure 2 in w.g. or less design pressure shall be equal to the maximum pressure indicated for the fans or air handling units on the Schedules and the pressure class shall be the same for the entire length, including branches, of the specific duct system.

C. Rectangular Ductwork (Sheet Metal)

1. Ductwork shall be constructed as shown on the Drawings in accordance with the specified SMACNA - Construction Standard.

2. Cross breaking shall conform to SMACNA standard. Cross breaking shall be applied to the sheet metal between the standing seams or reinforcing angles. The center of the cross break shall be of the required height to assure rigidity for each panel.

3. Alternate Construction Factory fabricated joint systems may be offered as an alternate form of construction. The system offered shall meet all requirements of SMACNA. Alternate joint systems shall be "Ductmate System" as manufactured by Ductmate Industries, Inc., installed in accordance with the manufacturer's recommendations. The system shall be sealed for zero leakage and angle attachment to the main duct section shall be by tack welding. The use of screws is not allowed.

D. Round Ductwork (Sheet Metal)

1. Ductwork shall be constructed as shown on the Drawings in accordance with the specified SMACNA - Construction Standard.

2. Round ductwork longitudinal seams shall be either lock type or continuous welded construction.

3. Slip joints shall be used on ductwork and fittings up to 36 in in diameter and Vanstone flanges shall be used on ducts over 36 in in diameter.

4. Fittings shall be fabricated with continuous welds. 90 degree elbows shall have a turning radius of 1.5 times the fitting diameter.

5. All fittings in the round duct system shall be of the male and female type. Mechanically fasten the conduits together using sheet metal screws not less than four per fitting 6 in on centers maximum and equally spaced around the circumference of fitting.

6. Round ductwork and fittings shall be manufactured by United Sheet Metal; SEMCO or equal.

2.07 DAMPERS

A. Dampers - Manual

1. Manual Volume Dampers - Provide dampers with parallel blades for 2 position controls, or opposed blades for modulating control. Construct blades of 16 gauge steel; provide heavy-duty molded self-lubricating nylon bearings, ½ inch diameter steel axles spaced on 9 inch centers. Construct

frame of 2 inches by ½ inch by 1 inch steel channel for face areas 25 sq. ft. and under; 4 inches by 1-¼ inches by 16-gauge channel for face areas over 25 sq. ft. Provide galvanized steel finish with aluminum touch-up.

2. Backdraft Dampers - Provide gravity backdraft dampers with extruded aluminum, 6063-T52 alloy, 0.081-inch thick 1 inch by 4 inches by 1 inch channel frame on all sides. Blades shall be extruded aluminum of same material and thickness. Seals shall be extruded silicone rubber leg at blade edges and expanded polyurethane on jambs. Shafts shall be ½ inch diameter extruded aluminum, pin-lock design. Bearings shall be oilite bronze with linkage installed in jamb out of the airstream. Counterbalance shall be mounted externally on extended shaft and assist opening.

3. Manufacturer - Subject to compliance with requirements, provide dampers of one of the following or an approved equal:

   a. Ruskin Mfg. Co.

   b. Arrow Louver and Damper; Div. of Arrow United Industries, Inc.

   c. Louvers & Dampers, Inc.

   d. Or Engineer's Approved Equal

B. Dampers – Automatic

1. Rectangular Automatic Control Dampers

   a. Provide control dampers that meet the following minimum construction standards: Frame shall be 16 gauge galvanized steel structural hat channel with tabbed corners for reinforcement. The blades shall be single skin, 16 gage galvanized steel with three longitudinal grooves for reinforcement. Blade edge seals shall be PVC coated polyester fabric suitable for -25°F to +180°F (-32°C to +83°C) mechanically locked into the blade edge. Adhesive or clip-on type seals are unacceptable. Jamb seals shall be flexible metal, compression type to prevent leakage between blade end and damper frame. Blade end overlapping frame is unacceptable. Bearings shall be corrosion resistant, molded synthetic sleeve type turning in an extruded hole in the damper frame. Axles shall be hexagonal positively locked into the damper blade. Linkage shall be concealed out of airstream, within the damper frame to reduce pressure drop and noise. Submittal must include leakage, pressure drop, maximum velocity and maximum pressure data based on AMCA Publication 500. Dampers shall be equipped with factory installed damper position indication switch package. The switch package shall include two position indication switches linked directly to the damper blade to provide full open and full closed damper blade position. The switch package shall provide the capability to

interface with the HVAC control system and provide remote damper blade position status.

b. Dampers shall have 120VAC direct coupled, spring return damper actuators, manufactured by the same manufacturer as the dampers. Control shall be fully open/fully closed from an auxiliary contact. The actuators shall have true spring return operation for reliable fail-safe operation and positive close off. Actuator shall be spring close, power open.

c. Manufacturer – Subject to compliance with requirements, provide dampers or an approved equal by:

1) Ruskin Mfg. Co.

2) Arrow Louver and Damper; Div. of Arrow United Industries, Inc.

3) Louvers & Dampers, Inc.

4) Or Engineer's Approved Equal

2.08 FASTENERS

A. Sheet metal screws, drive cleats, cinch bands and other fasteners shall be fabricated from stainless steel.

2.09 LABELS

A. The service of each duct along with and arrow indicating direction of flow shall be provided on each duct system. Labels shall be located not more than 26 linear feet apart and shall also be provided at both sides of wall penetrations, at each damper, and each equipment connection.

B. Labels shall contain the service spelled out, the duct size, and the equipment number of the equipment served. Label locations shall have unobstructed view from normal viewing locations.

C. Numbers and letters shall be die-cut from 3.5 mil vinyl film and pre-spaced on carrier film. Adhesive and finish shall be protected with one-piece removable liners. Colors shall be white letters on black backgrounds.

D. The system for preparation and application of letters shall be Type B a.s.i. /2 by ASI Sign Systems; Architectural Graphics Inc. or equal. Letters shall be 3-in high Optima Bold, upper case using Grid 2 spacing. Direction arrows are to match. The instructions of the manufacturer shall be followed in respect to storage, surface preparation and application of letters.

E. Each piece of equipment is to be provided with an identification label listing the unit number and the areas served. Labels shall be as specified above.

PART 3 – EXECUTION

3.01 INSTALLATION OF DUCTWORK

A. Fabricate and erect all ductwork where shown on the Drawings, as specified herein, and in accordance with SMACNA standards. Rigidly support and secure ductwork.

B. The Contractor shall not install any equipment or materials until the Owner and Engineer have approved all submittals. If any equipment or materials are installed prior to approval of the submittals, it shall be at the Contractor's risk.

C. Wherever ducts are divided, maintain the cross sectional area. All such changes must be approved and installed as directed by the Engineer or as approved on shop or erection Drawings.

D. During installation, temporarily close the open ends of ducts to prevent debris and dirt from entering. Install Work in accordance with the overall approved Progress Schedule and in cooperation with all other trades so there will be no delay to other trades.

E. Cross break sheet metal in accordance with SMACNA duct construction standard. Apply cross breaking to the sheet metal between the standing seams or reinforcing angles. The center of the cross break shall be of the required height to assure each panel section being rigid.

F. Beading as specified in SMACNA will be acceptable in lieu of cross breaking.

G. The Drawings of the air ducts and air risers show the general location for installation of the ducts and risers. Should additional offsets or changes in direction be made, these changes must be considered in the original bid and shall be installed at no additional cost to the Owner.

H. All necessary allowances and provisions shall be made in the installation of the ducts for the structural conditions of the building. Ducts shall be transformed or divided as may be required. Wherever this is necessary, maintain the cross sectional area. All of these changes, however, must be approved and ducts installed as directed by the Engineer or as approved on shop or erection Drawings.

I. The taper of all transformations shall be not more than 15 degrees.

J. Secure casing to curbs according to SMACNA "Duct Construction Standards."

K. Where ducts are constructed of materials other than galvanized steel the reinforcing members shall be of the same material as the ductwork.

L. The use of button punching or snap locks on ductwork constructed of aluminum shall not be permitted.

M. Ducts carrying moist air that pass through areas that could cause condensation shall be pitched to facilitate condensate removal. Low points of such ducts shall be provided with drains.

N. Ductwork connections to units that require corrosion resistant coatings shall be made with flanges. Flanges shall be factory drilled before coating. Resilient washers suitable for the environment shall be used to protect the coating from the bolts in the flange. The use of self-tapping screws or other fastening methods that will damage the coating are not acceptable.

3.02 HANGERS

A. Rectangular, Round and Flat Oval Ductwork Spacing and size of hangers shall be as recommended in the SMACNA standards except as noted in PART 2.

B. Install hangers plumb and securely suspended from supplementary steel or inserts in concrete slabs. Sufficiently thread lower ends of hanger rods to allow adequate vertical adjustment. Do not use building siding or metal decking to hang ductwork.

C. Ducts shall not be supported from furring, hung ceilings or from another duct or pipe.

D. C clamp type hangers shall be supplied with a retainer strap.

E. Ductwork shall not come in contact with any of the ceiling construction or any other equipment in the ceiling cavity.

F. Duct support at flexible connections shall be adjustable for ease of aligning the duct to the piece of equipment.

3.03 SEALING OF DUCTWORK

A. General: Unless otherwise indicated, seal all ductwork joints and seams using sealant in accordance with the instructions of the sealant manufacturer and this Section. All transverse seams, joints and fitting connections, both shop and field assembled, shall be sealed in accordance with this Section. Longitudinal seams shall be sealed on all duct systems with a design operating pressure greater than 2 in w.g.

B. Application of Sealant: Thoroughly clean all seams, joints, etc, of dirt, oil, grease, or other coatings which might interfere with the adhesion of the duct sealant before the sealant is applied.

C. Uncured sealant may be forced into the slotted side of the seam or joint before shop or field assembly and the joint or seam completed while the sealant is still uncured. Excess sealant shall be removed from both the inside and outside of the duct before it sets.

D. Duct Tape: The use of duct tape alone for sealing ductwork is prohibited. Duct tape may be used primarily for the purpose of retaining the uncured duct sealant in seams and joints until it has cured. Duct tape shall not be applied to the inside of any duct nor shall it be applied to standing type joints at any time. All duct tape used shall be compatible with the sealant. The use of sealant saturated tape is acceptable when part of an integrated sealing system.

E. Sealant shall be either in liquid form or a mastic with a maximum flame spread of 25 and a maximum rate of fuel contributed and smoke developed of 50 when tested in accordance with ASTM E84, NFPA 255 and UL 723.

F. Sealing systems shall be suitable for the environment. The following schedule is to be used to select the sealant.

1. Indoor, dry galvanized round and rectangular duct is to be sealed with Iron Grip 601 or equal.

2. Indoor, dry, aluminum is to be sealed with FTA 20 adhesive and DT-Tape gypsum or equal.

3. All other areas unless otherwise noted are to be sealed with FTA 50 adhesive and DT-Tape gypsum or equal.

4. All sealers listed are manufactured by Hardcast Inc and are to define the type of sealer. Other equal sealants are acceptable.

G. Installed duct systems shall be tested in accordance with the SMACNA - HVAC Air Duct Leakage Test Manual. Leakage rates shall not exceed those predicted for ASHRAE - Leakage Class 6 at the system design pressure. For flexible ducts and ducts with design pressures less than 2 in w.g., ASHRAE - Leakage Class 12 shall be used. Duct systems that fail to pass the test standards shall be repaired and tested again until standards are attained.

3.04 DUCTWORK FITTINGS AND ACCESSORY ITEMS

A. Duct Elbows: Changes in direction and offsets shall be made in a gradual manner to facilitate streamline flow of air. All elbows shall have a centerline radius of not less than 1 1/2 times the width of the duct in the plane of the elbow. For rectangular ductwork where full radius elbows cannot be installed, provide abrupt elbows equipped with shop installed turning vanes unless noted otherwise on the Drawings.

B. Flexible Fabric Connectors

1. Install flexible connectors for vibration isolation at all duct connections to fans, fan units or blowers, air handling units and air conditioning units. Make connections substantially airtight at all seams and joints.

2. Where the construction of the flexible connection or vibration isolator results in a cross sectional area of the connection which is less than 90 percent of the adjacent ductwork, the size of the connection shall be increased to provide a cross sectional area equal to or greater than 90 percent of the adjacent duct.

3. Provide flexible duct connections at both the intake and discharge connections for all fans and air handling units except as noted below.

   a. Wall and roof fans that have integral motor/fan wheel isolation.

   b. Air handling units where the fan is isolated from the intake and discharge connections by internal flexible connections or separations, and the unit is mounted without vibration isolators between the unit and the support structure.

4. Ductwork spacing and alignment for flexible connections shall be aligned to the tolerances of the flexible connection manufacturer, or plus/minus 1/4-in whichever is less. Bolts shall be torqued to the manufacturer's recommendations. Do not over tighten.

5. Where flexible connections are used as expansion joints, the manufacturer's pre-compression recommendations must be followed. When the temperature at installation differs from the temperature in the pre-compression recommendation, a correction shall be made.

C. Dampers

1. Install manual volume control dampers wherever it may be necessary to regulate air volume for system air balancing and where shown on the Drawings.

2. Install motorized dampers when supplied by other trades.

D. Access Doors

1. Hinged access doors shall be installed where listed below, wherever shown on the Drawings and wherever access may be required for service, maintenance and adjustment.

2. Provide access doors at the following locations (minimum requirements):

   a. Motorized dampers: linkage side

   b. Duct mounted temperature controllers

   c. Smoke detectors

   d. Plenums

   e. Fire dampers

f. Manual dampers and splitters

g. Inlet side of centrifugal fans

h. Inlet and outlet ducts to fans and air handlers

3. Where access doors are required in ductwork located above ceilings, coordinate the location of the access doors to clear the ceiling support system and to be accessible through the ceiling grid.

4. 12 in by 12 in handhole access panels may be substituted for access doors when ductwork dimensions are less than 14 in by 14 in.

3.05 FILLING IN SPACE AROUND DUCTWORK

A. To prevent sound passing through the area between the duct and the framed or cut opening in the floors, walls or partitions, pack mineral wool to completely fill the space the full depth of the opening. Whenever a fire rated wall or floor is penetrated and a fire damper is not required, fill the space around the duct with a locally approved fireproof rope.

B. At penetration, apply escutcheon plates on both faces of the wall to close the gap between the structure and the sides of the insulated or bare duct. Escutcheon plates shall be the same material as the duct for metal ducts.

3.06 DUCT SUPPORTS AT FLOOR PENETRATION

A. Where vertical ducts pass through floor openings and a fire damper is not required, rigidly attach supporting angles to the ducts and anchor with expansion bolts to the floor or curb. Angles shall be of the same material as the duct for metal duct, placed on the two long sides of the duct extending 3 in over edge of opening and shall not be less than the sizes recommended by SMACNA.

B. Remaining open area in the floor opening shall be sealed with a plate of the same material as the angle.

3.07 DUCTWORK TERMINATIONS AT MASONRY OR CONCRETE

A. Where ducts terminate at masonry or concrete openings, place a continuous 2 1/2 in by 2 1/2 in by 3/16 in angle of the same material as the duct around the ductwork. Bolt the angle to the construction and make airtight by applying caulking compound on the angle before it is drawn down tight to construction.

B. Fasten plenums to concrete curbs with 3 in by 3 in by 1/4 in continuous angle. Concrete curbs are provided under another Division. Mount angle on a continuous bead of caulking compound and anchor to the curb on 16 in centers. Terminate duct at the curb and bolt to the angle. Seal the duct to the curb with a continuous bead of caulking compound. Apply neoprene filler strip to level curb surface as necessary.

3.08 DUCTWORK GENERATED NOISE

A. All ductwork shall be free from pulsation, chatter, vibration or objectionable noise. After system is in operation, should these defects appear, correct by removing, replacing or reinforcing the work. No discreet tones will be allowed.

3.09 TEST PORTS

A. Where shown on the Drawings and where required for testing and balancing, provide instrument insertion ports. Size and location of ports shall be coordinated with the Contractor performing air balancing. Seal ports with plastic snap lock plugs. When the ductwork will be insulated, extend the port to the face of the insulation and seal the vapor barrier to the port. When the ductwork is lined, extend the port into the duct to the inner surface of the duct liner.

B. In round ductwork provide 2 ports 90 degrees on centers. In rectangular ductwork provide ports as required by AABC or NEBB for a full traverse measurement.

C. As a minimum, ports shall be provided in the following connections:

1. All duct mains.

2. All duct branches unless all connections are diffusers, registers, or grilles and the total can be calculated by summing the readings for all of the connections.

3. All connections to tanks or hoods where there is no other access for taking a measurement.

D. A main duct is defined as one of the following:

1. A duct emanating from a fan or plenum.

2. All other ducts are considered branch ducts.

3.10 PAINTING

A. Paint the outside face of all louver blank off panels and the interiors of unlined plenums and ductwork where connected to louvers. Prime and paint with two coats of flat black exterior paint. Painting shall be performed under this Section and shall be as specified in Division 09.

3.11 CLEANING OF DUCTWORK

A. Maintain all ductwork, fans, coils, air filters, outlets and other parts of the ductwork systems in a clean condition during installation.

B. Clean complete ductwork systems prior to testing and air balancing. Secure cheese cloth over all openings of the ductwork system for entrapment of dirt during the cleaning operation.

END OF SECTION

SECTION 23 34 00

HVAC FANS

PART 1 – GENERAL

1.01 SCOPE OF WORK

A. Provide fans as shown on the Drawings and as specified herein.

1.02 RELATED SECTIONS

A. Division 23, Section 23 05 00 COMMON WORK RESULTS FOR HVAC

B. Division 26 - Electrical

1.03 QUALITY ASSURANCE

A. NEMA Compliance: Motors and electrical accessories shall comply with NEMA standards.

B. Electrical Component Standard: Components and installation shall comply with NFPA 70 "National Electrical Code."

C. Classification for Spark Resistant Construction Conform to AMCA 99.

1.04 SUBMITTALS

A. Product Data: Submit the following:

1. Complete materials list of all items to be provided, including Supplier and estimated delivery schedule.

2. Submit Shop Drawings for all products and materials in accordance with Division 01 requirements.

3. Submit catalog cuts, complete parts listing showing materials of construction with applicable ANSI, ASTM, AMCA, or other Standards, manufacturer's Specifications and product data to demonstrate compliance with requirements.

4. Submit details of construction including extent of shop assembly of unit and manufacturer's recommended installation procedures.

5. Within 30 days of receipt of approved Shop Drawings, submit for review operation and maintenance manuals in accordance with Division 01 requirements. In addition to requirements specified in Division 01, operation and maintenance manuals shall also include detail

drawing/schematic of the propeller fan being provided, complete parts list including part numbers, list of recommended spare parts, maintenance and lubrication schedules, motor horsepower/efficiency and nameplate information.

1.05 PRODUCT HANDLING

A. Lift and support units with the manufacturer's designated lifting or supporting points.

B. Disassemble and reassemble units as required for movement into the final location following manufacturer's written instructions.

C. Deliver fan units as a factory assembled unit to the extent allowable by shipping limitations, with protective crating and covering.

1.06 SEQUENCING AND SCHEDULING

A. Coordinate the installation of roof penetrations and other associated Work with the Work of other trades.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Loren Cook
2. Greenheck Fan Corp.
3. PennBarry
4. Or Engineer's Approved Equal

2.02 SOURCE QUALITY CONTROL

A. Testing Requirements: The following factory tests are required:

1. Sound Power Level Ratings: Comply with AMCA Standard 301 "Method for Calculating Fan Sound Ratings From Laboratory Test Data." Test fans in accordance with AMCA Standard 300 "Test Code for Sound Rating." Fans shall bear the AMCA Certified Sound Ratings Seal.

2. Fan Performance Ratings: Establish flow rate, pressure, power, air density, speed of rotation, and efficiency shall be factory tested and ratings in accordance with AMCA Standard 210/ASHRAE Standard 51—Laboratory Methods of Testing Fans for Rating.

1.01 FLOW SWITCHES

A. Flow-proving switches shall be installed per manufacturer's instructions and the HVAC drawings.

2.03 INDUSTRIAL BELT DRIVEN PROPELLER FAN

A. General

1. Base fan performance at standard conditions (density 0.075 Lb/ft^3).

2. Fans selected shall be capable of accommodating static pressure and flow variations of +/-15% of scheduled values.

3. Each fan shall be belt drive in AMCA arrangement 1, 3, 9 or 10 according to drawings.

4. Fans are to be equipped with lifting lugs.

5. After fabrication all carbon steel components shall be cleaned and chemically treated by a phosphatizing process to insure proper removal of grease, oil, scale, etc. Fan shall then be coated with a minimum of 2-4 mils of Permatector (Polyester Urethane), electrostatically applied and baked. Finish color shall be as selected by the Engineer. Coating must exceed 1,000-hour salt spray under ASTM B117 test method.

B. Fan Housing and Outlet

1. Fan housing is to be aerodynamically designed with high-efficiency inlet, engineered to reduce incoming air turbulence.

2. The housings on all fan sizes shall be of continuously welded heavy gauge steel. All interior and exterior surface steel shall be coated with a minimum of 2-4 mils of Permatector (Polyester Urethane), electrostatically applied and baked. Finish color shall be selected by the Engineer. No uncoated metal fan parts will be allowed.

3. Housing and bearing support shall be constructed of welded structural steel members to prevent vibration and rigidly support the shaft and bearings.

4. An OSHA compliant belt guard shall be included to completely cover the motor pulley and belt(s).

C. Fan propeller

1. Fan propeller shall be aluminum.

D. Fan Motors and Drive

1. Motors shall meet or exceed EPACT (Energy Policy ACT) efficiencies. Motors to be NEMA T-frame, 1800 or 3600 RPM, Open Drip Proof (ODP) or Totally Enclosed Fan Cooled (TEFC) with a 1.15 service factor. Provide inverter duty rated motors for all variable speed fans.

2. Drive belts and sheaves shall be sized for 150% of the fan operating brake horsepower, and shall be readily and easily accessible for service, if required.

3. Fan shaft to be turned and polished steel that is sized so the first critical speed is at least 25% over the maximum operating speed for each pressure class.

4. Fan shaft bearings shall be Air Handling Quality, bearings shall be heavy-duty grease lubricated, self-aligning or roller pillow block type.

5. Air Handling Quality bearings to be designed with low swivel torque to allow the outer race of the bearing to pivot or swivel within the cast pillow block. Bearings shall be 100% tested for noise and vibration by the manufacturer. Bearings shall be 100% tested to insure the inner race diameter is within tolerance to prevent vibration.

6. Bearings shall be selected for a basic rating fatigue life (L-10) of 80,000 hours at maximum operating speed for each pressure class Average Life or (L-50) of 400,000 hours.

7. Bearings shall be fixed to the fan shaft using concentric mounting locking collars, which reduce vibration, increase service life, and improve serviceability. Bearings that use set screws shall not be allowed.

8. Bearings shall have Zerk fittings to allow for lubrication.

2.04 INDUSTRIAL BELT DRIVEN AIRFOIL SINGLE WIDTH CENTRIFUAGAL FAN

A. General

1. Base fan performance at standard conditions (density 0.075 Lb/ft^3).

2. Fans selected shall be capable of accommodating static pressure and flow variations of +/-15% of scheduled values.

3. Each fan shall be belt drive in AMCA arrangement 1, 3, 9 or 10 according to drawings.

4. Fans are to be equipped with lifting lugs.

5. After fabrication all carbon steel components shall be cleaned and chemically treated by a phosphatizing process to insure proper removal of grease, oil, scale, etc. Fan shall then be coated with a minimum of 2-4 mils of Permatector (Polyester Urethane), electrostatically applied and baked. Finish color shall be as selected by the Engineer. Coating must exceed 1,000-hour salt spray under ASTM B117 test method.

B. Fan Housing and Outlet

1. Fan housing is to be aerodynamically designed with high-efficiency inlet, engineered to reduce incoming air turbulence.

2. The housings on all fan sizes shall be of continuously welded heavy gauge steel. All interior and exterior surface steel shall be coated with a minimum of 2-4 mils of Permatector (Polyester Urethane), electrostatically applied and baked. Finish color shall be selected by the Engineer. No uncoated metal fan parts will be allowed.

3. Housing and bearing support shall be constructed of welded structural steel members to prevent vibration and rigidly support the shaft and bearings.

4. An OSHA compliant belt guard shall be included to completely cover the motor pulley and belt(s).

C. Fan Wheel

1. The fan wheel shall be of the non-overloading single width airfoil centrifugal type. Wheels shall be statically and dynamically balanced to balance grade G6.3 per ANSI S2.19.

2. Fan wheel shall be aluminum

3. The wheel and fan inlet shall be carefully matched and shall have precise running tolerances for maximum performance and operating efficiency.

D. Fan Motors and Drive

1. Motors shall meet or exceed EPACT (Energy Policy ACT) efficiencies. Motors to be NEMA T-frame, 1800 or 3600 RPM, Open Drip Proof (ODP) or Totally Enclosed Fan Cooled (TEFC) with a 1.15 service factor. Provide inverter duty rated motors for all variable speed fans.

2. Drive belts and sheaves shall be sized for 150% of the fan operating brake horsepower, and shall be readily and easily accessible for service, if required.

3. Fan shaft to be turned and polished steel that is sized so the first critical speed is at least 25% over the maximum operating speed for each pressure class.

4. Fan shaft bearings shall be Air Handling Quality, bearings shall be heavy-duty grease lubricated, self-aligning or roller pillow block type.

5. Air Handling Quality bearings to be designed with low swivel torque to allow the outer race of the bearing to pivot or swivel within the cast pillow block. Bearings shall be 100% tested for noise and vibration by the manufacturer. Bearings shall be 100% tested to insure the inner race diameter is within tolerance to prevent vibration.

6. Bearings shall be selected for a basic rating fatigue life (L-10) of 80,000 hours at maximum operating speed for each pressure class Average Life or (L-50) of 400,000 hours.

7. Bearings shall be fixed to the fan shaft using concentric mounting locking collars, which reduce vibration, increase service life, and improve serviceability. Bearings that use set screws shall not be allowed.

8. Bearings shall have Zerk fittings to allow for lubrication.

PART 3 – EXECUTION

3.01 INSTALLATION – GENERAL

A. Install fans level and plumb, in accordance with manufacturer's written instructions. Support units as described below, using the vibration control devices indicated.

3.02 ADJUSTING, CLEANING, AND PROTECTING

A. Adjust damper linkages for proper damper operation.

B. Clean unit cabinet interiors to remove foreign material and construction dirt and dust. Vacuum clean fan wheel and cabinet.

3.03 COMMISSIONING

A. Final Checks Before Start Up: Perform the following operations and checks before start up:

1. Remove shipping blocking and bracing.

2. Verify unit is secure on mountings and supporting devices and those connections for piping, ductwork, and electrical are complete. Verify proper thermal overload protection is installed in motors, starters, and disconnects.

3. Perform cleaning and adjusting specified in this Section.

4. Lubricate bearings, pulleys, belts, and other moving parts with factory recommended lubricants as required.

B. Starting procedures for fans:

1. Energize motor, verify proper operation of motor, drive system, and fan wheel. Adjust fan to indicated RPM.

2. Measure and record motor electrical values for voltage and amperage. Confirm that the readings meet the manufacturer's Specifications. Submit test results to the Owner and Engineer.

3. Test fan for proper operation when connected to the space thermostat. Exhaust fans shall operate when room temperature is above the set point.

END OF SECTION

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SECTION 23 81 26

SPLIT-SYSTEM AIR CONDITIONERS

PART 1 – GENERAL

1.01 DESCRIPTION OF WORK

A. Furnish, install, test and make ready for operation; Mini-Split AC/Heat Pump Units, controllers, accessories and all appurtenances as specified, as indicated in the Schedules and as shown on the Drawings.

1.02 SUBMITTALS

A. Submit in accordance with Division 01 to demonstrate conformance with specified features and scheduled ratings.

1.03 QUALITY ASSURANCE

A. System shall be rated in accordance with A.R.I. Standard 270.

B. System shall be certified in accordance with the unitary air conditioner equipment certification program, based on A.R.I. 210/240.

C. System shall be UL listed.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Equipment shall be stored and handled in accordance with Manufacturers' recommendations.

1.05 WARRANTY

A. Provide 10-year warranty unless stated otherwise.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. Mini-Split AC/Heat Pump Unit

1. Mitsubishi Electric (Basis of Design)

2. Daikin AC

3. Fujitsu

4. Engineer Approved Equal

B. Refer to the schedules on the Drawings for additional details and requirements

2.02 AC/HEAT PUMP UNIT

A. System Description

1. The system shall consist of a slim silhouette, compact, wall mounted indoor fan coil section with wireless remote controller and a slim silhouette, horizontal discharge, outdoor unit which shall be of an inverter driven heat pump design.

B. Quality Assurance

1. The units shall be tested by a Nationally Recognized Testing Laboratory (NRTL) and shall bear the ETL label.

2. All wiring shall be in accordance with the National Electrical Code (N.E.C.).

3. The units shall be rated in accordance with Air-conditioning, Heating, and Refrigeration Institute's (AHRI) Standard 240 and bear the AHRI Certification label.

4. The units shall be manufactured in a facility registered to ISO 9001 and ISO 14001, which is a set of standards applying to environmental protection set by the International Standard Organization (ISO).

5. A dry air holding charge shall be provided in the indoor section.

6. System efficiency shall meet or exceed 20 SEER and 10 HSPF when part of a 1:1 (indoor/outdoor) system.

C. Delivery, Storage, and Handling

1. Unit shall be stored and handled according to the Manufacturer's recommendations.

2. The wireless controller shall be shipped inside the carton with the indoor unit and able to withstand 105 F storage temperatures and 95% relative humidity without adverse effect.

D. Warranty

1. The units shall have the Manufacturer's parts and defects warranty for a period ten (10) years from date of installation. The compressor shall have a warranty of 10 years from date of installation.

E. Indoor Unit

1. General

a. The indoor unit shall be factory assembled, wired and run tested. Contained within the unit shall be all factory wiring, piping, control circuit board, fan and fan motor. The unit shall have a self-diagnostic function, 3-minute time delay mechanism, and an auto restart function. Indoor unit shall be charged with dry air before shipment from factory.

2. Unit Cabinet

a. The casing shall have a white finish – Munsell 1.0Y 9.2/0.2.

b. Multi-directional drain connection and refrigerant piping, offering three (3) direction pipe alignments for all refrigerant piping and two (2) direction pipe alignments for condensate draining shall be standard.

c. There shall be a separate, metal back-plate that secures the indoor unit firmly to the wall. The back plate shall be securely attached to the wall.

F. Fan

1. The indoor unit fan shall be an assembly with a line-flow fan direct driven by a single motor.

2. The fan shall be statically and dynamically balanced and be powered by a motor with permanently lubricated bearing.

3. A manual adjustable guide vane shall be provided with the ability to change the airflow from side to side (left to right).

4. An integral, motorized, multi-position, horizontal air sweep flow louver shall provide for uniform air distribution, up and down.

5. The indoor fan shall operate at three (3) selectable speeds: High, Medium and Low.

G. Filter

1. Return air shall be filtered by means of easily removed, washable, filter.

H. Coil

1. The indoor unit coil shall be of nonferrous construction with smooth plate fins on copper tubing.

2. The tubing shall have inner groves for high efficiency heat exchange.

3. All tube joints shall be brazed.

4. The coils shall be pressure tested at the factory.

5. A sloped, corrosion resistant condensate pan with drain shall be provided under the coil.

I. Electrical

1. The unit electrical power shall be as indicated on the Schedules on the Drawings.

2. The system shall be equipped with A-Control – a system directing that the indoor unit be powered directly from the outdoor unit using a 3-wire connection plus ground.

3. The indoor unit shall not have any supplemental electrical heat elements.

J. Control

1. The unit shall have a wireless controller to perform input functions necessary to operate the system.

2. The wireless controller shall have a Power On/Off switch, Mode Selector – Cool, Dry, Heat, Auto Modes - Temperature Setting, Timer Control, Fan Speed Select, and Auto Vane selector.

3. The indoor unit shall perform self-diagnostic function and check mode switching.

4. Temperature changes shall be by 1 F increments with a range of 59 – 89 F.

5. The microprocessor located in the indoor unit shall have the capability of sensing return air temperature and indoor coil temperature, receiving and processing commands from the wireless or a wired controller, providing emergency operation and controlling the outdoor unit.

6. The indoor units shall be capable of working with single-zone or multi-zone outdoor units.

7. The system shall be capable of automatically restarting and operating at the previously selected conditions when the power is restored after power interruption.

8. Control system shall control the continued operation of the air sweep louvers, as well as provide On/Off, System/Mode function.

K. Outdoor Units

1. Unit Cabinet: The casing shall be fabricated of galvanized steel, bonderized, finished with an electrostatically applied, thermally fused acrylic or polyester powder coating for corrosion protection.

2. Fan: The unit shall be furnished with a direct drive propeller type fan. The outdoor unit fan motor shall be a direct current (DC) motor and have permanently lubricated bearings. The fan motor shall be mounted for quiet operation. The fan shall be provided with a raised guard to prevent contact with moving parts. The outdoor unit shall have horizontal discharge airflow.

3. Coil: The outdoor unit coil shall be of nonferrous construction with lanced or corrugated plate fins on copper tubing. The coil shall be protected with an integral metal guard, and corrosion resistant coating.

4. Refrigerant flow from the outdoor unit shall be regulated by means of an electronically controlled, precision, linear expansion valve.

L. Compressor

1. The compressor motor shall be direct current (DC). The compressor shall be of a high performance hermetic; inverter driven, variable speed, rotary type. The outdoor unit shall have an accumulator. The compressor shall be equipped with an internal thermal overload.

2. There shall be no need for line size changes, traps shall not be used, and no additional refrigerant oil shall be required.

3. The compressor shall be equipped with vibration isolation.

M. Electrical

1. The unit electrical power shall be as indicated in the schedules on the Drawings.

2. The outdoor unit shall be controlled by the microprocessor located in the indoor unit and outdoor unit.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Install the system in accordance with the Manufacturer's instructions and the drawings.

B. Provide control wiring per the Manufacturer's recommendations.

3.02 TESTING

A. Test the system in accordance with the Manufacturer's instructions and Section 23 05 93 TESTING, ADJUSTING, AND BALANCING FOR HVAC.

B. Provide verification of installation site conditions as part of start-up testing and training.

3.03 PERSONNEL TRAINING

A. Train operating personnel in operating, adjusting, and maintaining the split air conditioning system.

END OF SECTION

SECTION 23 82 39

UNIT HEATERS

PART 1 – GENERAL

1.01 SUMMARY

A. Provide Electric Unit Heaters as specified below and as shown on the Drawings.

B. Unit heaters are wired by the Electrical Subcontractor.

1.02 RELATED SECTIONS

A. Division 23, Section 23 05 00 COMMON WORK RESULTS FOR HVAC

B. Division 23, Section 23 05 15 HVAC IDENTIFICATION

C. Division 23, Section 23 05 29 HANGERS AND SUPPORTS FOR HVAC PIPING

D. Division 26 – Electrical

1.03 QUALITY ASSURANCE

A. Products shall conform to applicable Specifications of the American Gas Association (AGA), Factory Mutual (FM) or UL.

B. Products shall be tested and listed by one of the above agencies.

PART 2 – PRODUCTS

2.01 ELECTRIC UNIT HEATERS

A. Provide electric unit heaters as shown on the Drawings. Electric unit heater shall be suspended mounting, with fan forced air distribution over electric resistance heating coils and horizontal discharge. Performance shall be as indicated on the equipment Schedule. Units shall be listed by UL Std. No. 1995 "Heating and Cooling Equipment."

B. Casing shall be treated to prevent corrosion and painted with a corrosion resistant, baked, polyester powdercoat finish.

C. Unit heater in the wet well must be Heresite coated.

D. Fans/Fan Guards - Fans shall be aluminum on all units and shall be secured to a steel hub. Each fan is balanced and is designed specifically for the unit heater on which it is installed. Horizontal units shall be equipped with a combination fan guard/motor-mounting bracket. The guard is constructed of steel rod.

E. Air Deflectors - Horizontal units shall be furnished with horizontal air deflectors as standard. The deflectors shall be adjustable to almost any desired position for downward, straight or upward airflow.

F. Provide captive-screw held panel for electrical connection and control compartment.

G. Provide internal shroud around heating elements to assure uniform air flow and delivery temperature across heater face.

H. Provide line voltage disconnect switch for each input circuit.

I. Thermostat: Furnish integral thermostat.

J. Manufacturers – The Unit Heaters shall be as manufactured by:

1. Qmark

2. Chromalox

3. Or Engineer's Approved Equal

PART 3 – EXECUTION

3.01 INSPECTION

A. Examine areas and conditions under which the unit heaters and convectors are to be installed. Do not proceed with Work until unsatisfactory conditions have been corrected in manner acceptable to the Engineer.

3.02 INSTALLATION OF UNIT HEATERS

A. Install Electric Unit Heaters where indicated, in accordance with manufacturer's published installation instructions, complying with recognized industry practices to ensure that the Unit Heaters comply with requirements and serve the intended purposes.

B. Provide access space around Unit Heaters for service as indicated, but in no case less than that recommended by the manufacturer and as shown in the manufacturer's installation manual.

C. Electrical power wiring of Unit Heaters shall be by the Electrical Subcontractor. Install power wiring in conduit in accordance with Division 16 requirements. Wire shall be of a size and type the meets or exceeds the NEC or as shown on the Drawings. Minimum wire size shall be #12 AWG.

D. Install electrical devices furnished by the manufacturer but not specified to be factory-mounted.

E. Electrical wiring installation shall be in accordance with manufacturer's submittal and installation requirements of applicable Division 26 Electrical sections.

F. Provide piping, wiring, valves, accessories, gauges, and supports, as indicated for a complete and functional installation.

G. For unit heaters being installed in classified spaces, ensure all installed equipment meets applicable standards.

3.03 ADJUSTING AND CLEANING

A. Start-Up: Start-up in accordance with manufacturer's instructions.

B. Cleaning: Clean factory-finished surfaces. Repair any marred or scratched surfaces with manufacturer's touch-up paint.

3.04 FIELD QUALITY CONTROL

A. Verify operation of each unit heater by measuring input voltage and current simultaneously for period of ten minutes of continuous operation.

B. Start and verify proper operation of each unit heater in accordance with the manufacturer’s installation manual

C. Provide Manufacturer’s written warranty of a minimum of 1 year on materials and workmanship. Submit warranty to the Owner.

END OF SECTION

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SECTION 23 90 00

LOUVERS AND VENTS

PART 1 – GENERAL

1.01 SUMMARY

A. This Section includes the following:

1. Fixed metal wall louvers.

2. Motor operated dampers

1.02 DEFINITIONS

A. Louver Terminology: Refer to AMCA Publication 501-85 for definitions of terms for metal louvers not otherwise defined in this section or referenced standards.

1.03 SUBMITTALS

A. Louvers

1. Shop drawings of louver units and accessories. Include plans, elevations, sections, and details showing profiles, angles, spacing of louver blades; unit dimensions related to wall openings and construction; free areas for each size indicated; and profiles of frames at jambs, heads and sills.

   a. Where installed products are indicated to comply with certain structural design loadings, include structural computations, material properties, and other information needed for structural analysis which has been prepared by, or under the supervision of, a qualified professional engineer.

2. Product test reports evidencing compliance of units with performance requirements indicated.

3. Product certificates signed by louver manufacturers certifying that their products which comply with Project requirements are licensed to bear AMCA Seal based on tests made in accordance with AMCA Standard 500 and complying with AMCA Certified Ratings Program.

1.04 QUALITY ASSURANCE

A. Manufacturer's Qualifications - Firms regularly engaged in manufacture of air outlets and inlets 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 outlets and inlets 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".

3. ADC Compliance: Test and rate air outlets and inlets in certified laboratories under requirements of ADC 1062 "Certification, Rating and Test Manual".

4. ADC Seal: Provide air outlets and inlets bearing ADC Certified Rating Seal.

5. AMCA Compliance: Test and rate louvers in accordance with AMCA 500 "Test Method for Louvers, Dampers and Shutters".

6. AMCA Seal: Provide louvers bearing AMCA Certified Rating Seal.

7. NDPA Compliance: Install air outlets and inlets in accordance with NFPA 90A "Standard for the Installation of Air Conditioning and Ventilating Systems".

8. SMACNA Standard: Comply with SMACNA “Architectural Sheet Metal Manual” recommendations for fabrication, construction details, and installation procedures.

9. UL and NEMA Compliance: Provide motors and related components for motor-operated adjustable louvers which are listed and labeled by UL and comply with applicable NEMA standards.

1.05 PROJECT CONDITIONS

A. Field Measurements: Check actual louver openings by accurate field measurements before fabrication; show recorded measurements on final shop drawings. Coordinate fabrication schedule with construction progress to avoid delay of the Work.

1. Where field measurements cannot be made without delaying the Work, guarantee opening dimensions and proceed with fabrication of louvers and vents without field measurements. Coordinate wall construction to ensure that actual opening.

PART 2 – PRODUCTS

2.01 RAIN RESISTANT STATIONARY LOUVERS

A. General - Except as otherwise indicated, provide manufacturer's standard rain resistant stationary louvers where shown; of size, shape, capacity and type indicated; constructed of materials and components as indicated.

B. Performance: Provide louvers that have minimum free area, and maximum pressure drop of each type as listed in manufacturer's current data, complying with louver schedule.

C. Substrate Compatibility – Provide louvers with frame and sill styles that are compatible with adjacent substrate and that are specifically manufactured to fit into construction openings with accurate fit and adequate support, for weatherproof installation.

D. Louvers shall possess stationary horizontal blades designed to prevent the penetration of wind driven rain. Louver blades shall be contained within a 7-inch frame. Extended sill shall be provided to capture and drain water to exterior of building. Louver components (heads, jambs, sill and blades) shall be factory assembled by the louver manufacturer. Louver sizes too large for shipping shall be built up by the contractor from factory assembled louver sections to provide overall sizes required. Louver design shall limit span between visible mullions to 5 ft. and shall withstand a wind load of 20 lbs. per sq. ft. (equivalent of a 90 mph wind).

E. Louvers shall be extruded 6063 T5 aluminum alloy construction as follows:

1. Frame: 0.125-inch wall thickness, caulking surfaces provided

2. Blades: 0.125-inch wall thickness, installed vertically on approximately 1-inch centers

3. Extended Sill: 0.125-inch wall thickness, with upturned side panels to prevent water leakage

4. Screen: 5/8-inch by 0.040-inch square mesh aluminum bird screen in removable frame

5. Finish: Before paint application, louvers shall be thoroughly cleaned and pretreated. Cleaning includes complete submersion in alkali cleaner, detergent deoxidization, amorphous chrome phosphate conversion coating and acidulated final rinse. Kynar 500® or Hylar 5000® finish shall be applied to provide 1.2 mils (30µm) factory applied, baked-on film build in accordance with AAMA 2605-02* "Voluntary Specification Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Architectural Extrusions and Panels". Color shall be submitted for approval.

F. Manufacturer –Ruskin is the basis for design. Or an approved equal of one of the following companies:

1. Construction Specialties, Inc.

2. Louvers & Dampers, Inc.

3. Greenheck

4. Or approved equal

2.02 MOTOR OPERATED DAMPERS

A. General – Provide insulated, motor operated, control dampers as shown on the drawings and as specified herein.

B. Submittals - Comply with requirements of Division 01. Submit manufacturer's product data to include:

1. Leakage, pressure drop, and maximum pressure data

2. Indicate materials, construction, dimensions, and installation details.

3. Verify damper pressure drop ratings based on tests and procedures performed in accordance with AMCA 500.

C. Frame: 8-1/8 inches x 1 inch x minimum 0.125 inch (206 x 25 x minimum 2.1 mm) 60 63-T5 extruded aluminum hat-shaped channel, mounting flanges on both sides of frame, reinforced at corners. Damper shall include a Thermal Break.

D. Blades:

1. Sets: Minimum 2 sets with minimum 4 inches (102 mm) dead air space between sets.

2. Style: Airfoil-shaped, single-piece

3. Action: Parallel

4. Orientation: Horizontal

5. Material: Heavy duty 60 63-T5 extruded aluminum

6. Width: Maximum 4 inches (102 mm)

E. Bearings: Molded synthetic sleeve, turning in hole in frame.

F. Seals

1. Blade: Extruded vinyl rubber edge type for extremely low leakage. Mechanically attached to blade edge.

2. Jamb: Flexible metal compression type

G. Linkage: Concealed in frame

H. Axles: Minimum 1/2 inch (13 mm) diameter plated steel, hex-shaped, mechanically attached to blade.

I. Mounting: Horizontal

J. Motor Operator – Provide a matching motor operator designed for 120 VAC power.

K. Manufacturers

1. Damper Operators – Greenheck, Belimo, Honeywell or approved equal

PART 3 – EXECUTION

A. Louvers

1. Coordinate louver location and size with building manufacturer.

2. Locate and place louver plumb, level, and in proper alignment with adjacent work.

3. Use concealed anchorages where possible. Provide brass or lead washers fitted to screws where required to protect metal surfaces and to make a weathertight connection.

4. Form closely fitted joints with exposed connections accurately located and secured.

5. Provide perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.

6. Repair finishes damaged by cutting, welding, soldering, and grinding operations require for fitting and jointing. Restore finishes so there is no evidence of corrective work. Return items which cannot be refinished in field to the shop, make required alterations and refinish entire unit, or provide new units.

7. Protect galvanized and nonferrous metal surfaces from corrosion or galvanic action by application of a heavy coating of bituminous paint on surfaces which will be in contact with concrete, masonry, or dissimilar metals.

8. Install concealed gaskets, flashings, joint fillers, and insulation, as louver installation progresses where required to make louver joints weathertight. Comply with Section 07 92 00 JOINT SEALANTS for sealants applied during installation of louver.

3.02 ADJUSTING AND PROTECTING

A. Protect louvers and vents from damage of any kind during construction period including use of temporary protective coverings where needed and approved by louver manufacturer. Remove protective covering at time of Substantial Completion.

B. Restore louvers and vents damaged during installation and construction period, so that no evidence remains of correction work. If results of restoration are unsuccessful, as judged by the Owner, remove damaged units and replace with new units.

1. Clean and touch-up minor abrasions in finishes with air-dried coating that matches color and gloss of, and is compatible with, factory-applied finish coating.

3.03 CLEANING

A. Periodically clean exposed surfaces of louvers and vents, which 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 with a mild soap or detergent not harmful to finishes. Rinse thoroughly and dry surface.

END OF SECTION

SECTION 26 05 00

COMMON WORK RESULTS FOR ELECTRICAL

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes

1. Provide the labor, tools, equipment, and materials necessary to furnish and install all electrical work as specified herein and in accordance with the Drawings and applicable reference standards listed in Article 1.03.

2. Coordinate with the local Telephone, Cable/Phone Utility and Electric Utility to provide electrical, cable, and phone services as shown on the Drawings. Payment for costs associated with the work of the Utility Companies shall be covered as part of the allowances as indicated in the Bid Form.

3. In general, electrical Work shall include but not be limited to the following:

   a. All motor wiring, safety disconnects, and motor starters unless integral with equipment

   b. Power distribution equipment

   c. Power outlets and equipment connections

   d. Wiring devices

   e. Motor controls not provided by other divisions

   f. Control wiring not provided by other divisions

   g. Complete grounding system

   h. Power Factor Correction/ Harmonic Filtering Equipment

   i. Standby Power Systems

   j. Service Entrance work

   k. Lighting – Building interior and exterior

   l. Tele/Data Communications System

   m. All support material and hardware for raceway and electrical equipment

   n. Branch circuit wiring

o. Underground electrical construction All excavation, backfill, surface restoration, and concrete and rebar work shall be provided by the General Contractor. Manholes, Handholes, conduit, and conduit spacers/supports shall be provided by the Electrical Contractor. Manholes and handholes shall be installed by the General Contractor.

p. Installation, termination & labeling of all cable and signal wiring for instrumentation and process control equipment.

q. Building wall, floor and roof penetrations for raceways

r. Start up, acceptance testing test reports and instruction of systems operation to the Owner

s. Install and wire all electrical equipment and devices for the following items furnished by others:

1) Raw Water Pumps

2) HVAC Equipment

3) Grinder

4) Odor Control System

5) SCADA Control Panel and associated Instrumentation and Control Wiring.

1.02 PRICE AND PAYMENT PROCEDURES

A. Measurement and payment requirements: per Division 01 General Requirements.

1.03 REFERENCES

A. Reference Standards

1. Electrical equipment, materials, installation and workmanship shall comply with all state and local building codes, safety and fire law Regulations at the location of the Work and shall conform to the latest edition of the applicable codes and standards of the organizations listed:

A. NATIONAL ELECTRICAL CODE (NEC)

B. NEC NEW HAMPSHIRE AMENDMENTS

C. UNDERWRITERS' LABORATORIES (UL)

D. INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE C2)

E. AMERICAN NATIONAL STANDARDS INSTITUTE, INC. (ANSI)

F. NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

G. NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

H. INSULATED POWER CABLE ENGINEERS ASSOCIATION (IPCEA)

I. ASSOCIATION OF EDISON ILLUMINATING COMPANIES (AEIC)

J. OCCUPATIONAL SAFETY HEALTH ACT (OSHA)

K. AMERICANS WITH DISABILITIES ACT (ADA)

2. Where the Contract requires the Work or any part of the same, to be above the standards required by applicable Laws, ordinances, rules and Regulations and other statutory provisions pertaining to the Work, such Work shall be performed and completed in accordance with the Contract requirements.

3. Should any changes in the Specifications and Drawings be necessary to conform to the requirements of any of the above mentioned codes or standards, the Contractor shall so notify the Owner's Representative.

B. Drawings required by Governing Authorities: Prepare any detailed diagrams or Drawings which may be required by the governing authorities.

C. Permits, Certificates, Inspections, Fees and Utility Costs

1. The Contractor shall obtain and make payments for all permits, licenses, and certificates that are required for the associated Work.

2. Following completion of the Work, the Contractor shall obtain certificates of approval from the responsible agencies concerned with the Work.

3. Arrange for timely inspections required for Work under this section.

4. All utility company and municipal back charges shall be the responsibility of the Contractor. Cost of electricity shall be borne by the Contractor until substantial completion as determined by the Owner.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination, Sequencing, and Scheduling: per Division 01 General Requirements.

B. The electrical work shall be coordinated with the Work of other trades to prevent interferences and so that the progress in construction of the building will in no way be retarded.

C. Coordinate with all local utility companies and make all installations for their services in accordance with all utility company requirements.

D. Where lighting fixtures and other electrical items are shown in conflict with locations of structural members and mechanical or other equipment, furnish and install all required supports and wiring to clear the encroachment for a complete installation.

E. Any Work installed contrary to or without acceptance by the Engineer shall be subject to change as directed by the Engineer, and no extra compensation will be allowed to the Contractor for making these changes.

1.05 SUBMITTALS

A. Submit in accordance with Division 01 General Requirements.

B. Furnish manufacturer's product data, test reports, and materials certifications as required.

C. Follow the procedures specified in Division 01 Section “Submittals” and in addition, the Contractor shall prepare and submit a complete submittal list to the Engineer. The submittal list shall include all submittal items covered in the Division 26 Specification sections.

D. Shop Drawings shall be submitted to the General Contractor who shall review and approve them prior to submittal to the Engineer for approval. Shop Drawings shall identify the specific equipment and material being supplied; the quantity being supplied; and all accessories, dimensions, descriptions, mounting and connection details, wiring diagrams, elementary control diagrams, equipment interface diagrams and any other information necessary to determine compliance with the Plans and Specifications. Fabrication and installation shall be in accordance with the approved Shop Drawings.

E. As-built copies of all Shop Drawings shall be submitted to the Engineer.

F. Submit copies of reports, permits, and easements necessary for installation, use, and operation.

G. Submit copies of reports of tests, inspections, and meter readings as specified.

1.06 QUALITY ASSURANCE

A. Provide in accordance with Division 01 General Requirements.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Provide in accordance with Division 01 General Requirements.

1.08 SITE CONDITIONS

A. Existing Conditions: per Division 01 General Requirements.

1.09 WARRANTY

A. Special Warranty/Extended Correction Period

B. Compile and assemble the warranties specified in Division 26 into a separate set of vinyl covered three ring binders, tabulated and indexed for easy reference.

C. Provide complete warranty information for each item. Information to include:

1. Product or equipment list

2. Date of beginning of warranty or bond

3. Duration of warranty or bond

4. Names, addresses, and telephone numbers and procedures for filing a claim and obtaining warranty services

1.10 DRAWINGS

A. The Specifications supplement the Drawings and provide information pertaining to the methods and materials to be used in the execution of the Work. When a discrepancy occurs between the two, the stricter of the two shall govern.

B. All electrical equipment such as junction and pull boxes, panelboards, switches, controls and such other apparatus as may require maintenance and operation from time to time shall be made easily accessible and properly labeled.

C. The Contractor shall examine all Contracts and reference Drawings, and verify and properly coordinate the placement of outlets. Contractor shall also check all Drawings including mechanical Drawings and Shop Drawings for apparatus for which he must rough-in and to which he must connect.

1.11 RECORD DRAWINGS

A. The Contractor shall maintain a complete and separate set of prints of Drawings and Specifications at job Site for duration of the Contract. The Contractor shall record Work completed and all changes from original Contract. Drawings shall clearly and accurately include Work installed as a modification or as an addition to the original design.

B. At completion of Work and prior to final request for payment, the Contractor shall submit a complete set of reproducible Record Drawings showing all systems as actually installed.

1.12 JOB CONDITIONS

A. Existing Conditions

1. Existing Utilities: Locate existing underground utilities in excavation areas. If utilities are indicated to remain, support and protect services during excavation operations.

2. Prior to all Work of this section, carefully inspect the installed Work of all other trades and verify that all such Work is complete to the point where this installation may properly commence.

3. Verify that the electrical installation may be made in complete accordance with all pertinent codes and Regulations and the original design.

B. Coordination

1. Coordinate the installation of electrical items with the schedules for Work of other trades to prevent unnecessary delays in the total Work.

2. Coordinate with all local utility companies and make all installations for their services in accordance with all utility company requirements.

3. Any changes shall be done at the Contractor's expense.

4. Where lighting fixtures and other electrical items are shown in conflict with locations of structural members and mechanical or other equipment, furnish and install all required supports and wiring to clear the encroachment for a complete installation.

5. Any Work installed contrary to or without acceptance by the Engineer shall be subject to change as directed by the Engineer, and no extra compensation will be allowed to the Contractor for making these changes.

C. Accuracy of Data

1. The Drawings are diagrammatic and functional only, and are not intended to show exact circuit layouts, number of fittings, components and place in satisfactory operational power, lighting, and other electrical systems shown. Install additional circuits, components and material wherever needed to conform to the specific requirements of the equipment whether or not indicated or specified.

2. Information and components called for in the Specification but not shown on Plans or vice versa shall apply and shall be provided as though required expressly by both.

3. The locations of equipment, fixtures, outlets and similar devices shown on the Drawings are approximate only. Field measurements shall take precedence over scaled dimensions from Drawings. Exact locations shall be as accepted by Engineer during construction. Obtain in the field all information relevant to the placing of electrical work and, in case of any interference with other Work, proceed as directed by the Engineer and furnish all labor and materials necessary to complete the Work in an acceptable manner.

4. The Drawings and the Specifications are intended to comply with all pertinent codes, Regulations and standards. In the event of discrepancy, the Contractor shall immediately notify the Engineer in writing of said discrepancies and apply for an interpretation and, unless an interpretation is offered in writing by the Engineer prior to the execution of the Contract, the applicable rules and Regulations shall be complied with as a part of the Contract.

5. In case of difference between building codes, Specifications, state Laws, industry standards and the Contract Documents, the most stringent shall govern. Should the Contractor perform any Work that does not comply with the requirements of the applicable building codes, state Laws, and industry standards, he shall bear all cost arising in correcting these deficiencies.

6. Verify size and ratings of motors and other electrically operated devices supplied by others.

7. Check with Engineer before installation of Work for outlets not specified as to location or for Work that interferes with other trades.

1.13 FLASHING, CUTTING, FIREPROOFING AND WATERPROOFING

A. Flashing around all electrical items penetrating roof or exterior walls shall be the responsibility of the General Contractor.

B. All cutting of surfaces, including core drilling of walls and slabs, shall be done by the General Contractor.

C. Patching shall be done by the General Contractor Electrical Contractor.

D. The Electrical Contractor shall fireproof, waterproof and seal all openings in slabs and walls.

1.14 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Use all means necessary to protect electrical system materials before, during and after installation and to protect the installed Work and materials of all other trades.

B. In the event of damage, immediately make all repairs and replacements necessary to the acceptance of the Engineer and at no additional cost to the Owner. If any apparatus has been subject to possible injury by water, it shall be thoroughly dried out and put through such special tests as directed by the Engineer, at the cost and expense of the Contractor, or shall be replaced by the Contractor at his own expense.

C. Protect the Work of other trades. Restore any damage caused to other trades to the condition existing prior to damage at no additional cost to the Owner.

D. Investigate each space in the building through which equipment must pass to reach its final location. If necessary, the manufacture shall be required to ship his material in sections sized to permit passing through such restricted areas in the building.

1.15 WORK PERFORMANCE

A. Electrical work shall be accomplished with all affected circuits or equipment de-energized. When an electrical outage cannot be accomplished in this manner for the required Work, the following requirements are mandatory:

1. Electricians must use full protective equipment (i.e., certified and tested insulating material to cover exposed energized electrical components, certified and tested insulated tools, etc.) while working on energized systems in accordance with NFPA 70E.

2. Electricians must wear personal protective equipment while working on energized systems in accordance with NFPA 70E.

3. Before initiating any Work, a job specific Work plan must be developed by the Contractor and the Owner. The Work plan must include procedures to be used on and near the live electrical equipment, barriers to be installed, and safety equipment to be used and exit pathways.

4. Work on energized circuits or equipment cannot begin until prior written approval is obtained from the Owner.

1.16 DEFINITIONS

A. As used in this Specification, “provide” means “furnish and install”, “furnish” means “to purchase and deliver to the Project Site complete with every necessary appurtenance and support and to store in a secure area in accordance with manufacturer’s instructions”, and “install” means “to unload at the delivery point at the Site or retrieve from storage, move to point of installation and perform every operation necessary to establish secure mounting and correct operation at the proper location in the Project”.

B. Finished Areas: In general, areas with carpet or tile floors, lay-in or fixed ceiling tile, special architectural ceiling treatment, or tiled, plastered, or paneled walls shall be considered finished areas.

C. Interior: For the purposes of this Specification, interior is any area within the boundaries of the foundation of any building within the superstructure or other structures not classified as a building.

1.17 TEMPORARY POWER

A. The Contractor shall furnish, install, maintain, and remove the temporary electrical power and lighting systems, including lamps, and pay for all labor, materials, and equipment required therefore. All such temporary electrical work shall meet the requirements of the National Electrical Code, the local utility company, and OSHA.

B. The Contractor shall make all necessary arrangements with the local utility company as to where the temporary electric service can be obtained.

C. The Contractor shall secure and pay for all required permits and back charges for Work performed by others, and other expenses incidental to the installation of the temporary electric service.

1.18 POSTED OPERATING INSTRUCTIONS:

A. Provide for each system and principal item of equipment as specified in the technical sections for use by operation and maintenance personnel. The operating instructions shall include the following:

1. Wiring diagrams, control diagrams, and control sequence for each principal system and item of equipment.

2. Start up, proper adjustment, operating, lubrication, and shutdown procedures.

3. Safety precautions.

4. The procedure in the event of equipment failure.

5. Other items of instruction as recommended by the manufacturer of each system or item of equipment.

B. Print or engrave operating instructions and frame under glass or in approved laminated plastic. Post instructions where directed. For operating instructions exposed to the weather, provide weather-resistant materials or weatherproof enclosures. Operating instructions shall not fade when exposed to sunlight and shall be secured to prevent easy removal or peeling.

1.19 MANUFACTURER'S NAMEPLATE

A. Each item of equipment shall have a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

1.20 FIELD FABRICATED NAMEPLATES

A. Provide laminated plastic nameplates for each equipment enclosure, relay, switch, and device; as specified in the technical sections or as indicated on the Drawings. Each nameplate inscription shall identify the name of the equipment, function and, when applicable, the position. Nameplates shall be melamine plastic, 0.125 inch thick, black with white letters. Surface shall be matte finish. Corners shall be square. Accurately align lettering and engrave into the core. Minimum size of nameplates shall be one by 2.5 inches. Lettering shall be a minimum of 0.25 inch high normal block style. All electrical equipment shall be labeled with the following:

1. Panel Name
2. Fed from "Panel Name" & "CKT #"
3. Amps
4. Volts
5. Phase

1.21 ARC FLASH LABEL

A. Provide arc flash labels for all electrical equipment with operating voltages greater than 50 volt per NEC 110.16.

1.22 WARNING SIGNS

A. Exterior warning and caution signs shall be weather resistant, nonfading, preprinted cellulose acetate butyrate signs with 20 gauge, galvanized steel backing, with colors, legend, and size appropriate to the location.

B. Interior warning and caution signs shall be aluminum signs with preprinted baked enamel finish and punched for fasteners. Colors, legend, and size appropriate to location.

1.23 WIRE AND CABLE MARKERS

A. Underground line marking tape shall be permanent, bright colored, continuous printed, metal backed, plastic tape compounded for direct burial service not less

than 6 inches wide. Printed legend indicative of general type of underground line below.

B. Wire labels for wires smaller than No. 4. shall be vinyl or vinyl cloth, self-adhesive, wraparound, wire markers with preprinted numbers and letters. Wire sizes No. 4 and larger and multi conductor cables shall be marked with one-piece, nylon locking marker ties equal to Panduit PLM Series.

C. Reference Section 26 05 43 UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS for further requirements.

PART 2 – PRODUCTS

2.01 MATERIALS

A. Materials and equipment shall be listed by UL unless it can be demonstrated that no UL standards exist for a specific item or class of equipment.

B. All other materials, not specifically described but required for a complete and operable electrical installation, shall be new, first quality of their respective kinds, Specification grade or better, and as selected by the Contractor subject to the acceptance by the Engineer.

C. All materials and equipment furnished and installed on this Project shall meet the most stringent efficiency standards of the local utility to qualify for the maximum rebate.

2.02 MATERIAL AND CONSTRUCTION REQUIREMENTS

A. Unless otherwise shown or specified, all enclosures, motors, wiring and other materials and all construction methods shall conform to the following:

1. Indoor, Above Ground, Dry Areas: NEMA 12, General Purpose, with gasketing for applications where atmospheric conditions are normal. Enclosures shall be sheet steel, treated to resist corrosion, prime painted and finished with a gray baked-on enamel. Control stations shall have NEMA 13, oil tight and dust-tight enclosures.

2. Outdoors, Damp Areas and Indoor Below Grade Areas: NEMA 4X, watertight. Enclosures shall be cast aluminum or stainless steel. Where indicated on electrical Plans provide NEMA 4X enclosures of stainless steel or reinforced non-metallic (Krydon) construction. All installations shall utilize only stainless steel fasteners/hardware.

3. Indoor-Outdoor, Subject to Submersion in Liquid: NEMA 6, submersible, liquid tight construction. Enclosures shall be cast aluminum.

4. Hazardous Areas: NEMA 7 & 9, explosion-proof construction for Class 1, Division 1, Group D areas. Enclosures shall be cast aluminum.

5. Corrosive Atmospheres - All Work located in corrosive atmospheres shall be of such construction that the corrosive agent cannot enter into and damage the electrical work. All materials in these areas shall be non-corrodible or finished with an inert coating. Stainless steel, or reinforced PVC electrical enclosures and PVC coated rigid conduit and fittings are required. In addition, provide gas tight seals in all conduits passing from or into corrosive areas (similar to Crouse Hinds Type EYS), to minimize migration of corrosive fumes to other building areas.

2.03 INTERCHANGEABILITY

A. In all design and purchasing, interchangeability of items of equipment, subassemblies, parts, motors, starters, relays and other items is essential. All similar items shall be of the same manufacturer, type, model and dimensions.

B. For ease of maintenance and parts replacement, to the maximum extent possible, use equipment of a single manufacturer.

C. The Engineer reserves the right to reject any submittal which contains equipment from various manufacturers if suitable materials can be secured from fewer manufacturers and to require that source of materials be unified to the maximum extent possible.

2.04 SOURCE QUALITY CONTROL

A. Provide in accordance with Division 01 General Requirements.

PART 3 – EXECUTION

3.01 COORDINATION

A. Prior to all Work of this section, carefully inspect the installed Work of all other trades and verify that all such Work is complete to the point where this installation may properly commence.

B. Field verify all locations and dimensions to ensure that the equipment will be properly located, readily accessible, and installed in accordance with all pertinent codes and Regulations, the Contract Documents, and the referenced standards.

C. The Work shall be carefully laid out in advance, and where cutting, drilling, etc., of floors, walls, ceilings, or other surfaces is necessary for the proper installation, this Work shall be carefully done, and any damage to building, piping, or equipment shall be repaired by skilled mechanics of the trades involved at no additional cost to the Owner.

D. In the event any discrepancies are discovered, immediately notify the Owner's Representative in writing. Do not proceed with installation in areas of discrepancy until all such discrepancies have been fully resolved.

3.02 INSTALLATION

A. Install all equipment and fixtures in complete accordance with the manufacturer's recommendations and all pertinent codes and Regulations.

B. Thoroughly inspect all items of equipment and any items dented, scratched, or otherwise damaged in any manner shall be replaced or repaired and painted to match original finish. All items so repaired and refinished shall be brought to the attention of the Engineer for inspection and acceptance.

C. Coordinate the installation of required supporting devices and sleeves to be set in poured-in-place concrete or supported from or on other structural components, as they are constructed.

D. Sequence, coordinate, and integrate installations of electrical materials and equipment for efficient flow of the Work. Give particular attention to large equipment requiring positioning prior to closing in the building and equipment which must be placed in service before further construction can take place.

E. Where mounting heights are not detailed or dimensioned, install systems, materials, and equipment to provide the maximum headroom possible.

F. The final routing of raceways shall be determined by structural conditions, interferences with other trades and by terminal locations on apparatus. The Engineer reserves the right of a reasonable amount of shifting at no extra cost up until time of roughing in the Work.

G. Where circuits are shown as "home-runs" all necessary fittings and boxes shall be provided for a complete raceway installation.

H. In general, wiring and raceway systems for security alarm, fire alarm, telephone and intercommunications systems are not indicated on the Drawings but shall be furnished and installed under this section.

I. Each lighting and each receptacle circuit shall have its own neutral, dedicated to that circuit. A common neutral for more than one signal phase circuit is not allowed.

J. Surface mounted panel boxed, junction boxes, conduits, etc., shall be supported by spacers to provide a clearance between wall and equipment.

K. Upon completion of all installation, lamping, and testing, thoroughly inspect all exposed portions of the electrical installation and completely remove all exposed labels, soils, markings and foreign material.

3.03 MARKING AND LABELING

A. All panelboards, indoor transformers, cabinets, control panels and other specified equipment shall be labeled with engraved laminated plastic plates with engraved letters. Punch tapes with mastic backings are not acceptable.

B. All starters, disconnect switches and other specified equipment shall be marked with engraved laminated plastic plates and engraved letters. Where individual switches are circuit breakers in power or distribution panel boards do not have cardholders, they shall be marked with ½" high labels.

C. All empty conduits shall have labels tied to the pull string at each end of each empty conduit, marked as to identification of each end. Junction boxes with circuits provided for future use shall be labeled with appropriate circuit designation.

D. All panelboards directories shall be filled out with typewritten identification of each circuit.

3.04 WIRE AND CABLE MARKERS

A. Tag control circuit conductors at both ends and at junction box splices using permanent wire marker tape with printed identification numbers as designated on equipment wiring diagrams. Provide typed listing to identify conductors by number and use.

B. Wire and marker tape: shall consist of a polyester film tape with acrylic, pressure-sensitive adhesive. Must meet ASTM D-1000 standard test methods. Tape shall be suitable for temperatures of -40 to 250 degrees F. 3M ScotchCode Wire Marker Tape or equal.

C. Identify spare conductors, individually, at both ends and at junction box splices with number between 1 and 999. Do not duplicate numbers.

D. Identify wire numbers on terminal block marking strips.

E. Provide permanent plastic name tag indicating load for each feeder for all junction boxes, handholes and manholes. Label all process motor wires to yard equipment in handholes and manholes.

3.05 TEST & SETTINGS

A. Provide the services of an independent Testing Agency to perform the specified tests outlined in their respective specification sections.

B. Provide the services of a recognized independent testing agency to perform Commissioning of Electrical Systems as specified in Section 26 08 00 Commissioning of Electrical Systems.

C. Provide necessary material, equipment, labor and technical supervision to perform and complete the Electrical Acceptance Tests as required.

D. Acceptance tests as herein specified are defined as those tests and inspections required to determine that the equipment involved is acceptable as delivered to the job Site, that the equipment may be energized for final operational tests and is in accordance with the Specifications.

E. Final acceptance of the equipment and/or workmanship will depend upon performance characteristics as determined by the subject tests, in addition to complete operation tests, on all electrical equipment to show that it will perform the functions for which it was designed.

F. If the test and inspection data submitted should indicate deficiencies in the operation of the electrical apparatus or in the manufacturer thereof, the Contractor shall promptly implement the necessary adjustments, corrections, modifications and/or replacements necessary to be made to meet the specified requirements.

G. Upon completion of the remedial Work, the Testing Agency shall repeat all of the tests on components previously found deficient on the first test or any additional test if they be required. It shall be the responsibility and obligation of the Contractor to have all remedial Work accomplished as may be required by second and/or additional tests.

3.06 CLEANING

A. When all Work is complete and has been tested and accepted by the Owner's Representative, the Contractor shall clean all light fixtures, equipment, and exposed surfaces that have been directly affected by this Work. The Contractor, insofar as the Work is concerned, shall at all times keep the premises in a neat and orderly condition and at the completion of the Work shall properly clean up and remove from the Site any excess materials.

3.07 FIELD QUALITY CONTROL

A. Provide in accordance with Division 01 General Requirements.

3.08 STARTUP & COMMISSIONING

A. Provide in accordance with Division 01 General Requirements.

END OF SECTION

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SECTION 26 05 19

LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes

1. Provide the labor, tools, equipment, and materials necessary to install wires, cables, and connectors in accordance with the Plans and in accordance with this section and applicable reference standards listed in Article 1.03.

2. This section includes wires, cables, and connectors for power, lighting, signal, control, and related systems rated 600 volts and less.

B. Related Requirements

1. Division 26, Section 26 05 00 COMMON WORK RESULTS FOR ELECTRICAL

1.02 PRICE AND PAYMENT PROCEDURES

A. Measurement and payment requirements: per Division 01 General Requirements.

1.03 REFERENCES

A. Reference Standards

1. NATIONAL FIRE PROTECTION ASSOCIATION (NFPA) 70

2. NATIONAL ELECTRICAL CODE (NEC)

3. UNDERWRITER'S LABORATORIES, INC. (UL)

a. UL Standard 83 Thermoplastic Insulated Wires and Cables

b. UL Standard 486A Wire Connectors and Soldering Lugs for Use with Copper Conductors

c. UL Standard 854 Service Entrance Cable

4. NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

a. WC 5 Thermoplastic Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy

b. WC 7 Cross-Linked Thermosetting Polyethylene Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy

c. WC 8 Ethylene Propylene Rubber Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy

5. INSTITUTE OF ELECTRICAL AND ELECTRONIC ENGINEERS (IEEE)

a. Standard 82 Test Procedure for Impulse Voltage Tests on Insulated Conductors

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination, Sequencing, and Scheduling: per Division 01 General Requirements.

1.05 SUBMITTALS

A. Submit in accordance with Division 01 General Requirements.

B. Product Data

1. Product data for electrical wires, cables, and connectors

2. Product data for Megger insulation testing instrument

3. Report sheets for Megger testing

C. Manufacturer Reports

1. Furnish manufacturer's product data, test reports, and materials certifications as required

1.06 QUALITY ASSURANCE

A. Provide in accordance with Division 01 General Requirements.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Provide in accordance with Division 01 General Requirements.

B. Deliver wire and cable properly packaged in factory fabricated type containers, or wound on NEMA specified type wire and cable reels.

C. Store wire and cable in clean dry space in original containers. Protect products from weather, damaging fumes, construction debris, and traffic.

1.08 SITE CONDITIONS

A. Existing Conditions: per Division 01 General Requirements.

PART 2 – PRODUCTS

2.01 MATERIALS

A. General

1. Provide factory-fabricated wires of sizes, ampacity ratings, and materials for applications and services indicated. Where not indicated, provide proper wire selection as determined by Installer to comply with Project's installation requirements, NEC and NEMA standards.

2. Provide color-coding for phase identification as specified herein.

3. Provide factory applied nylon or polyvinyl chloride (PVC) external jackets on wires and cables for pulls in raceways over 100 feet in length, for pulls in raceways with more than three equivalent 90 degree bends, for pulls in conduits underground or under slabs on grade, and where indicated.

B. Service & Distribution Wiring

1. 98 percent conductivity copper

2. 600 volt insulation, type XHHW or XHHW-2

3. U.L. listed for underground use in wet locations at 75°C

C. Building Wiring

1. 98 percent conductivity copper

2. 600 volt insulation, type, THWN/THHN, or XHHW

3. Stranded conductor: 14 AWG and larger

4. Minimum branch circuit: 12 AWG

5. Minimum 10 AWG for 120-volt circuits more than 100 feet long

6. Minimum 10 AWG for 277-volt circuits more than 230 feet long

D. Control Wiring

1. Control wiring for digital/discrete signal wiring, shall be 600V, minimum 14 AWG, THHN/THWN, copper stranded, unless specifically indicated otherwise.

2. Instrument cable for analog signal wiring (4-20mA DC) shall be shielded, 2-conductor, 300 volt rated, minimum 18 AWG, Belden No. 8760, Alpha Wire, or approved equal. Provide 600 volt rated cable where cable occupies the same enclosure and/or raceway with voltages greater than 300 volt as specified below

3. Single Shielded Pair Instrument Cable

   a. Tinned copper, XLPE insulated stranded conductors, 18 AWG minimum, twisted pair with overall shield, stranded tinned 18 AWG copper drain wire and overall PVC jacket. Rated for 600 volts minimum and conforming to UL 1581. Cables shall be rated for tray cable (TC) use where installed within a cable tray.

1. Multi-paired Shielded Instrument Cable

   a. Tinned copper, XLPE insulated stranded conductors, No. 16 AWG minimum, twisted pairs with shield over each pair, stranded tinned No. 18 AWG copper drain wire, and overall PVC outer jacket. Rated for 600 volts minimum and conforming to UL 1581 or UL 13. Cables shall be rated for tray cable "TC" use where installed within a cable tray.

E. Variable Frequency Drive (VFD) Cable

1. VFD load-side power cable shall be shielded type specifically listed for use with Variable Frequency Drives.

2. VFD cable shall be UL listed with 600V black XLPE insulation.

3. Cable shall be equipped with 100 percent foil shield.

4. Cables shall be stranded type with number and sizes of conductors as indicated on the Drawings.

5. Cable shall be equal to Belden Series 295XX, or Engineer approved equal.

F. Splices

1. No. 10 and smaller with 600-volt pressure type insulated connector of wire-nut type, or equal; soldered and crimped type not allowed. Ideal type wire nut Buchanan type B-Cap and Minnesota Mining (3M) type Scotchlok.

2. No. 8 and larger with solderless lugs or solderless connectors of lock-tite or similar type properly taped with plastic insulating tape, Minnesota Mining Co. #33, or equal, then two half-lap servings of friction tape, Manson, or equal.

3. Wire connector systems for use with underground conductors shall be UL listed specifically for such use

4. Service entrance conductors shall be installed without splices. Electrical equipment feeders shall be spliced only where shown or specifically approved. Control and metering conductors shall be installed without splices.

5. All splices shall be made only by specific permission of the Engineer and then only in manholes or pull boxes and shall be sealed watertight with a heat-shrunk insulation.

6. Tighten electrical connectors and terminals in accordance with manufacturer's published torque tightening values. Where manufacture's torqueing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL Standards 486A and 486B.

7. Use UL listed splice for all underground wires, ducts buried, in conduit and in ducts. Connectors and splices shall be waterproof.

2.02 SOURCE QUALITY CONTROL

A. Provide in accordance with Division 01 General Requirements.

PART 3 – EXECUTION

3.01 WIRE AND CABLE INSTALLATION

A. All wire and cables shall be installed in conduit of size and type indicated on the Drawings and Specifications.

B. Install electrical cables, wires, and connectors in compliance with NEC.

C. Pull conductors simultaneously where more than one is being installed in same raceway. Use UL listed pulling compound or lubricant, where necessary.

D. Use pulling means including, fish tape, cable, rope, and basket weave wire/cable grips, which will not damage cables or raceways. Do not use rope hitches for pulling attachment to wire or cable.

E. Conceal all cable in finished spaces.

F. Install exposed cable parallel and perpendicular to surfaces or exposed structural members, and follow surface contours, where possible.

G. Conductors shall be sized such that voltage drop does not exceed 3 percent for branch circuits or 5 percent for feeder/branch circuit combination.

H. Provide adequate length of conductors within electrical enclosures and train the conductors to terminal points with no excess. Bundle multiple conductors, with conductors larger than 10 AWG cabled in individual circuits. Make terminations so there is no bare conductor at the terminal.

I. All feeder and branch circuit wiring shall be color coded at all termination and splice locations. System neutrals shall be designated in addition to phase conductors. Equipment grounds shall be green.

J. The number of conductors shown on the Drawings is not necessarily the correct number required. As many conductors as are required in each case shall be installed. In general, grounding conductors are not scheduled.

K. In general, wiring for the following systems shall be installed in separate conduits. Do not mix categories in a single raceway.

1. 120 volt power wiring

2. 120 volt control wiring, including, digital input and output signals

3. 24 volt DC control wiring, including, digital input and output signals

4. 24 volt DC analog control wiring (4-20mA)

5. Communications wiring

6. Special & Emergency Systems

L. Conductors 600 volts and below shall be color coded in accordance with the following:

CONDUCTOR	120 / 208 COLOR	480 / 277 COLOR
Phase A	Black	Brown
Phase B	Red	Orange
Phase C	Blue	Yellow
Neutral	White	White / Gray
Equipment Grounds	Green	Green

3.02 FIELD QUALITY CONTROL

A. Provide in accordance with Division 01 General Requirements.

B. The Contractor shall test each electrical circuit after permanent cables are in place with terminators installed, but before cable or wire is connected to equipment or devices to demonstrate that each circuit is free from improper grounds and short circuits.

C. The Contractor shall Megger Test the insulation resistance between phases and from each phase to ground for each of the following feeder and motor branch circuits:

1. Secondary Service Entrance

2. Power Distribution Equipment

3. Generator and ATS

4. Transformers

5. Variable Frequency Drives

6. Motors

D. The Megger Testing shall be witnessed by the Engineer. The Engineer shall be notified at least 48 hours in advance of testing.

E. Measure the insulation resistance with a digital Megger insulation testing instrument in accordance with manufacturer's recommendations. All test instruments are to be provided by the Contractor.

F. If any insulation resistance measures less than 50 megohms, the cable shall be considered faulty with the cable failing the insulation test. In moist environments, bag the ends of the cable to prevent a faulty Megger test.

G. Any cable which fails the insulation tests or which fails when tested under full load conditions shall be replaced with new cable for the full length and retested at no additional cost to Owner.

H. The below grade service or feeder splice shall be water immersion Megger tested in the presence of the Engineer. Each splice shall be immersed in a grounded water immersion bath for 24 continuous hours prior to and during the test. Criteria for failure shall be as described for cable above.

3.03 STARTUP & COMMISSIONING

A. Provide in accordance with Division 01 General Requirements.

3.04 CLOSEOUT ACTIVITIES

A. Provide in accordance with Division 01 General Requirements.

END OF SECTION

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SECTION 26 05 26

GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 – GENERAL

1.01 SUMMARY

A. Provide all labor, tools, equipment, materials and appurtenances necessary to furnish and install grounding materials in accordance with the Drawings and as specified herein. This section includes solid grounding of electrical systems and equipment.

B. Related Requirements

1. Division 26, Section 26 08 00 COMMISSIONING OF ELECTRIAL SYSTEMS

1.02 PRICE AND PAYMENT PROCEDURES

A. Measurement and payment requirements: per Division 01 General Requirements.

1.03 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. Unless otherwise noted, the most recent version of the listed publications, including revisions, at time of bid opening shall apply.

B. NATIONAL ELECTRICAL CODE (NEC), as applicable to electrical grounding and bonding, Art. 250.

C. UNDERWRITERS' LABORATORIES, INC. (UL)

1. UL 467 Electrical Grounding and Bonding Equipment

D. INSTITUTE OF ELECTRICAL AND ELECTRONIC ENGINEERS (IEEE) IEEE 81 AND 142

1. 81-2012 IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Grounded System (Part 1)

2. 141-1993 IEEE Recommended Practice for Electric Power Distribution for Industrial Plants

3. 142-2007 IEEE Recommended Practice for Grounding of Industrial and Commercial Power Systems

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination, Sequencing, and Scheduling: per Division 01 General Requirements.

1.05 SUBMITTALS

A. Submit in accordance with Division 01 General Requirements.

B. All submittals shall have pertinent numerical data and information specified in the "English" language using "English" units. The submittals shall include but are not limited to the following in addition to Division 01 General Requirements.

C. Product Data

1. Provide product data for all grounding equipment and appurtenances, including but not limited to; wires, connectors, lugs, clamps, ground rods, bonding jumpers and accessories.

1.06 QUALITY ASSURANCE

A. Provide in accordance with Division 01 General Requirements.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Provide in accordance with Division 01 General Requirements.

1.08 SITE CONDITIONS

A. Existing Conditions: per Division 01 General Requirements.

PART 2 – PRODUCTS

2.01 GENERAL

A. Provide each electrical grounding system with assembly of materials required for complete installation including wires/cables, connectors, lugs, clamps, ground rods, bonding jumpers and accessories.

B. Provide electrical grounding conductors for grounding connections matched to power supply wiring materials and sized according to NEC.

C. Provide electrical connectors, lugs, clamps, boding jumpers and accessories as recommended by the respective manufacturer for the particular application, unless other indicated.

D. Ground Rods: Solid copper clad, 3/4-inch diameter by 10 feet long

E. Insulated Conductors: Green in color

F. Ground Bus. Bare annealed copper bars of rectangular cross section, ¼-inch x 3-inch x length as required, with 98 percent conductivity, rigidly attached to structure.

G. Bonding Strap Conductor/Connectors: Soft copper, 0.05-inch thick and 2-inches wide, except as indicated.

H. Pressure Connectors: High conductivity plated units

I. Bolted Clamps: Heavy-duty units listed for the application

J. Exothermic Welded Connections: Provided in kit form and selected for the specific types, sizes, and combinations of conductors and other items to be connected.

2.02 SOURCE QUALITY CONTROL

A. Provide in accordance with Division 01 General Requirements.

PART 3 – EXECUTION

3.01 GROUNDING & BONDING

A. Ground main service entrance ground bus or lug to neutral of incoming service, to enclosure, to building steel, to ground rods/grounding ring, to rebar in concrete footing, and to main cold water pipe. Install grounding bushings or service conduits. Use exothermic style ground connections to the ground rods and building steel.

B. Use of conduit system for ground conductor shall not be allowed.

C. Provide and install 600 volt insulated bonding conductors throughout the distribution system with connection to bonding (or grounding) terminal on each panel and panel board with connections to other equipment where specifically indicated and noted.

D. Bonding conductors shall be continuous where possible. Where splices are required, provide compression connectors of approved pattern. Insulate connectors to equivalent thickness of conductors.

E. Provide grounding system for grounded circuit conductors of dry type transformer secondaries in accordance with NEC. Use exothermic style ground connections to building steel. Enclose grounding conductors in schedule 40 PVC conduit.

F. Provide equipment grounding conductors in all conduits containing power, control, or instrumentation conductors on the load side of the service equipment or on the load side of a separately derived system.

G. Comply with NEC Article 250 for sizes and quantities of equipment grounding conductors, except that larger sizes indicated or shown on the Contract Documents shall take precedence. Use of metallic conduit systems for equipment grounding as recognized by the NEC shall not be permitted under this specification.

H. Install grounding bushings on conduits at both primary and secondary entrances to transformers. Ground transformer enclosures to bushings.

I. Install bonding jumper for flexible metal conduit unless fittings are approved for grounding or otherwise comply with NEC.

1. Size jumper to match over-current device

2. Green insulation

3. Connect to grounding bushing at each end.

J. Ensure that entire electrical system is electrically continuous and permanently and effectively grounded, including all electrical equipment and motors.

1. Locate ground rods with a minimum of two rod length from each other and at least the same distance from any other grounding electrode. Connect ground conductors to ground rods by means of exothermic welds except at test wells and as otherwise indicated. Drive rods until tops are 24 inches below finished floor or final grade except as otherwise indicated.

K. Route grounding electrode conductors along the shortest and straightest paths possible without obstructing access or placing conductors where they may be subjected to strain, impact, or damage, except as indicated.

L. Ensure that grounding electrode conductor connections to interior piping, structural members, and the like are accessible for periodic inspection during the life of the structure.

3.02 BONDING FOR OTHER TRADES

A. Signal raceways, water piping, heating piping and metallic air ducts shall be bonded together and to the grounding conductor with No. 8 soft drawn bare solid conductors. Connections to pipes shall be made with cast clamps of like material as the pipes to which attached, to ducting terminated in a secure manner by best practical means, bonding across any flexible or insulated connections.

B. All bonding conductors shall be installed in a neat manner properly shaped for contour of surface involved and properly supported. At locations remote from the main service entrance panel boards, bond to the largest raceway nearby.

3.03 FIELD TESTING

A. Provide the services of an independent Testing Agency to perform the specified tests for the following systems:

1. Ground resistance. The Testing Company shall perform all testing in accordance with National Electrical Testing Association (NETA) standards and procedures. All testing results shall be submitted on NETA forms and the testing data shall be certified by the respective Agency. Test results shall indicate recommended action for a sub-par test results. Results shall list recommended test values that should be obtained for new installation.

A. Measure ground resistance without the soil being moistened by any means other than natural precipitation or natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance. Perform tests by the three-point fall of potential method in accordance with Section 9.03 of IEEE 81. Simple moisture addition is not acceptable.

B. Ground/resistance maximum values shall be as follows:

1. Equipment rated 500 kVA and less: 10 ohms

2. Equipment rated 500 kVA to 1000 Kva: 5 ohms

3. Equipment rated over 1000 kVA: 3 ohms

4. Unfenced substations and pad mounted equipment: 5 ohms

5. Fence Grounds: 10 ohms

C. Where ground resistances exceed specified values, and if directed, modify the grounding system to reduce resistance values.

3.04 FIELD QUALITY CONTROL

A. Provide in accordance with Division 01 General Requirements.

3.05 STARTUP & COMMISSIONING

A. Provide in accordance with Division 01 General Requirements.

3.06 CLOSEOUT ACTIVITIES

A. Provide in accordance with Division 01 General Requirements.

END OF SECTION

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SECTION 26 05 33

RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes

1. Provide the labor, tools, equipment, and materials necessary to furnish and install raceways, boxes, and supporting devices in accordance with the Plans and applicable reference standards listed in Article 1.03.

B. Types of products specified in this section include

1. Conduit, Raceways & Fittings

2. Supporting Devices

3. Boxes and Fittings

C. Related Requirements

1. Division 26, Section 26 05 00 COMMON WORK RESULTS FOR ELECTRICAL

2. Division 26, Section 26 05 43 UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS

1.02 PRICE AND PAYMENT PROCEDURES

A. Measurement and payment requirements: per Division 01 General Requirements.

1.03 REFERENCES

A. Reference Standards

1. UNDERWRITERS LABORATORIES, INC. (UL) Listing and Labeling. Items provided under this section shall be listed and labeled by UL

2. NATIONAL ELECTRICAL CODE (NEC)

3. NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination, Sequencing, and Scheduling: per Division 01 General Requirements.

1.05 SUBMITTALS

A. Submit in accordance with Division 01 General Requirements.

B. Furnish manufacturer's product data, test reports, and material certifications as required.

C. Product data for cabinets and enclosures.

D. Shop Drawings for floor boxes and boxes, enclosures and cabinets that are to be shop fabricated (non-stock items)

1.06 QUALITY ASSURANCE

A. Provide in accordance with Division 01 General Requirements.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Provide in accordance with Division 01 General Requirements.

1.08 SITE CONDITIONS

A. Existing Conditions: per Division 01 General Requirements.

PART 2 – PRODUCTS

2.01 CONDUIT, RACEWAYS & FITTINGS

A. Provide conduit with 3/4 inch diameter minimum, except where specifically shown smaller on the Drawings.

B. Conduit, connectors, and fittings shall be approved for the installation of electrical conductors.

C. Refer to Table 3.01A for approved conduit installation guidelines.

1. Electrical Metallic Tubing (EMT)

a. EMT shall be rigid metallic conduit of the thin wall type in straight lengths, elbows, or bends and must conform to NEMA C80.3 and the requirements of UL 797.

b. Couplings and connectors shall be steel compression fittings. Where EMT enters outlet boxes, cabinets, or other enclosures,

connectors must be the insulated-throat type, with a locknut. Fittings must meet the requirements of NEMA FB 1.

2. Rigid Galvanized Steel Conduit

   a. Rigid steel conduit (RGS), including couplings, elbows, bends, and nipples, shall conform to the requirements of UL 6 and NEMA C80.1 Steel fittings shall be galvanized by the hot-dip process.

   b. Fittings for rigid steel conduit shall be threaded and shall conform to NEMA FB 1.

   c. Gaskets shall be solid for fittings sized 1-1/2 inches and less. Conduit fittings with blank covers shall have gaskets except in clean, dry areas or at the lowest point of a conduit run where drainage is required.

   d. Covers shall have captive screws and be accessible after the Work has been completed.

3. Rigid Aluminum Conduit

   a. RAC, including couplings, elbows, bends, and nipples, shall conform to the requirements of UL 6 and ANSI C80.5.

   b. Fittings for rigid aluminum conduit shall be threaded and shall conform to NEMA FB 1. Fittings shall be galvanized by the hot dip process, unless manufacturer dictates aluminum for specific application.

   c. Gaskets shall be solid for fittings sized 1-1/2 inches and less. Conduit fittings with blank covers shall have gaskets except in clean, dry areas or at the lowest point of a conduit run where drainage is required.

   d. Covers shall have captive screws and be accessible after the work has been completed.

4. PVC Coated Rigid Metal Conduit

   a. Rigid galvanized metal conduit coated with 40 mils thick polyvinylchloride coating.

   b. Fittings, elbows, supporting devices and accessories shall include factory applied 20 mils thick polyvinylchloride coating and be manufactured by the same as that of the conduit.

   c. Use tools as recommended by the manufacturer so as not to damage PVC coating. Where coating is damaged, touch-up with PVC paint in the field after installation.

5. Rigid Plastic Conduit

   a. PVC Schedule 40: Conduit shall be made of polyvinyl chloride compound that shall be homogeneous plastic material free from cracks, holes or foreign inclusions. Conduit shall be rated for use with 90°C conductors, UL Listed. Use solvent cement to join conduits as manufactured the same as the conduit manufacturer.

   b. PVC Schedule 80: Heavy wall PVC conduit that shall be made of polyvinyl chloride compound that shall be homogeneous plastic material free from cracks, holes or foreign inclusions. Conduit shall be rated for use with 90°C conductors, UL Listed. Use solvent cement to join conduits as manufactured the same as the conduit manufacturer.

6. Flexible Metallic Conduit

   a. Flexible metallic (FM) conduit shall meet the requirements of UL1.

   b. Liquid tight flexible metallic conduit shall be provided with a protective jacket of PVC extruded over a flexible interlocked galvanized steel core to protect wiring against moisture, oil, chemicals, and corrosive fumes.

   c. Fittings for flexible metallic conduit shall meet the requirements of UL 514B, Type I box connector, electrical, Type III coupling, electrical conduit, flexible steel, or Type IV adapter, electrical conduit.

7. Wireways

   a. Wireways and auxiliary gutters for use in exposed, dry locations shall be a prefabricated channel-shaped sheet metal trough with hinged or removable covers, associated fittings, and supports for housing, and protecting electrical wires and cables in accordance with UL 870.

   b. Straight sections of trough, elbows, tees, crosses, closing plates, connectors, and hanging brackets shall be constructed from sheet steel of commercial quality not less than 16-gage. Sheet metal component parts shall be cleaned, phosphatized, and coated with a corrosion-resistant gray paint.

   c. Straight sections of wireways and auxiliary gutters shall be solid or have knockouts as indicated in both sides and bottom, 3 inches on center.

   d. Straight sections shall be not more than 5-feet long, with covers held closed with screws.

8. Conduit Seals

a. Provide factory fabricated watertight conduit sealing bushing assemblies suitable for sealing around conduit, or tubing passing through concrete floors and walls. Provide a cast in place water stop wall sleeve with a mechanical pipe seal between the conduit and the sleeve. Construct seals with steel sleeve, malleable iron body, neoprene sealing grommets or rings, metal pressure rings, pressure clamps, and cap screws.

b. Provide E.Y.S. seal fittings with appropriate potting material where conduits enter or leave a Class 1, Division 1 or 2 environments or a Class 2, Division 1 or 2 environment, and chemical rooms.

2.02 SUPPORTING DEVICES

A. Supports, support hardware, and fasteners shall be protected with zinc coating or with treatment of equivalent corrosion resistance using approved alternative treatment, finish, or inherent material characteristic. Products for use outdoors shall be hot dip galvanized unless material is inherently corrosion resistant.

B. Refer to Table 2.02A for approved supporting device installation guidelines.

1. Conduit Supports

a. Single run hangers: Galvanized steel conduit straps or clamps, or cast metal beam clamps. Perforated straps and spring steel clips and clamps will not be permitted.

b. Group run hangers: Minimum 12-gauge galvanized performed U-channel rack with conduit fittings; 25 percent spare capacity

c. Hanger rods: Threaded steel, 3/8-inch diameter, or as identified on the Drawings

d. Vertical run supports: Minimum 12-gauge galvanized performed U-channel struts with conduit fittings

2. Equipment and Lighting Supports

a. 12-gauge galvanized performed U-channel struts with fixture and conduit fittings, as applicable, unless indicated otherwise on the Drawings.

3. Corrosive Area Supports

a. Clamp Hangers, Pipe Straps, and Clamp Back Spacers for use with PVC-coated rigid metal conduit shall have 40 mil gray PVC exterior coating.

b. Clamp Hangers, Pipe Straps, etc. for use with PVC nonmetallic conduit shall be of nonmetallic PVC material.

c. Hanger Rods: 20 mil gray PVC exterior coated rod with threaded ends only 3/8 inch and 1/2 inch sizes as required.

d. Strut Support: 20 mil gray PVC exterior coating strut. Standard channel, slotted channel, and back to back channel are acceptable.

e. Provide stainless steel supports and accessories in lieu of PVC coated supports when indicated in Table 2.02A below.

TABLE 2.02A – Supporting Devices

LOCATION/EQUIPMENT	ACCEPTABLE SUPPORT TYPE
Electrical & Control Rooms	Galvanized Steel U-Channel
Odor Control Room	Galvanized Steel U-Channel
Exterior	Galvanized Steel U-Channel
Pump Station Wet Well/ Stairwell	PVC Coated Steel U-Channel
Pump Station Dry Well/ Stairwell	304 Stainless Steel U-Channel

2.03 BOXES AND FITTINGS

A. Boxes must have sufficient volume to accommodate the number of conductors entering the box in accordance with the requirements of NFPA 70 and UL 514A.

B. In general, boxes that are exposed to weather, process areas, normally wet locations, and locations exposed in mechanical spaces shall be cast-metal. Boxes in all other finished areas shall be sheet metal. Boxes installed in corrosive areas, such as the chemical feed room, shall be nonmetallic.

C. Refer to Table 2.03A for approved enclosure types.

1. Sheet Metal Outlet Boxes

a. Sheet Metal Outlet Boxes: Standard type galvanized steel, minimum four inch square or octagon by 1-1/2 inch deep.

b. Luminaire and Equipment Supporting boxes: Rated for weight of equipment supported; include 2 inch male fixture studs where required.

c. Single Wall Type: Minimum size, four inch square by 1-1/2 inch or 2-1/8 inch deep, except as noted. Provide dry wall device covers raised 3/4 inch minimum to insure flush finish mounting.

d. Ganged Wall Type: Minimum depth three inches except as noted, ganged as required under common plate to contain devices shown. On 277-volt circuits, ganged boxes for switches shall contain only

one circuit or equip box with permanent barriers per NEC Art 404-8.

2. Cast Outlet Boxes

   a. Type FS shallow and type FD deep, cast ferroalloy

   b. Provide number of threaded hubs as required.

   c. Use in all exterior, damp and locations exposed in mechanical spaces.

   d. Provide gasketed cover and accessories by box manufacturer for complete weatherproofing. Provide correct box to accept weatherproof covers as specified.

3. Sheet Metal Pull & Junction Boxes

   a. Sheet metal boxes shall be standard type galvanized steel and must conform to UL 50.

   b. Box dimensions shall be minimum four inch square or octagon by 2/1/2 inch deep.

   c. Sizes up to 12 by 12 by 6 inches: Provide screw-type or hinged covers.

   d. Sizes greater than 12 by 12 by 6 inches: Provide hinged covers.

   e. Boxes shall be sized to accommodate all incoming raceways.

4. Nonmetallic Outlet, Device, and Wiring Boxes

   a. Conform to NEMA OS 2, Nonmetallic Outlet Boxes, Device Boxes, Covers, and box Supports, and UL 514C, Nonmetallic Outlet Boxes, Flush Device Boxes and Covers. Boxes shall be molded polyvinyl chloride (PVC), or fiberglass units of type, shape, size, and depth to suit location and application.

   b. Boxes shall be equipped with threaded screw holes for device and cover plate mounting. Each box shall have a molded cover of matching material suitable for the application and location installed.

TABLE 2.03A – Electrical Enclosure Types

LOCATION/EQUIPMENT	ACCEPTABLE ENCLOSURE TYPE
Electrical & Control Room	NEMA 1G
Odor Control Room	NEMA 7 within 3'-0" of Odor Control System, NEMA 12 beyond 3'-0" of Odor Control System
Exterior	NEMA 4X (Metallic)
Pump Station Wet Well/ Stairwell	NEMA 7 (Explosion Proof) NEMA 4X for Intrinsically Safe Equipment
Pump Station Dry Well/ Stairwell	NEMA 7 (Explosion Proof) NEMA 4X for Intrinsically Safe Equipment

2.04 SOURCE QUALITY CONTROL

A. Provide in accordance with Division 01 General Requirements.

PART 3 – EXECUTION

3.01 CONDUIT

A. Uses Permitted

1. Use liquid tight flexible metal conduit for the final 24 inches of connections to motors or control items subject to movement or vibration.

2. Use RGS for all exterior aboveground installations unless otherwise noted.

3. Use PVC coated rigid steel conduit, or as scheduled below, for installation in corrosive areas, and other areas as identified on the Drawings.

4. Exposed raceways in Manufacturing Areas, Utility Rooms, Mechanical Rooms, Warehouse Areas, etc., shall be Rigid Galvanized Steel below 15 feet.

5. Conduit and raceway runs in finished areas concealed in or behind walls, above ceilings, or exposed on walls and ceilings 15 feet or more above finished floors and not subject to mechanical damage may be electrical metallic tubing (EMT).

6. Use Schedule 40 PVC conduit for exterior direct buried installations. Use Schedule 40 PVC conduit for exterior concrete encased installations. Use Schedule 80 PVC conduit for underground installations under driveways. The transition from underground and from concrete encasement to riser

shall be PVC coated rigid steel conduit to a minimum of 12 inches above finished floor and/or finished grade elevation. All elbows shall be prefabricated Rigid Steel to prevent wire burn through. Reference Section 26 05 43 UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS for further requirements.

7. Install conduit seals for conduit penetrations of slabs on grade and exterior walls below grade and where indicated. Tighten sleeve seal screws until sealing grommets have expanded to form watertight seal. Provide seals for the interior of conduits that penetrate exterior or water bearing walls, consisting of gland type sealing bushings or RTV closed cell silicone foam.

8. Refer to Table 3.01A below for approved conduit types.

TABLE 3.01A – Conduit Types

LOCATION/EQUIPMENT	APPROVED CONDUIT TYPE
Electrical & Control Rooms	Rigid Galvanized Steel
Odor Control Room	Electrical Metallic Tubing
Exterior	Rigid Galvanized Steel
Pump Station Wetwells	PVC Coated RGS
Pump Station Drywells	Rigid Galvanized Steel
Underground	Schd 40 (Concrete Encased)

B. Power, lighting, control, emergency light and power, and special-service systems and all related components shall be installed in accordance with NFPA 70, and shall be enclosed in separate conduit or separate conduit systems as indicated on the Drawings and as specified herein.

C. Any run of conduit between outlet and outlet, between fitting and fitting, or between outlet and fitting shall contain no more than the equivalent of three 90-degree bends, including those bends located immediately at the outlet or fitting. Field bends shall be made in accordance with the manufacturer's recommendations, which normally require use of a one-size-larger bender than would be required for uncoated conduit. Installed conduit and fittings shall be free of dirt and trash and shall not be deformed or crushed. Empty conduit shall have a pull rope stalled.

D. Conduit shall be installed with a minimum of 3 inches of free air space separation from mechanical piping.

E. Conduit in finished areas shall be installed concealed. Conduit passing through masonry or concrete walls shall be installed in sleeves. Conduit shall be securely clamped and supported at least every 10 feet vertically and 8 feet horizontally.

Galvanized pipe straps shall be fastened to structure with bolts, screws, and anchors. Wooden masonry plugs shall not be used.

F. Install exposed conduits, parallel or perpendicular to walls, ceilings, or structural members. Do not run through structural members. Avoid horizontal runs within partitions or sidewalls. Avoid ceiling inserts, lights, or ventilation ducts or outlets. Do not run conduits across pipe shafts or ventilation duct openings and keep conduits a minimum of 6 inches from parallel runs of flues, hot water pipes, or other sources of heat. Wherever possible, install horizontal raceway runs above water and steam piping.

G. Do not run conduits exposed on the exterior surface of buildings. Conduits penetrating exterior walls below grade, at grade floors, or below grade floors shall be sealed to prevent moisture migration. The exterior of the conduit shall be sealed with a mechanical pipe seal. The interior conduit seal shall be a gland type sealing bushing or RTV closed cell silicone foam. Ensure that conduits do not retain water against these seals.

H. Raceways penetrating fire rated walls, floors, and partitions shall be sealed with a fire rated sealant.

I. All conduits shall be supported with materials specifically made for this purpose. Do not use wire hangers. Do not attach any parts of the raceway system to ventilation ducts. Conduit supports shall be attached to the building. Support conduits on each side of bends and on a spacing not to exceed the following: 6 feet for conduits smaller than 1 1/4 inches and 8 feet for conduits 1 1/4 inches and larger. Support riser conduits at each floor level with clamp hangers. All underground conduits shall be securely anchored to prevent movement during placement of concrete or backfill. Use precast separators and heavy gauge wire ties or other approved fasteners.

J. Provide E.Y.S. seal fittings with appropriate potting material where conduits enter or leave a Class 1, Division 1 or 2 environments or a Class 2, Division 1 or 2 environment, and chemical rooms.

K. Conduit connections to boxes and fittings shall be supported not more than 36 inches from the connection point. Conduit bends shall be supported not more than 36 inches from each change in direction. Conduit shall be installed in neat symmetrical lines parallel to the centerlines of the building construction and the building outline. Multiple runs shall be parallel and grouped whenever possible on common supports. Exposed ends of conduit without conductors shall be sealed with watertight caps or plugs.

L. Bonding wires shall be used in flexible conduit for all circuits. Flexible conduit shall not be considered a ground conductor.

M. Liquid tight flexible metallic conduits shall be used in wet and oily locations and to complete the connection to motor-driven equipment.

N. Electrical connections to vibration-isolated equipment shall be made with flexible metallic conduit in a manner that will not impair the function of the equipment.

O. A polypropylene pull rope with a tensile strength not less than 130 pounds shall be installed in empty conduit.

P. Electrical conduit may be embedded in concrete according to the provisions of Article 6.3 of ACI 318 Building Code Requirements for Reinforced Concrete, provided the following conditions are met:

1. Outside diameter of conduit shall not exceed 1/3 of concrete thickness. Maximum conduit outside diameter shall not exceed 3 inches when embedded in slab.

2. Conduit shall not be placed closer than three diameters on center. Route conduit to minimize crossing of different conduit runs.

3. Conduit shall not be embedded in structural concrete slabs less than four inches thick.

4. A 1-1/2 inch minimum concrete cover shall be provided for conduits in structural concrete slabs.

Q. Installation of Underground Conduit

1. Minimum of 3/4 inch conduit in or under concrete slab on grade.

2. Where conduits are installed in concrete slabs, on the ground, underground, or exposed to the weather, make all joints liquid tight and gas tight.

3. Bury all underground conduit, except under concrete slabs placed on fill, to a depth of at least 30 inches below finished grade unless otherwise indicated on the Drawings .

4. Slope ducts to drain away from buildings into manholes and/or handholes. Adjust final slopes to coordinate with existing Site utilities.

5. Install on undisturbed soil where possible. Concrete encase conduits as shown on Drawings. Use pit run gravel and sand, placed 8-inch lifts and compacted for backfill.

1. Reference Section 26 05 43 UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS for further requirements.

R. Installation of Rigid Metal Conduit

1. Ends of conduit shall be cut square, reamed and threaded, and joints shall be brought butt-to-butt in the couplings. Joints shall be mechanically tight.

Conduit shall be protected against damage and the entrance of water or foreign material during construction.

2. Ninety-degree bends of conduit with a diameter larger than 1 inch shall be made with factory-made elbows. Conduit elbows larger than 2 1/2 inches shall be long radius. Field-made bends and offsets shall be made with an approved hickey or conduit-bending machine. Changes in directions of runs shall be made with symmetrical bends or cast-metal fittings.

3. At connections to sheet metal enclosures and boxes, a sufficient number of threads shall project through to permit the bushing to be drawn tight against the end of the conduit, after which the locknut shall be pulled up sufficiently tight to draw the bushing into firm electrical contact with the box. Conduit shall be fastened to sheet metal boxes and cabinets with two locknuts where required by NFPA 70 where insulating bushings are used, where bushings cannot be brought into firm contact with the box, and where indicated.

4. Conduit joints shall be made with tapered threads set firmly. Each length of conduit cut in the field shall be reamed before installation. Where conduit is threaded in the field, each threaded end shall consist of at least five full threads. Corrosion-inhibitive compound (cold galvanizing paint) shall be used on all conduit threads or any locations where the original hot galvanized surface has been compromised.

5. Conduit stubbed-up through concrete floors for connections to free-standing equipment except motor-control centers, cubicles, and other such items of equipment shall be provided with a minimum of a 12 inch riser above the floor slab is of sufficient thickness; if not, a floor box shall be provided and set flush with the finished floor. Conduits installed for future use shall be terminated with a coupling and plug set flush with the floor.

3.01 SUPPORTING DEVICES

A. Install supporting devices to fasten electrical components securely and permanently in accordance with NEC requirements.

B. Coordinate with the building structural system and with other electrical installations.

C. Conform to manufacturer's recommendations for selection and installation of supports.

D. Install individual and multiple (trapeze) raceway hangers and riser clamps as necessary to support raceways. Provide U-bolts, clamps, attachments, and other hardware necessary for hanger assembly and for securing hanger rods and conduits.

E. Support parallel runs of horizontal raceways together on trapeze type hangers.

F. Support individual horizontal raceways by separate pipe hangers. Spring steel fasteners may be used in lieu of hangers only for 1 1/2 inch and smaller raceways serving lighting and receptacle branch circuits above suspended ceilings only. For hanger rods with spring steel fasteners, use 1/4 inch diameter or larger threaded steel. Use spring steel fasteners that are specifically designed for supporting single conduits or tubing.

G. In vertical runs, arrange support so the load produced by the weight of the raceway and the enclosed conductors is carried entirely by the conduit supports with no weight load on raceway terminals.

H. Support miscellaneous electrical components as required to produce the same structural safety factors as specified for raceway supports. Install metal channel racks for mounting cabinets, panelboards, disconnects, control enclosures, pull boxes, junction boxes, transformers, and other devices.

I. Install sleeves in concrete slabs and walls and all other fire rated floors and walls for raceways and cable installations. For sleeves through fire rated wall or floor construction, apply UL listed fire-stopping sealant in gaps between sleeves and enclosed conduits and cables.

3.02 BOXES AND FITTINGS

A. Pullboxes shall be furnished and installed where necessary in the conduit system to facilitate conductor installation. Conduit runs longer than 100 feet or with more than three right angle bends shall have a pull box installed at a convenient intermediate location.

B. Boxes and enclosures shall be securely mounted to the building structure with supporting facilities independent of the conduit entering or leaving the boxes.

C. Bonding jumpers shall be used around concentric or eccentric knockouts.

D. Installation of Outlet Boxes

1. Use nonmetallic boxes in corrosive areas such as chemical feed area and as designated on the Plans.

2. Use explosion proof boxes in Hazardous areas as identified on the Drawings.

3. Use cast metal boxes in all other locations. Each box with associated covers and fittings shall have a NEMA rating for each location installed.

E. Installation of Pull and Junction Boxes

1. Reference TABLE 2.03A – Electrical Enclosure Types.

3.03 FIELD QUALITY CONTROL

A. Provide in accordance with Division 01 General Requirements.

3.04 STARTUP & COMMISSIONING

A. Provide in accordance with Division 01 General Requirements.

3.05 CLOSEOUT ACTIVITIES

A. Provide in accordance with Division 01 General Requirements.

END OF SECTION

SECTION 26 05 43

UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS

PART 1 – GENERAL

1.01 SUMMARY

A. Provide all labor, materials, equipment and incidentals as shown, specified and required to furnish and install underground duct banks, manholes and handholes including all necessary excavation, backfill and surface restoration.

B. Provide underground conduit duct banks with manholes and pullboxes for power, and lighting circuits as shown on the Drawings.

C. Coordination: Duct bank routing when shown on the Drawings is diagrammatic. Coordinate installation with piping and other underground systems and structures and locate clear of interferences. Coordinate manhole and handhole installation with piping, sheet piling and other underground systems and structures and locate clear of interferences.

D. Related Requirements

1. Division 26, Section 26 05 00 COMMON WORK RESULTS FOR ELECTRICAL

2. Division 26, Section 26 05 33 RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

3. Division 26, Section 26 05 19 LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

4. Division 26, Section 26 05 26 GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

5. Division 26, Section 26 21 00 LOW-VOLTAGE ELECTRICAL SERVICE ENTRANCE

1.02 PRICE AND PAYMENT PROCEDURES

A. Measurement and payment requirements: per Division 01 General Requirements.

1.03 REFERENCES

A. Reference Standards

1. NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

2. THE AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

3. THE INSTITUTE OF ELECTRICAL AND ELECTRONIC ENGINEERS (IEEE)

4. INSULATED CABLE ENGINEERS ASSOCIATION (ICEA)

5. NATIONAL ELECTRICAL CODE (NEC)

6. NATIONAL ELECTRICAL SAFETY CODE (NESC)

7. ANSI A14.3, SAFETY REQUIREMENTS FOR FIXED LADDERS

8. OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION (OSHA)

9. ASTM INTERNATIONAL (ASTM)

   a. ASTM A 48 Gray Iron Castings

   b. ASTM D756 Procedure E: Accelerated Service Exposure

   c. ASTM G53 Recommended Practice for Operating Light and Water Exposure on Nonmetallic Materials (with a U.V.A. 340 bulb)

   d. ASTM D570 Section 5, 6.1, 6.5: Water Absorption

   e. ASTM D790 Flexural Properties

   f. ASTM D635 Flammability Test

B. Definitions

1. Duct: Electrical conduit and other raceway, either metallic or nonmetallic, used underground, embedded in earth or concrete.

2. Duct bank: 2 or more conduits or other raceway installed underground in the same trench or concrete envelope.

3. Handhole: An underground junction box in a duct or duct bank with cover accessible from grade.

4. Manhole: an underground utility structure, large enough for a person to enter, with facilities for installing and maintaining cables. Where required manholes shall comply with the Utility Companies requirements.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination, Sequencing, and Scheduling: per Division 01 General Requirements.

1.05 SUBMITTALS

A. Submit in accordance with Division 01 General Requirements.

B. Shop Drawings

1. Layouts showing the proposed routing of duct banks and the locations of manholes, handholes and areas of reinforcement

2. Profiles of duct banks showing crossings with piping and other underground systems

3. Typical cross sections

4. Installation procedures

5. Manufacturer's technical information for manholes, handholes and accessories proposed for use

6. Drawings showing interior and exterior manhole and handhole dimensions and details of openings, jointing, inserts, reinforcing, size and locations of openings, and accessory locations

7. Certificate of concrete and steel used in underground pre-cast concrete utility structures, according to ASTM C858

8. Product Data for nonmetallic conduit and manhole accessories

C. Record Drawings

1. Layouts showing the actual routing of duct banks including the dimensions and depth of the top of duct bank below grade. Record Drawings for duct banks should also include cross sections of the duct bank indicating the circuit, use, conduit size, orientation and number of conduits.

2. Locations of manholes, handholes, and areas of reinforcement

1.06 QUALITY ASSURANCE

A. Provide in accordance with Division 01 General Requirements.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Provide in accordance with Division 01 General Requirements.

1.08 SITE CONDITIONS

A. Existing Conditions: per Division 01 General Requirements.

PART 2 – PRODUCTS

2.01 DUCT BANK CONDUIT

A. Duct: Schedule 40 and Schedule 80 PVC conduit and fittings in accordance with Section 26 05 33 RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS.

B. Rigid Steel Conduit: Rigid steel conduit and fittings in accordance with Section 26 05 33 RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS.

C. All shielded instrumentation and communications cable shall be installed in ferrous metal, steel conduit throughout the entire run of conduit from end to end.

2.02 MANHOLES

A. Manholes shall conform to the requirements as shown and detailed on the Drawings.

B. Material and Construction

1. Pre-cast reinforced concrete

2. Minimum interior dimensions as indicated on the Drawings or required by the Utility Company

3. Duct entrances sized and located to suit duct banks. Duct-bank penetration shall be watertight.

4. Modular sections with tongue-and-groove joints. Joints shall be gasketed and water tight.

5. Nominal inside dimensions as shown

6. Base Section: Shall include sump, grate, and ground rod openings.

7. Sump Covers; ASTM A48; Class 30B galvanized iron

C. Frames and Covers

1. Material: Cast iron conforming to ASTM A 48, Class 30A

2. Covers: 42 inch minimum diameter, watertight, sealed type, marked "ELECTRICAL" in raised 2-inch letters

3. Frame shall be grouted on the manhole.

4. Manufacturer: Provide frames and covers of one of the following

   a. Neenah Foundry Company

   b. Flockhart Foundry Company

   c. Campbell Foundry Company

   d. Approved equal

D. Pulling Irons

1. Material: Galvanized steel

2. Cast in the wall opposite to the centerline of each incoming duct bank and 12 inches below centerline of bottom line of ducts.

3. Product and Manufacturer: Provide one of the following

   a. Cat. No. DU2T3 by McGraw Edison Company

   b. Cat. No. 8119 by A.B. Chance Company

   c. Approved equal

E. Cable Racks

1. Cable racks shall adequately support cables with space allowed for future cables. Provide as indicated to support mounting channels and racks. Cast-in Place anchors with minimum rated pullout working capacity of 2000 pounds. Pennsylvania Insert Corp. 5/8-11-INSERT, with 5/8-11 hex head cap screw made from 316 stainless steel.

2. Each rack shall be a vertical assembly of 24-inch cable racks extending from within 6 inches of the manhole roof slab to within 6 inches of the manhole floor.

3. Cable Rack Mounting Channel: Heavy-duty non-metallic stanchions. Underground Devices, Inc., Model C36 or approved equal

4. Cable Racks: Heavy-duty non-metallic racks. 8, 14, 20 inches as indicated.

5. Product and Manufacturer: Provide one of the following

   a. Underground Devices, Inc., Model RA 08, RA14, RA20 or

   b. Approved equal

F. Insulators

1. Material: Porcelain

2. Product and Manufacturer: Provide one of the following

a. Cat. No. J 5122 by Joslyn Manufacturing and Supply Company

b. Cat. No. 2120 by Hubbard and Company

c. Approved equal

G. Manhole Steps

1. Material: Extruded aluminum

2. Steps spaced evenly at approximately twelve to sixteen inch centers and shall project evenly from manhole walls

3. Manufacturer: Provide manhole steps of one of the following

a. Flockhart Foundry Company

b. Neenah Foundry Company

c. Approved equal

2.03 HANDHOLES

A. The pull/splice box underground enclosures shall be constructed of polymer concrete consisting of sand and aggregate bound together with a polymer resin. Internal reinforcement may be provided by means of steel, fiberglass, or a combination of the two. Handholes for installation in roadways shall concrete reinforced H20 traffic rated.

B. Enclosure

1. The enclosure must be manufactured with an open or closed bottom and a removable cover. The enclosures shall be green or concrete gray in color.

2. The enclosures shall be designed to be installed flush to grade with the cover fitting flush to the box.

3. The enclosures shall be suitable for installation in either direct or buried native soil, embedded in concrete, or embedded in asphalt surfacing. (A concrete collar is required for installation in asphalt).

4. The enclosures shall be of a stackable design for greater installation flexibility.

5. All covers are to be equipped with a minimum of two stainless steel lockdown mechanisms. All covers shall have a logo recessed into the cover and it shall read ELECTRIC.

6. All enclosure covers will have some type of recessed access point to allow removal of the cover with a hook. The access points will be placed in such a location to allow for the greatest amount of leverage and safety possible

7. Enclosures shall be designed and suitable for installation and use through a temperature range of minus 40ºC (minus 40ºF) to 60ºC (140ºF).

8. A certified copy of all test reports must be signed and stamped by a registered professional Engineer and submitted prior to shipment of products.

C. Material Requirements

1. Permanent deflection of any surface shall not exceed 10 percent of the maximum allowable static design load deflection.

2. The covers shall be skid resistant and have a maximum coefficient of friction of 0.50 on the top surface of the cover. Coatings will not be allowed.

3. Any point on the covers must be able to withstand a 70 foot-pound impact administered with a 12-pound weight having a “C” tup (ASTM D-2444) without puncturing or splitting. The test shall be performed with the cover resting on a flat, rigid surface such as concrete or a 1 steel plate

4. Covers shall have molded lettering, ELECTRIC or COMM as applicable

5. Fastening devices used to secure the cover to the box shall be capable of withstanding a minimum torque of 15 foot-pounds and minimum straight pullout strength of 750 pounds.

6. The material is tested according to the requirements of ASTM D543, Section 7, Procedure 1, for chemical resistance. The manufacturer is responsible for proof of compliance with the latest version of the ASTM standards

7. Comply with the following acceptance standards.

a. ASTM D756

b. ASTM G53

c. ASTM D570

d. ASTM D790

e. ASTM D635

D. Acceptable level of quality for handholes: equivalent to Strongwell Quazite, or approved equal.

2.04 SOURCE QUALITY CONTROL

A. Provide in accordance with Division 01 General Requirements.

PART 3 – EXECUTION

3.01 GENERAL

A. Concrete shall be measured, mixed and placed, and compacted as required in Division 03.

B. Provide not less than 3 inches of concrete between the outside of a duct and the earth. Provide not less than 2 inches of concrete between adjacent ducts. Refer to Drawings for spacing requirements. Provide side forms for each duct bank.

C. All duct line concrete pours shall be continuous between manholes or handholes and between manholes or handholes and structures.

D. Where duct lines pass through concrete walls, concrete envelopes shall be extended through the finished flush with inside surfaces. Watertight construction joints of an approved type shall be provided.

E. Duct banks shall be reinforced when laid on backfill covering new pipelines, roads, parking lots or any are subject to vehicular traffic. Beneath these areas, install reinforcing bars as shown on the Drawings, extending 10 feet beyond area needing protection.

F. Duct lines shall be laid in trenches on mats of gravel not less than 6 inches thick and well graded.

G. All electrical duct banks shall be colored red for safety purposes.

H. Install raceways to drain away from buildings. Raceways between manholes or handholes shall drain toward the manholes or handholes. Raceway slopes shall not be less than 3 inches per 100 feet.

I. Make raceway entrances to buildings and vaults with hot dipped rigid galvanized steel conduit not less than 10 feet long. Conduits which are not concrete encased for runs below floor slabs in slab-on-grade construction shall be hot dipped rigid galvanized steel conduit. Conduits which are concrete encased for runs below floor slabs in slab-on-grade construction shall be encased under the slab to their respective equipment.

J. Raceway terminations at manholes shall be with end bells for PVC conduit and insulated throat grounding bushings with lay-in type lugs for metal conduit.

3.02 PROJECT CONDITIONS AND COORDINATION

A. Coordination with other Underground Utilities

1. Locate all existing underground utilities through the use of an underground utility piping location Services Company. Locate the existing underground utilities and piping before any excavation is to begin.

2. Coordinate conduit routing, duct bank and manholes with other new and existing underground utilities. Revise locations and elevations as required to suit field conditions and ensure that conduits, duct runs, manholes, and handholes do not interfere with existing and new underground utilities and piping.

3.03 INSTALLATION

A. Provide excavation and backfilling required for ductbank manhole and handhole installation.

B. Make duct bank installations and penetrations through foundation walls watertight.

C. Assemble duct banks using non-magnetic saddles, spacers, and separators. Position separators to provide 3-inch minimum separation between the outer surfaces of the ducts.

D. Firmly fix ducts in place during pouring of concrete. Carefully spade and vibrate the concrete to insure filling of all spaces between ducts.

E. Make bends with sweeps of not less than 48-inch radius or 5-degree angle couplings.

F. Make a transition from non-metallic to PVC coated rigid steel conduit where duct banks enter structures or turn upward for continuation above grade. Terminate the ducts in insulated grounding bushings. Continue ducts inside buildings with steel, metallic conduit.

G. Where ducts enter manholes and handholes, terminate the ducts in suitable end bells.

H. Provide expansion/deflection fittings in accordance with the requirements specified in Section 26 05 33 RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS.

I. Do not backfill with material containing large rock, paving materials, cinders, large or sharply angular substances, corrosive material, or other materials that can damage or contribute to corrosion of ducts or cables or prevent adequate compaction of fill.

J. Slope duct runs for drainage toward manholes and away from buildings with a slope of approximately 3 inches per 100 feet.

K. After completion of the duct bank and prior to pulling cable, pull a mandrel, not less than 12 inches long and with a cross section approximately 1/4 inch less than the inside cross section of the duct, through each duct. Then pull a rag swab or sponge through to make certain that no particles of earth, sand or gravel have been left in the duct.

L. Install a bare stranded copper duct bank ground cable in each duct bank envelope. Make ground electrically continuous throughout the entire duct bank system. Connect ground cable to building and station ground grid or to equipment ground buses. In addition, connect ground cable to steel conduit extensions of the underground duct system. Provide ground clamp and bonding of each steel conduit extension, where necessary to maintain continuity of the ground system. Terminate ground conductor at last manhole or handhole for outlying structures.

M. Install a warning ribbon approximately 12 inches below finished grade over all underground duct banks. The identifying ribbon shall be a PVC tape, 3 inches wide, yellow color, permanently imprinted with CAUTION BURIED ELECTRIC LINE BELOW in black letters.

N. Plug and seal all empty spare ducts entering buildings and structures. Seal all ducts in use entering buildings and structures. Seal shall be watertight, O-Z/Gedney Type Dux Duct Sealing Compound or equal.

O. Install duct banks in conformance with National Electrical Code and National Electrical Safety Code.

P. Install manholes and handholes where shown on Drawings. Verify final locations in field.

Q. Complete installation of manholes and handholes so that structures are watertight. Provide expansion/deflection fitting for each conduit entry into the manholes.

R. Provide sump opening in manhole floor.

S. Provide grading rings or brick stacks for manholes when required to adjust manhole cover to proper grade. Stacks shall be a minimum of 12 inches in height, constructed on the roof slab or cone section on which the manhole frame and cover shall be placed. The height of the stack shall be such as is necessary to bring the manhole frame to the proper grade.

T. Cable Racks

1. Provide cable hooks to support each cable on each rack along the cable run within the manholes.

2. Individually support each cable at each hook on porcelain insulators.

3. In the manhole, securely tie each cable in place at each insulator block to prevent excessive movement of insulators, cables, or fireproof tape. Tie cables with non-metallic 3/4 inch strapping tape as manufactured by 3M or tie down with nylon straps.

U. Conduits shall extend 3 inches above concrete slab surface, unless otherwise indicated. All conduits shall be bushed to protect cables and provide means for grounding.

V. Duct Bank Conduit Spacers: Non-metallic, snap together intermediate and bottom pieces, sized for conduit diameter and code spacing. Carlon Span-Loc or approved equal. Separators shall be compatible with the conduit utilized. The joints of the conduits shall be staggered by rows and layers to provide a duct line having the maximum strength. During construction, partially completed duct lines, shall be protected from the entrance of debris such as mud, sand, and dirt by means of suitable conduits plugs. As each section of a duct line is completed, a testing mandrel not less than 12 inches long with a diameter 1/4 inch less than the size of the conduit, shall be drawn through each conduit, after which a brush having the diameter of the duct, and having stiff bristles shall be drawn through until the conduit is clear of all particles of earth, sand and/or gravel; conduit plugs shall then be immediately installed. Provide a plastic pull rope, having a minimum of 3 additional feet at each end, in all spare ducts.

3.04 DUCT BANK INSTALLATION

A. All bends shall have a radius greater than 36 inches or 12 times conduit inside diameter whichever is greater.

B. Install duct with minimum slope of 4 inches per 100 feet. Slope duct away from building entrances.

C. Install no more than equivalent of three 90-degree bends between pull points.

D. Provide suitable fittings to accommodate expansion and deflection where required.

E. Use suitable separators and chairs installed not greater than 4 feet on centers. Conduit separation shall be per code, and not less than 3 inches.

F. Securely anchor duct to prevent movement during concrete placement. Use re-bar holders at spacers and secure with No. 4 re-bar driven into the earth at a minimum of 1 foot.

G. Connect to manhole wall using No. 6 re-bar dowels. Dowels shall be located at each corner, and 12 inches on center. Insert dowels minimum 3 inches into manhole and 3 feet into duct bank.

H. Tops of concrete-encased ducts shall be

1. Not less than 24 inches and not less than shown on the Drawings, below finished grade

2. Not less than 30 inches and not less than shown on the Drawings, below roads and other paved surfaces

I. Tops of direct burial ducts and conduits shall be

1. Not less than 24 inches and not less than shown on the Drawings, below finished grade

2. Not less than 30 inches and not less than shown on the Drawings, below roads and other paved surfaces

3.05 PRE-CAST MANHOLE INSTALLATION

A. Install and seal pre-cast sections in accordance with manufacturer's instructions.

B. Install manholes plumb.

C. Attach cable racks to inserts after manhole installation is complete.

D. Provide 12 inches minimum gravel bedding under manholes, and 12 inches gravel fill around manholes.

E. Conduit/Ductwork penetration shall be grouted and sealed. Penetration shall be watertight.

3.06 CABLE PULLING

A. The inspection, handling, storage, temperature conditioning prior to installation, bending and training limits, pulling limits, and calculation parameters for installation of all cables must comply with the manufacturer's recommendations. For ease of installation and prevention of cable damage, the Contractor shall utilize quadrant blocks located properly along the cable run. Failure to comply with any of the above shall make this Contractor responsible for any cable failures that occur within the manufacturer's Warranty Period.

B. Cable lubricant shall be soapstone, graphite, or talc for rubber or plastic jacketed cables.

C. Lubricants for assisting in the pulling or jacketed cables shall be those specifically recommended by the cable manufacturer.

D. Cable pulling tensions shall not exceed the maximum pulling tensions recommended by the cable manufacturer.

E. All medium voltage cables shall be individually fire/arc proofed.

3.07 CABLE TERMINATING

A. Terminations of insulated power and lighting cables shall be protected from accidental contact, deterioration of coverings and moisture by the use of terminating devices and materials. Terminations shall be made using materials and method as indicated or specified herein or as designed by the written instruction of the cable manufacturer and termination kit manufacturer.

3.08 GROUNDING

A. Manholes shall be grounded with ground rods. A bare stranded copper ground wire from the ground wire loop shall be used to bond together and ground the manhole cover frame, ladder support bracket, concrete inserts, cable racks, duct bank ground conductors, and the shields of any medium voltage cables that are spliced in the manhole.

B. Grounding: Install a ground rod for each manhole. Bond all exposed metal manhole accessories and the concrete reinforcing rods with bare copper wire and connect to the ground rod and to the ductbank ground cable. Provide foam sealant for rod penetration in manhole floor for watertight seal.

C. Install a bare stranded copper duct bank ground cable in each duct bank envelope. Make ground electrically continuous throughout the entire duct bank system. Connect ground cable to building and station ground grid or to equipment ground buses. In addition, connect ground cable to steel conduit extensions of the underground duct system, manholes, and handholes. Provide ground clamp and bonding of each steel conduit extension, where necessary to maintain continuity of the ground system.

3.09 FIELD QUALITY CONTROL

A. Provide in accordance with Division 01 General Requirements.

3.10 STARTUP & COMMISSIONING

A. Provide in accordance with Division 01 General Requirements.

3.11 CLOSEOUT ACTIVITIES

A. Provide in accordance with Division 01 General Requirements.

END OF SECTION

SECTION 26 08 00

COMMISSIONING OF ELECTRICAL SYSTEMS

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes

1. Perform Acceptance Tests for all electrical equipment furnished in accordance with this Section and applicable reference standards listed in Article 1.03.

   a. The test requirements for equipment shall be as required by applicable standards and manufacturer's recommendations, and in accordance with this Specification. In no case will the absence of test requirements herein be construed as alleviation of acceptance testing.

   b. The purpose of electrical field acceptance tests is to ensure that all electrical equipment is operational and within industry and manufacturer's tolerances and is installed in accordance with the Specifications and approved Shop Drawings.

   c. Tests are in addition to factory tests at the Manufacturer's facility, and may not substitute for same.

   d. Tests are in addition to all other tests specified under other Specifications and shall be coordinated by the Contractor.

   e. Tests in general shall be conducted after the equipment installation is complete. Tests shall be complete and in order given herein and/or in Specifications for the particular equipment unless otherwise approved by the Engineer.

   f. Tests are also intended to provide, ensure, or determine the following:

      1) Provide initial acceptance tests and recorded data that can be used as a benchmark for future routine maintenance and troubleshooting by plant personnel.

      2) Ensure a successful start-up with a minimum of last minute interruptions and problems.

      3) Determine the suitability of the equipment and systems for energization and placing into operation.

4) Provide assurance that each system component is not only installed satisfactorily but performs, and will continue to perform its function in the system with reasonable reliability throughout the life of the equipment.

B. Related Requirements

1. Division 26, Section 26 05 00 COMMON WORK RESULTS FOR ELECTRICAL

1.02 PRICE AND PAYMENT PROCEDURES

A. Measurement and payment requirements: per Division 01 General Requirements.

1.03 REFERENCES

A. Reference Standards

1. AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)
2. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)
3. ASSOCIATION OF EDISON ILLUMINATING COMPANIES (AEIC)
4. CANADIAN STANDARDS ASSOCIATION (CSA)
5. INSTITUTE OF ELECTRICAL AND ELECTRONIC ENGINEERS (IEEE)
6. INSULATED CABLE ENGINEERS ASSOCIATION (ICEA)
7. INTERNATIONAL ELECTRICAL TESTING ASSOCIATION (NETA)
8. NATIONAL ELECTRICAL MANUFACTURER'S ASSOCIATION (NEMA)
9. NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)
10. OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION (OSHA)
11. UNDERWRITERS LABORATORY (UL)

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination, Sequencing, and Scheduling: per Division 01 General Requirements.

1.05 SUBMITTALS

A. Submit in accordance with Division 01 General Requirements.

B. General

1. Contractor shall submit detailed test procedure including test equipment for all field acceptance testing prior to testing.

2. Contractor shall submit to the Engineer six copies of all test reports. Format and types of reports, data sheets, forms, etc. shall be submitted for approval.

3. Each test report shall include as minimum the following:

   a. Listing of equipment tested including the list of test equipment used and the test equipment's associated calibration dates

   b. Test method and standards governing the test

   c. Test results

   d. Recommendations

4. Test results shall incorporate inspection reports, instrument calibration curves, plotted test results, and all measurements and data.

5. All inspections, tests, and calibrations are to be reported in writing. The recorded data form shall have the signatures of the persons conducting the tests and authorized witnesses. The forms shall be designed to serve as the test and inspection checklist for inspection requirements. The test and checkout data shall also include any data taken prior to the adjustments, repairs, drying out, or similar Work prior to final testing and acceptance. As-found and as-left test data shall be recorded and reported in writing.

6. Copies of Test Data Reports shall be incorporated in each of the related Operations and Maintenance Manuals. The Data Reports shall include those items of equipment contained in the Service Manual. Reports shall be separated by a divider labeled Electrical Field Acceptance Tests. Reports shall contain data for all power conductors and controls including instrumentation conductors and devices for static and dynamic equipment in the Operations and Maintenance Manual. In addition, Operating Tests of the equipment shall be included in this section of the Operations and Maintenance Manual.

1.06 QUALITY ASSURANCE

A. Provide in accordance with Division 01 General Requirements.

B. Qualifications: per Division 01 General Requirements for testing and as follows.

1. The Contractor shall engage the services of a recognized independent testing agency approved by the Engineer to perform acceptance tests as specified herein.

    a. The testing firm shall submit proof of the certification by NETS or NICET, and proof of the qualifications for the lead, on-Site technical person when requested.

2. The testing firm shall provide all material, equipment, labor, and technical supervision to perform such tests and inspections.

3. All cost associated with the testing shall be the responsibility of the Contractor, including the expenses of retest because of defects and failure of equipment to meet Specifications.

4. Wiring and equipment which is defective, or which fails to meet Specifications, shall be replaced by the Contractor, unless specific approval for repair is given by the Engineer. The Contractor shall bear the costs for either action.

5. Contractor shall open circuits, place and connect all instruments and equipment needed for the tests, remove same and restore circuits when tests are complete.

6. Coordinate activities, and cooperate with others on Project, to ensure that systems are energized when required, loads applied, and requirements of other Specification Sections are carried out on timely, coordinated basis.

7. Other Specification Sections may require services of one or more manufacturer's representatives, to ensure that equipment supplied has been installed properly and adjusted to proper working order. Advise representative of all applicable tests in this Section, so that Work will be coordinated, and tests combined where feasible.

8. Contractor shall notify the Engineer, in writing; at least 14 calendar days before the test are to take place. The tests shall be conducted in the presence of the Engineer or his representative and shall not be started without his permission.

9. Perform all tests as closely as possible to conditions of actual use.

10. All testing and checkout Work shall be performed with fully qualified personnel skilled in the particular tests being conducted. This is essential for obtaining and properly evaluating data while the tests are in progress and for insuring that important facts and questionable data are reported.

11. It is important that equipment warranties or guarantees not be voided by the Contractor's testing and checkout Work. The tests will normally be supplemental to and compatible with the manufacturer's installation

instructions and recommendations. Where deviations are apparent, the manufacturer's review and approval shall be obtained prior to testing. Reasonable cooperation is to be extended to permit witnessing by the manufacturer's representative if so requested. Where any questionable repairs, modifications, significant adjustments, tests or checks are to be made, the Contractor shall contact the Owner's Representative to determine if the Work should be performed by or with the manufacturer's representative.

12. The Contractor shall ensure that all testing and checkout Work is conducted in a safe manner. Special safety pre-cautions such as the following to be utilized where appropriate:

    a. Occupational Safety and Health Act (OSHA)

    b. Accident Prevention Manual for Industrial Operations, National Safety Council

    c. Applicable state and local safety operating procedures

    d. Owner safety procedures

    e. National Fire Protection Association (NFPA 70E)

    f. American National Standards for Personnel Protection

    g. Locking procedures

    h. Barricades

    i. Maintenance of voice communications

    j. Erection of warning signs

    k. Stationing of guards and watchmen

    l. De-energize and/or isolate equipment prior to testing. Exceptions must be thoroughly reviewed to identify safety hazards and devise adequate safeguards.

13. The sequence of all tests and checks shall be such that the equipment can be energized immediately after the completion of the applicable tests.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Provide in accordance with Division 01 General Requirements.

1.08 SITE CONDITIONS

A. Existing Conditions: per Division 01 General Requirements.

PART 2 – PRODUCTS

2.01 MATERIALS

A. Test Equipment

1. Provide all necessary test equipment and tools as specified herein and as recommended by the tested equipment manufacturer.

2. All test equipment shall be in good mechanical and electrical conditions, and shall be calibrated per NETA ATS schedule requirements. Records, which show date and results of instrument calibration or testing, must be kept up-to-date and provided with the test report upon request.

3. The accuracy shall be directly traceable to the National Institute of Standards and Technology.

4. Calibrating standard shall be of higher accuracy than that of the instrument tested.

5. Test equipment shall include but not limited to and shall have operating accuracy equal to, or better than listed.

   a. Portable multimeters shall be true RMS measuring

   b. Multimeters shall have the following accuracy limits, or better (for 60 Hz where applicable):

      1) AC voltage ranges: 0.75 percent plus or minus 3 last single digits

      2) AC current ranges: 0.90 percent plus or minus 3 last single digits, including adapters, transducers

      3) DC voltage ranges: 0.25 percent plus or minus 1 last single digit

      4) Resistance ranges: 0.50 percent plus or minus 1 last single digit

      5) Frequency range: 0.10 percent plus or minus 1 last single digit

   c. Clamp-on ammeters: AC current plus or minus 3 percent of range plus or minus 1 last single digit

   d. Dissipation/power factor field equipment

      1) Plus or minus 0.1 percent power factor values up to 2.0 percent

2) 5 percent of the reading for power factor values above 2

e. Low-range DC resistance equipment: 1.0 percent of reading, plus or minus 2 last single digits

f. Transformers turns-ratio test equipment: 0.5 percent or better

g. Ground electrode test equipment: plus or minus 2.0 percent of range

h. Insulation (Megger) test sets: 0 - 1000V DC plus or minus 20 percent of reading at mid-scale for equipment 600 volts and less and 0 - 2500 volts DC plus or minus 20 percent of reading at mid-scale for equipment over 600 volts.

i. Electrical load survey equipment

1) Plus or minus 5 percent total error, including sensors

2) 1 percent resolution

3) Current transformers plus or minus 2 percent of range

4) Voltage transformers plus or minus 0.5 percent of range

j. Liquid dielectric strength test equipment: plus or minus 2 percent of scale

k. Infrared scanning equipment: sensitivity of 2 degrees C

l. Phase shifting equipment: plus or minus 1 degree over entire range

m. High-current test equipment: plus or minus 2 percent of range

n. DC high potential test equipment: plus or minus 2 percent of scale

o. AC high potential test equipment: plus or minus 2 percent of scale

p. Multi-amp SR-90, or equal, relay test set

2.02 SOURCE QUALITY CONTROL

A. Provide in accordance with Division 01 General Requirements.

PART 3 – EXECUTION

3.01 CONSTRUCTION REQUIREMENTS

A. All tests shall be performed with regard to protecting solid-state devices and electronic components from potential damage. Where applicable, disconnect solid-state devices and electronic components prior to applying testing voltage.

B. Make up no connections at service entrance, transformers, substations, motors, motor control centers, and switchgear permanently until correct phase rotation of all equipment is determined and electrical tests have been completed. Install and

insulate these connections temporarily, if necessary. Make permanent connections after proper rotation has been established and subsequent to completion of insulation resistance and dielectric tests.

C. Wire and cable insulation resistance tests

1. Low voltage, 600V maximum

a. Inspect wire and cables for physical damage and proper connection in accordance with approved Shop Drawings.

b. Check color-coding with Specifications and NEC standards.

c. Perform continuity test to insure proper connection.

d. Perform insulation-resistance test on each conductor with respect to ground and adjacent conductors. Applied potential shall be 1000 volts DC for 1 minute.

e. Evaluate test results by comparison with wires and cables of the same length and type. Investigate any values less than 50 Megaohms.

2. Medium-voltage, 15 kV Maximum

a. Inspect exposed section of cables for physical damage and for proper connection in accordance with single-line diagram.

b. Inspect for shield grounding, cable support and termination. Visually inspect jacket and insulation condition.

c. Check for visible cable bends against IPCEA (Insulated Power Cable Engineers Association) or manufacturer's minimum allowable bending radius.

d. Inspect for proper phase identification and arrangement.

e. Inspect for proper fireproofing.

f. If cables are terminated through window-type CT's, verify that neutrals and grounds are properly terminated for proper operation of protective devices.

g. Perform a shield-continuity test on each power cable by ohmmeter method and record ohms value.

h. Perform an insulation-resistance test utilizing a megohmeter with a voltage output of at least 1000 volts. Individually test each conductor with all other conductors and shields grounded. Test duration shall be 1 minute.

i. After completing the insulation resistance test, a high potential test shall be performed in accordance with IPCEA Standard S-66-524 and NEMA WC-1. Perform test in accordance with ANSI/IEEE standard 400 and NETA AST requirements.

j. The high voltage conductor tests at rated system voltage shall then be performed. The cables shall be energized and loaded for a period of eight hours.

k. Shielding shall exhibit continuity. Investigate resistance value in excess of 10 ohms per 1000 feet of cable length.

l. Circuit tested shall have an insulation resistance between conductors and between each conductor and ground not less than 10 Megaohms.

m. In no case shall a phase conductor have an insulation resistance 40 percent less than the phase conductor with the highest insulation resistance.

D. Grounding Systems

1. Verify that grounding system is in accordance with Specifications and applicable codes.

2. The grounding system shall be tested for continuity of connection and for resistance to flow of current through ground connections.

a. The resistance between the main grounding electrode and ground shall be no greater than 5 ohms for 600V systems. For electrical substation grounds the ground resistance shall be no greater than 1 ohm.

b. The ground resistance of conduits, equipment cases, and supporting frames shall be only fractionally higher than system ground.

c. Method of measurement of ground resistance shall be as specified by NETA-AST and be approved by the Engineer before the start of tests.

E. Switchboards and Switchgear Assemblies

1. Inspect for physical, electrical, and mechanical condition.

2. Compare equipment nameplate information with latest one-line diagram.

3. Check for proper anchorage, required area clearances, physical damage, and proper alignment.

4. Inspect all bus connections for high resistance as recommended in NETA-ATS standard. Compare bus connection resistance to value of similar connections.

5. Verify torque on all bolts for bus bar connections.

a. Bus bar and terminal connections shall be inspected to ensure that all joints have proper torque tightness.

b. Torque values for all types of joints involved shall be in accordance with manufacturer's recommendations.

6. Check support and bracing

a. Bus bar support insulators and barriers shall be inspected to ensure that they are free from contamination.

b. Insulators shall be checked for cracks and signs of arc tracking: Mounting hardware shall be inspected and all joints checked for proper torque value.

7. Test all electrical and mechanical interlock systems for proper operation and sequencing.

a. Closure attempt shall be made on locked-open devices. Opening attempt shall be made on locked-closed devices.

b. Key exchange shall be made with devices operated in off-normal positions.

8. Clean switchgear.

9. Inspect accessible insulators for evidence of physical damage or contaminated surfaces.

10. Verify proper barrier and shutter installation and operation.

11. Verify appropriate contact lubricant on moving current carrying parts and surfaces. Verify appropriate lubrication on moving and sliding surfaces.

12. Exercise all active components.

13. Inspect all mechanical indicating devices for proper operation.

14. Verify proper operation of switchgear/switchboard heaters. Insure filters and/or vents are clear.

15. Electrical Tests

a. Solid-state devices and electronic components shall be disconnected prior to applying 500 volts or higher to the circuit.

b. Perform tests on all instrument transformers.

c. Perform ground-resistance tests in accordance with Section 26 05 26 GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS.

d. Perform insulation-resistance tests on each bus section, phase-to-phase and phase-to-ground for 1 minute. Test voltages and minimum resistance shall be as shown below:

e. Over potential test voltages shall be applied in accordance with manufacturer's recommendations or NETA-ATS. Test results are evaluated on a go/no-go basis by slowly raising the test voltage to the required value. The final test voltage shall be applied for 1 minute.

f. Perform resistance measurements on all bus joints with a low-resistance ohmmeter.

g. Performance insulation-resistance tests at 1000 volts DC on all control wiring. Do not perform the test on wiring connected to solid state components.

h. Perform control wiring performance test. Use the elementary diagrams of the switchgear to identify each remote control and protective device. Conduct tests to verify satisfactory performance of each control feature.

i. Perform the following tests on dry-type control power transformers:

1) Inspect for physical damage, cracked insulation, broken leads, tightness of connections, defective wiring, and overall general condition.

2) Verify that primary and secondary fuse ratings or circuit breakers match Drawings.

3) Perform insulation-resistance test.

a) Measurements shall be made from winding-to-winding and windings-to-ground. Test voltages and minimum resistance shall be in accordance with Table Switchgear Insulation-Resistance Test Voltage above.

b) Determine accuracy of all meters and calibrate watt-hour meters per NETA-ATS requirements.

c) Perform current injection test on the entire current circuit in each section of switchgear.

F. Air Switches - Low Voltage and Medium Voltage Metal-Enclosed Switches

1. Provide visual and mechanical inspection to ensure proper connections and installation of cables, fuse holders, barriers.

2. Check blade alignments. Perform mechanical operation tests. Verify that fuse sizes and types are in accordance with approved coordination study.

3. Test all electrical and mechanical interlock systems for proper operation.

4. Perform electrical tests, including insulation-resistance tests on each pole, phase-to-phase and phase-to-ground for 1 minute and contact-resistance test across each switch blade and fuse holder. Test values shall be in accordance with NETA-ATS requirements unless otherwise specified by manufacturer.

G. Circuit Breakers - Low Voltage

1. Circuit breakers are to be checked for possible damage during shipment or storage.

2. Inspect the breaker visually for physical damage.

3. Perform several mechanical ON-OFF operations.

4. Perform circuit continuity check on each pole with the circuit breaker in the closed position.

5. Determine short-time pickup and delay, long-time pickup and delay by primary current injection.

6. Tests solid-state trip devices at multiple setting range of pickup and time delays.

7. Apply 300 percent of breaker rated continuous current to each pole to determine that the circuit breaker will trip on an overload.

H. Circuit Breaker - Medium Voltage, Vacuum Type

1. Inspect breaker for physical and mechanical damage.

2. Inspect anchorage, alignment, and grounding.

3. Perform all mechanical operational tests on both circuit breaker and its operating mechanism.

4. Measure critical dimensions such as contact gap and wipe as recommended by manufacturer. Make adjustments as needed.

5. Perform all other tests as recommended by manufacturer before acceptance of the breaker.

6. Perform contact-resistance test.

7. Perform minimal pickup voltage tests on trip and close coils, trip circuit breaker by operation of each protective device.

8. Perform insulation-resistance tests on each pole, pole-to-pole and pole-to-ground at 2500V minimum. Test values shall be in accordance with NETA-ATS requirements unless otherwise specified by manufacturer.

9. Perform all other tests as recommended by manufacturer.

I. Power Transformers

1. The field acceptance tests for power transformers shall be performed as specified herein, and as recommended by the transformer manufacturer.

2. Perform visual and mechanical inspection, insulation resistance tests, dielectric absorption tests, turn ratio tests, oil sample tests, AC over potential tests, insulation power factor tests on all windings and bushings, individual exciting current tests on each phase, winding resistance tests, top gas analysis, oil PCB levels, and any special

3. Perform tests and adjustments as applicable, and as recommended by the transformer manufacturer.

4. Test values shall be as recommended by manufacturer and specified by NETA-ATS.

5. The Contractor shall employ the services of the manufacturer and independent testing company to check, set and adjust the operation of the cooling equipment and demonstrate to the Owner that all equipment and alarms are functional and operational.

J. AC Motors - Induction Motors

1. Inspect for physical damage and compare nameplate information with Drawings and Specifications

2. Inspect for proper installation, grounding, connection, and lubrication. Motor alignment, wiring capacity, speed and operation shall be checked to verify compliance with Specifications.

3. Check for unusual mechanical or electrical noise or signs of overheating during initial test run.

4. Perform insulation-resistance tests in accordance with ANSI/IEEE Standard 43. Test duration as recommended by NETA-ATS.

5. Perform insulation-resistance test on pedestal per manufacturer's instructions.

6. Perform insulation-resistance test on surge protection device in accordance with NETA-ATS Specifications.

7. Check resistance temperature detector (RTD) circuits for conformance with Drawings. Check that metering or relaying devices using the RTD's are of the proper rating.

8. Check that the motor space heater is operating.

9. Perform a rotation test to insure proper shaft direction if the motor has been electrically disconnected.

10. Measure running current and evaluate relative to load conditions and nameplate full-load amperes.

11. Check motor operation.

    a. The motor shall be run for at least four-hours as close to full load as possible

K. AC Motors - Synchronous Motors

1. Inspect for physical damage and compare nameplate information with Drawings and Specifications.

2. Inspect for proper installation, grounding, connection, and lubrication.

3. Perform insulation-resistance tests on the main rotating field winding, the exciter field winding, and the exciter armature winding in accordance with ANSI/MEE Standard 43.

4. Measure and record resistances of the following:

    a. Motor-field winding

    b. Exciter-stator winding

    c. Exciter rotor windings

    d. Field discharge resistors

5. Check that the field application and power-factor relay enable time-delay relays have been tested and set to the motor drive manufacturer's recommended values.

6. The motor shall be run for at least four hours as close to full load as possible.

7. Test Values shall be in accordance with NETA-AST and NEMA publication.

L. Motor Control

1. Low and medium voltage motor controls shall be tested in accordance with NETA-ATS requirements and manufacturer recommendations.

M. Instrument Transformers

1. Inspect transformers for physical damage and nameplate information for compliance with Drawings and Specifications.

2. Verify proper connection of transformers with system requirements.

3. Verify tightness of all bolted connections and assure that adequate clearances exist between primary circuits to secondary circuit wiring.

4. Verify that all required grounding and shorting connections provide good contact.

5. Verify proper operation of transformer withdrawal mechanism (tip out) and grounding operation when applicable.

6. Electrical Tests - Current transformers

a. Perform insulation-resistance tests on current transformer secondary and wiring to-ground winding at 1000 volts DC for 1 minute. Value of test voltage on secondary wiring shall be 1000 volts DC for 1 minute. Do not perform this test with solid-state devices connected.

b. Perform a polarity test on each transformer winding, and verify manufacturer's polarity markings.

c. Perform a turns-ratio verification test of each current transformer.

d. The test data shall include the following:

1) Manufacturer's stated ratio for each tap position

2) Test turns ratio results

3) Percent error per tap position

4) Manufacturer's indicated polarity

5) Test result polarity

e. On each set of transformer windings, the turn’s ratio shall be determined for all no-loads taps, using the two-voltmeter method for control transformers and the two-ammeter method for current transformers.

f. Confirm test switch wiring and operation.

1) A functional test shall be performed on the test switch of the current transformer to ensure that the secondary leads are shorted and that no open circuit conditions exist. A functional test shall also be performed on the control transformers to ensure that no short circuit exists across the secondary leads.

2) All control wiring shall be checked to ensure proper operation of the device being powered.

g. Perform other tests specified by the NETA-ATS as required by application.

7. Electrical Tests - Voltage Transformers

a. Perform insulation-resistance tests on voltage transformers, winding-to-winding and windings-to-ground. Value of test voltage on secondary wiring shall be 500 volts DC for 1 minute. Do not perform this test with solid-state devices connected.

b. Perform a polarity test on each transformer to verify the polarity marks or H1-X1 relationship as applicable.

c. Perform ratio test as specified in NETA-ATS.

d. Perform a dielectric withstand test on the primary windings with the secondary windings connected to ground. The DC dielectric voltage shall be in accordance with Table Switchgear Insulation-Resistance Test Voltage above.

N. Metering and Instrumentation

1. Inspect all devices for physical damage and tightness of electrical connections.

2. Check calibration and accuracy of meters at 25/50/75/100 percent of full scale.

3. Verify all instrument multipliers.

O. Protective Relays

1. Inspect relays for physical damage and compliance with Drawings and Specifications.

2. Standard testing and calibration Specifications

a. To demonstrate that the relay will function as designed throughout the entire range of its operations. Acceptance tests shall be

performed in accordance with NETA-ATS Protective Relay Testing Specifications:

b. Calibrate and set relays in accordance with approved coordination study.

c. Use approved relay test set.

3. Perform insulation-resistance test on each circuit-to-frame.

4. Test all relays in place to demonstrate that the relaying system will function as specified. Acceptance tests shall be performed as specified and in accordance with NETA-ATS.

5. Test lockout relays and associated test switch trip links and closing circuit contacts. The lockout relays shall be functionally tested to ensure proper system operation. Associated equipment shall be checked for proper alignment and contact closure.

6. All relays shall be checked and calibrated under service conditions against portable standards devices connected in series with the relay-undergoing test. For some in-Service testing the test plugs shall be used to connect devices which shall measure the currents and voltage being applied to the relays.

7. Test all electrical interlocks.

a. Check all electrical interlocks for loose wiring, proper mechanical alignment, and operation. Also, inspect all contact surfaces to ensure they are clean and not pitted.

b. All relays shall be checked and calibrated using the built-in test switch and test plug.

1) Test for correct settings and operation of all relay trips and operation indicating flags and seal in contacts.

P. Operating Tests

1. Mechanical and electrical interlocks

a. Mechanical interlocks shall be examined to ensure the interlock is free to operate and that bearing surfaces are free to perform their intended function.

b. Checks for correct adjustment of primary disconnect mechanisms in plug-in units. Shall be mechanically interlocked with the door to ensure that the door is held closed with primary disconnect in the ON position.

c. Check for padlock provisions on disconnect operating mechanisms.

d. Check motor starters equipped with a defeater mechanism to ensure that they can be operated to release the door interlock with the disconnect device in the ON position.

2. Circuit Breaker Operation

a. Test trip all medium voltage circuit breakers from all devices in the trip circuit and verify operation of all interlocks.

b. Installation and inspection of 480V power circuit breakers shall be in accordance with NEMA Pub. No. SG-3:

1) Perform tests in accordance with NETA-ATS Specification and this Specification.

c. Test all remote control stations for operation.

1) A functional test shall be performed for all remote pushbutton stations and manual motor starters to ensure their proper operation.

2) Tests shall be as included in the appropriate standards.

3.02 FIELD QUALITY CONTROL

A. Provide in accordance with Division 01 General Requirements.

3.03 STARTUP & COMMISSIONING

A. Provide in accordance with Division 01 General Requirements.

3.04 CLOSEOUT ACTIVITIES

A. Provide in accordance with Division 01 General Requirements.

END OF SECTION

SECTION 26 21 00

LOW-VOLTAGE ELECTRICAL SERVICE ENTRANCE

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes

1. Provide the labor, tools, equipment, and materials necessary to provide service entrance Work as defined on the Drawings in accordance with this Section and applicable reference standards listed in Article 1.03.

B. Related Requirements

1. Division 26: Section 26 05 00 COMMON WORK RESULTS FOR ELECTRICAL

1.02 PRICE AND PAYMENT PROCEDURES

A. Measurement and payment requirements: per Division 01 General Requirements.

1.03 REFERENCES

A. Reference Standards

1. NATIONAL ELECTRICAL CODE (NEC), INCLUDING ARTICLES 230, 250, AND 338

2. NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA) COMPLIANCE

3. UNDERWRITERS' LABORATORIES, INC. (UL) COMPLIANCE

   a. UL 50 Electrical Cabinets and Boxes

   b. UL 854 Service Entrance Cables

   c. UL 869 Electrical Service Equipment

4. INSTITUTE OF ELECTRICAL AND ELECTRONIC ENGINEERS (IEEE) COMPLIANCE

5. AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI) COMPLIANCE

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination, Sequencing, and Scheduling: per Division 01 General Requirements.

1.05 SUBMITTALS

A. Submit in accordance with Division 01 General Requirements.

B. Product Data

1. Furnish manufacturer's product data, test reports, and materials certification as required

2. Submit manufacturer's data on service entrance equipment and accessories

1.06 QUALITY ASSURANCE

A. Provide in accordance with Division 01 General Requirements.

B. Electric Utility Company: Eversource

1. Work Request #2764974

2. Contact: Mark Collins, Tel (603) 332-4227 x 5555325

C. Install work in accordance with Utility Company's rules and regulations.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Provide in accordance with Division 01 General Requirements.

1.08 SITE CONDITIONS

A. Existing Conditions: per Division 01 General Requirements.

B. The Contractor shall be responsible for providing and installing all service entrance conduit and conductors for associated service work as indicated on the Contract Drawings.

C. Services shall be wired for 277/480 volts, three phase, 4-wire, wye, connected as indicated on the Contract Drawings.

PART 2 – PRODUCTS

2.01 MATERIALS

A. Provide service entrance equipment and accessories; of types, sizes, ratings and electrical characteristics indicated, which comply with utility and manufacturer's standard materials, design and construction.

B. Conductors

1. Copper conductors with XHHW insulation, 600 volt rated

2. Cable identifications shall indicate the manufacturer's name, wire size, insulation type, voltage, etc.

3. Spade connectors and lug extensions shall be provided as required to accommodate all service conductors at transformer.

C. Metering

1. Provide utility meter and meter enclosure for the building service as required by the local utility company.

2. Coordinate all metering requirements with utility company for a complete installation in accordance with the utility company’s Specifications.

D. Manholes, Handholes and Pullboxes

1. Provide in accordance with Division 26 05 43 “Underground Ducts and Raceways for Electrical Systems”.

2.02 SOURCE QUALITY CONTROL

A. Provide in accordance with Division 01 General Requirements.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Provide and install required conduit wire, pullboxes, and accessory items to accomplish the Work involved in providing the electrical service as shown on the Drawings.

B. Coordinate service Work with the Owner and utility company to insure proper timing of installation and connection of equipment.

C. Obtain all permits, pay all fees, and provide all materials and labor necessary for interfacing with utility equipment to install electric service.

D. Furnish and install all electrical conduits for low voltage cables, and low voltage wire and accessory items necessary to accomplish the Work detailed in the Drawings.

E. Furnish and install utility meter, meter enclosure, and all associated metering conduits in accordance with the utility company's requirements.

F. All conductors shall be terminated at the pad-mounted transformer secondary by the Contractor, per local utility company requirements. Primary wiring and terminations shall be by the utility company.

3.02 FIELD QUALITY CONTROL

A. Provide in accordance with Division 01 General Requirements.

3.03 STARTUP & COMMISSIONING

A. Provide in accordance with Division 01 General Requirements.

3.04 CLOSEOUT ACTIVITIES

A. Provide in accordance with Division 01 General Requirements.

END OF SECTION

SECTION 26 22 00

LOW VOLTAGE DRY-TYPE TRANSFORMERS

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes

1. Provide low-voltage dry-type distribution transformers in accordance with this Section and applicable reference standards listed in Article 1.03.

B. Related Requirements

1. Division 26, Section 26 05 00 COMMON WORK RESULTS FOR ELECTRICAL

2. Division 26, Section 26 05 26 GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

1.02 PRICE AND PAYMENT PROCEDURES

A. Measurement and payment requirements: per Division 01 General Requirements.

1.03 REFERENCES

A. Reference Standards

1. NFPA 70, Article 100

2. IEEE C2

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination, Sequencing, and Scheduling: per Division 01 General Requirements.

1.05 SUBMITTALS

A. Submit in accordance with the Division 01 General Requirements.

B. Product Data: Include data on features, components, ratings and performance for each type of transformer specified. Include dimensioned Plans, sections and elevation views. Show minimum clearances and installed devices and features.

C. Wiring Diagrams: Detail wiring and identify terminals for tap changing and connecting field-installed wiring

D. Product Certificates: Signed by manufacturers of transformers certifying that the products furnished comply with requirements

E. Factory Test Reports: Certified copies of manufacturer's routine factory tests required by referenced standard

F. Sound-Level Test Reports: Certified copies of manufacturer's sound-level tests applicable to equipment for this Project

G. Field Test Reports: Indicate and interpret test results for tests specified in Part 3.

H. Maintenance Data: For transformers and components to include in maintenance manuals

I. Closeout and Maintenance Material Submittals: per Division 01 General Requirements.

1.06 QUALITY ASSURANCE

A. Provide in accordance with Division 01 General Requirements.

B. Qualifications: Per Division 01 General Requirements for listing and labeling and as follows.

1. Listing and Labeling Agency Qualifications: A Nationally Recognized Testing Laboratory as defined in OSHA Regulation 1910.7

2. Listing and Labeling: Provide transformers specified in this Section that are listed and labeled.

3. The Terms "listed" and "labeled": As defined in NFPA 70, Article 100.

4. Subparagraph below is required by some Federal agencies.

5. Comply with IEEE C2.

6. Comply with NFPA 70.

1.07 DELIVERY, STORAGE AND HANDLING

A. Provide in accordance with Division 01 General Requirements.

B. Cover transformer-ventilating openings to keep out dust. Store in a warm dry location with uniform temperature or apply temporary heat according to manufacturer's recommendations within the enclosure of each ventilated type transformer.

C. Handle transformers using only lifting eyes and brackets provided for that purpose. Protect units against entrance of rain, sleet or snow if handled in inclement weather.

D. Temporary Heating: Apply temporary heat according to manufacturer's written instructions within the enclosure of each ventilated-type unit throughout periods during which equipment is not energized and is not in a space that is continuously under normal control of temperature and humidity.

1.08 SITE CONDITIONS

A. Existing Conditions: per Division 01 General Requirements.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering transformers that may be incorporated into the Work include, but are not limited to, the following:

1. Square D; Schneider
2. Eaton Corp.
3. GE Electrical Distribution & Control
4. Hammond Co.
5. Siemens Energy & Automation, Inc.
6. Powersmiths International Corp.
7. Approved Equal

2.02 TRANSFORMERS, GENERAL

A. Description: Factory assembled and tested, air-cooled units of types specified, designed for 60 Hz service.

1. Cores: Grain-oriented, non-aging silicon steel
2. Coils: Copper - Continuous windings without splices, except for taps
3. Internal Coil Connections: Brazed or pressure type
4. Enclosure: Class complies with NEMA 250 for the environment in which installed

5. Low Sound Level Units: Minimum of 3 dBA less than NEMA ST 20 standard sound levels when factory tested according to IEEE C57.12.91

2.03 GENERAL PURPOSE DISTRIBUTION AND POWER TRANSFORMERS

A. Comply with NEMA ST 20 and list and label as complying with UL 1561

1. Cores: One leg per phase

2. Windings: One coil per phase in primary and secondary

3. Enclosure: Indoor, ventilated, drip-proof

4. Insulation Class: 180 or 220°C class for transformers 15 kVA or smaller; 220°C class for transformers larger than 15 kVA

5. Rated Temperature Rise: 150°C maximum rise above 40°C, for 220°C class insulation; 115°C maximum rise for 185°C class insulation

6. Taps: For transformers 3 kVA and larger, full-capacity taps in high-voltage windings; Taps, 3 through 15 kVA shall be two 5-percent taps below rated high voltage; Taps, 15 through 500 kVA shall be six 2.5-percent taps, 2 above and 4 below rated high voltage.

7. Transformers shall meet or exceed the energy efficiency requirements of US Department of Energy Candidate Standard Level 3 (CSL-3).

a. No load losses (core loss) shall not exceed: 15kVA: 49W, 30kVA: 90W, 45kVA: 100W, 75kVA: 145W, 112.5kVA 205W, 150kVA: 250W, 225kVA: 320W, 300kVA: 350W

b. Shall meet or exceed DOE 10CFR Part 430 CSL-3 efficiency requirement tested per NEMA TP-2: 15kVA: 97.6%, 30kVA: 98.1%, 45kVA: 98.3%, 75kVA: 98.6%, 112.5kVA: 98.8%, 150kVA: 98.9%, 225kVA: 98.9%, 300kVA: 99.0%.

2.04 HARMONIC CANCELLATION AND NOISE REDUCTION TRANSFORMERS

A. The manufacturing process shall incorporate Epoxy Vacuum Impregnation

B. Quality assurance program: MIL-I-45208, equivalent or better

C. General Transformer Characteristics

1. Indoor, dry type, 60 Hz, NEMA-1, drip proof enclosure with kVA size, primary and secondary voltages as indicated on the Drawings

2. Construction: 3-phase Common Core.

3. Winding and terminals: Copper

4. Neutral conductor rating shall be 200 percent of phase

5. Insulation Class shall be R, with an operating Temperature rise of 130°C

6. Taps shall be 2 by 2 1/2 percent above and below nominal

7. BIL test: 10 kV.

8. Sound Level: 45 Db max at 5 feet

9. Noise attenuation: Anti-vibration pads

10. Efficiency: 97.5 percent at 50 percent load

11. Positive and negative sequence impedance shall be between 3.2 – 4.5 percent

12. Zero Sequence Impedance shall be less than 1 percent and the Zero Sequence Reactance shall be less than 0.3 percent

2.05 CONTROL AND SIGNAL TRANSFORMERS

A. Units comply with NEMA ST 1 and are listed and labeled as complying with UL 506

B. Ratings: Continuous duty - If rating is not indicated, provide capacity exceeding peak load by 50 percent minimum

C. Description: Self-cooled, 2-windings

2.06 VIBRATION ISOLATOR

A. Vibration Isolator shall consist of rigid steel frames containing minimum 1-1/4 inch (32mm) thick neoprene elements at the top and steel spring. The ratio of the spring diameter divided by the compressed spring height shall be no less than 0.8. Springs shall have a minimum additional travel to solid equal to 50 percent of the rated deflection. The spring element shall be seated in a steel washer reinforced neoprene cup on the bottom. The neoprene element and the cup shall have neoprene bushings projecting through the steel box. Spring diameters and hanger box lower hole sizes shall be large enough to permit the hanger rod to swing through a 30 degree arc from side to side before contacting the cup bushing and short circuiting the spring. Submittals shall include a hanger drawing showing the 30 degree capability. Hangers shall be type 30N as manufactured by Mason Industries, Inc. or approved equal.

2.07 SOURCE QUALITY CONTROL

A. Provide in accordance with Division 01 General Requirements.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Comply with safety requirements of IEEE C2

B. Arrange equipment to provide adequate spacing for access and for circulation of cooling air

C. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.02 GROUNDING

A. Separately Derived Systems: Comply with NFPA 70 requirements for connecting to grounding electrodes and for bonding to metallic piping near the transformer

3.03 FIELD QUALITY CONTROL

A. Provide in accordance with Division 01 General Requirements.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to supervise the field assembly and connection of components and the testing and adjusting of transformer components and accessories.

C. Test Objectives: To ensure transformer is operational within industry and manufacturer's tolerances, is installed according to the Contract Documents, and is suitable for energizing

D. Test Labeling: On satisfactory completion of tests for each transformer, attach a dated and signed Satisfactory Test label to tested component

E. Schedule tests and provide notification at least 7 days in advance of test commencement

F. Report: Submit a written report of observations and tests. Report defective materials and installation

G. Tests: Include the following minimum inspections and tests according to manufacturer's written instructions. Comply with IEEE C57.12.91 for test methods and data correction factors.

1. Inspect accessible components for cleanliness, mechanical and electrical integrity, and damage or deterioration. Verify that temporary shipping

bracing has been removed. Include internal inspection through access panels and covers.

2. Inspect bolted electrical connections for tightness according to manufacturers' published torque values or, if not available, those specified in UL 486A and UL 486B.

H. Test Failures: Compare test results with specified performance or manufacturer's data. Correct deficiencies identified by tests and retest. Verify that transformers meet specified requirements.

3.04 STARTUP & COMMISSIONING

A. Provide in accordance with Division 01 General Requirements.

3.05 CLOSEOUT ACTIVITIES

A. Provide in accordance with Division 01 General Requirements.

END OF SECTION

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SECTION 26 24 16

PANELBOARDS

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes

1. Provide the labor, tools, equipment, and materials necessary to install panelboards in accordance with this Section and applicable reference standards listed in Article 1.03.

2. This section includes power distribution panelboards, and lighting and power panelboards rated 600 volts or less.

B. Related Documents

1. Division 26, Section 26 05 00 COMMON WORK RESULTS FOR ELECTRICAL

2. Division 26, Section 26 05 33 RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

3. Division 26, Section 26 05 26 GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

4. Division 26, Section 26 43 00 SURGE PROTECTIVE DEVICES

1.02 PRICE AND PAYMENT PROCEDURES

A. Measurement and payment requirements: per Division 01 General Requirements.

1.03 REFERENCES

A. Reference Standards

1. NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

a. NEMA PB 1 Panelboards

b. NEMA PB 1.1 Instructions for Safe Installation, Operation, and Maintenance of Panelboards Rated 600 Volts or Less

c. NEMA AB 1 Molded Case Circuit Breakers

2. UNDERWRITERS' LABORATORIES (UL)

   a. UL 50 Enclosures for Electrical Equipment

   b. UL 67 Panelboards

   c. UL 489 Molded – Case Circuit Breakers and Circuit Breaker Enclosures

3. CANADIAN STANDARDS ASSOCIATION (CSA)

   a. CSA Standard C22.2 No. 29-M1989 Panelboards and Enclosed Panelboards

   b. CSA Standard C22.2 No. 5-M91 Molded Case Circuit Breakers

4. FEDERAL SPECIFICATIONS

   a. Federal Specification W-P-115C – Type I Class I

   b. Federal Specification W-C-375B/Gen – Circuit Breakers, Molded Case, Branch Circuit and Service

   c. Federal Specification W-C-865C – Fusible Switches

5. NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

   a. NFPA 70 – National Electrical Code (NEC)

6. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination, Sequencing, and Scheduling: per Division 01 General Requirements.

1.05 SUBMITTALS

A. Submit in accordance with Division 01 General Requirements.

   1. Product data for each type panelboard specified

   2. Approval documents shall include drawings. Drawings shall contain overall panelboard dimensions, interior mounting dimensions, and wiring gutter dimensions. The location of the main, branches, and solid neutral shall be clearly shown. In addition, the drawing shall illustrate one line diagrams with applicable voltage systems.

   3. Panel schedules for installation in panelboards. Submit final versions after load balancing.

B. Furnish manufacturer's product data, test reports, and materials certifications as required.

1.06 QUALITY ASSURANCE

A. Provide in accordance with Division 01 General Requirements.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Provide in accordance with Division 01 General Requirements.

1.08 SITE CONDITIONS

A. Existing Conditions: per Division 01 General Requirements.

PART 2 – PRODUCTS

2.01 MANUFACTURER

A. Acceptable panelboard manufacturers shall be:

1. Square D Company
2. General Electric Co.
3. Eaton
4. Siemens
5. Approved Equal

B. Substitutions must be submitted in writing three weeks prior to original bid date with supporting documentation demonstrating that the alternate manufacturer meets all aspects of the specification herein.

2.02 POWER DISTRIBUTION PANELBOARDS

A. Panelboard Interior

1. Power Distribution Panelboards shall be rated 600 Vac or 250 Vdc maximum. Continuous main current ratings as indicated on associated schedules not to exceed 1200 amperes maximum. Panelboard bus current ratings shall be determined by heat-rise tests conducted in accordance with UL 67.

2. Provide UL Listed short circuit current ratings (SCCR) as indicated on the associated schedules not to exceed the lowest interrupting capacity rating of any circuit breaker installed with a maximum of 200,000 RMS symmetrical amperes. Main lug and main breaker panelboards shall be suitable for use as Service Equipment when application requirements comply with UL 67 and NEC Articles 230.VI and VII.

3. The panelboard interior shall have three flat bus bars stacked and aligned vertically with glass reinforced polyester insulators laminated between phases. The molded polyester insulators shall support and provide phase isolation to the entire length of bus.

4. The bussing shall be fully rated with sequentially phased branch distribution. Panelboard bussing rated 100 through 600 amperes shall be aluminum. Bussing rated 800 amperes and above shall be plated copper. Bus bar plating shall run the entire length of the bus bar. The entire interleaved assembly shall be contained between two (2) U-shaped steel channels, permanently secured to a galvanized steel-mounting pan by fasteners.

5. Interior trim shall be of dead-front construction to shield user from all energized parts. Main circuit breakers through 800 amperes shall be vertically mounted. Main circuit breaker and main lug interiors shall be field convertible for top or bottom incoming feed.

6. A solidly bonded equipment ground bar shall be provided.

7. Solid neutral shall be equipped with a full capacity bonding strap for service entrance applications. Gutter-mounted neutral will not be acceptable.

8. Nameplates shall contain system information and catalog number or factory order number. Interior wiring diagram, neutral wiring diagram, UL Listed label, and Short Circuit Current Rating shall be displayed on the interior or in a booklet format. Leveling provisions shall be provided for flush mounted applications.

B. Group Mounted Circuit Breakers through 1200A

1. Circuit breaker(s) shall be group mounted plug-on with mechanical restraint on a common pan or rail assembly.

2. The interior shall have three flat bus bars stacked and aligned vertically with glass reinforced polyester insulators laminated between phases. The molded polyester insulators shall support and provide phase isolation to the entire length of bus.

3. Circuit breakers equipped with line terminal jaws shall not require additional external mounting hardware. Circuit breakers shall be held in mounted position by a self-contained bracket secured to the mounting pan by fasteners. Circuit breakers of different frame sizes shall be capable of being mounted across from each other.

4. Line-side circuit breaker connections are to be jaw type.

5. All unused spaces provided, unless otherwise specified, shall be fully equipped for future devices, including all appropriate connectors and mounting hardware.

C. Electronic Trip Molded Case Standard Function 80% Rated Circuit Breakers

1. All electronic circuit breakers shall have the following time/current response adjustments: Long Time Pickup, Long Time Delay, Short Time Pickup, Short Time Delay, Ground Fault Pickup, Ground Fault Delay, and Instantaneous settings. Each adjustment shall have discrete settings (fully adjustable) and shall be independent of all other adjustments.

2. Circuit breaker trip system shall be a microprocessor-based true RMS sensing designed with sensing accuracy through the thirteenth (13th) harmonic. Sensor ampere ratings shall be as indicated on the associated schedule or drawings.

3. Local visual trip indication for overload, short circuit and ground fault trip occurrences.

4. Long Time Pickup indication to signal when loading approaches or exceeds the adjustable ampere rating of the circuit breaker shall be provided.

5. Furnish thermal magnetic molded case circuit breakers for 250A frames and below.

D. Thermal Magnetic Molded Case Circuit Breakers

1. Molded case circuit breakers shall have integral thermal and instantaneous magnetic trip in each pole.

2. Circuit protective devices shall be molded case circuit breakers. Circuit breakers shall be standard interrupting. Ampere ratings shall be as shown on the drawings.

E. Enclosures

1. Type 1 Boxes

a. Boxes shall be hot zinc dipped galvanized steel constructed in accordance with UL 50 requirements. Unpainted galvannealed steel is not acceptable.

b. Boxes shall have removable blank end walls and interior mounting studs. Interior support bracket shall be provided for ease of interior installation.

c. Maximum enclosure dimensions shall be 44” wide and 9.5” deep.

2. Type 1 Trim Fronts

   a. Trim front steel shall meet strength and rigidity requirements per UL 50 standards. Shall have an ANSI 49 medium gray enamel electrodeposited over cleaned phosphatized steel.

   b. Trim front shall be hinged 1-piece with door available in flush or surface mount as indicated on the panel schedules. Trim front door shall have rounded corners and edges free of burrs. A clear plastic directory cardholder shall be mounted on the inside of the door.

   c. Locks shall be cylindrical tumbler type with larger enclosures requiring sliding vault locks with 3-point latching. All lock assemblies shall be keyed alike. One (1) key shall be provided with each lock.

3. Type 3R, 5 and 12

   a. Enclosures shall be constructed in accordance with UL 50 requirements. Enclosures shall be painted with ANSI 49 gray enamel electrodeposited over cleaned phosphatized steel

   b. All doors shall be gasketed and be equipped with a tumbler type vault lock and two (2) additional quarter turn fasteners. A clear plastic directory cardholder shall be mounted on the inside of door. All lock assemblies shall be keyed alike. One (1) key shall be provided with each lock

   c. Maximum enclosure dimensions shall not exceed 44” wide and 14.5” deep.

2.03 LIGHTING AND APPLIANCE PANELBOARDS

A. Lighting and Appliance Panelboards shall be designed for three phase, four wire, solid neutral, 60-hertz service rated for 480/277 volt or 120/208V service as indicated. Where main circuit breakers are indicated on the Drawings, provide main circuit breaker type interiors. Back-fed branch circuit breakers shall not be utilized for main circuit breakers.

B. Panelboards shall be flush or surface mounted, etc., as indicated by panel schedule; code gauge galvanized steel boxes and enameled steel fronts sized for minimum 6" minimum side, top and bottom gutters, or greater as required by NEC.

C. Each panel shall have door in door trim with full length piano hinge to allow for access to wireways.

D. Each panel shall have door provided with cylinder lock and latch allowing for common key access to each panel. Each panel shall have fully typed out directory indicating outlets, fixtures, devices and locations served by the intended circuit. Panelboards for use as service disconnecting means shall additionally conform to UL 869.

E. Mechanical lugs furnished with panelboards shall be cast copper or copper alloys of sizes suitable for the conductors indicated to be connected thereto. Panelboards shall have fully capacity neutral bus, ground bus and bolt-on circuit breakers.

F. Circuit breakers shall be molded-case, thermal-magnetic, quick-make, quick-break, bolt-in type. Interrupting rating of circuit breakers shall be as indicated. Provide with suitable handle locks where indicated. Where interrupting rating is not indicated, panels for 120/208 volts service shall have breakers with 10,000 ampere RMS minimum interrupting rating at 240 volts, main circuit breakers where indicated shall have 25,000 ampere RMS minimum interrupting rating at 240 volts. Panels for 480/277 volt service shall have breakers with 14,000 ampere RMS minimum interrupting rating at 480 volts.

2.04 SPD DEVICES

A. Refer to Section 26 43 00 SURGE PROTECTIVE DEVICES for specific requirements.

B. IEEE C62.41, integrally mounted, plug-in style, solid-state, parallel-connected, sine-wave tracking suppression and filtering modules.

C. Minimum single-impulse current rating shall be as follows:

1. Line to Neutral: 100,000A

2. Line to Ground: 100,000A

3. Neutral to Ground: 50,000A

D. Protection modes shall be as follows:

1. Line to neutral

2. Line to ground

3. Neutral to ground

E. EMI/RFI Noise Attenuation Using 50-ohm Insertion Loss Test: 55dB at 100kHz.

F. Accessories shall include the following:

1. Form-C contacts, one normally open and one normally closed, for remote monitoring of system operation. Contacts to reverse position on failure of any surge diversion module.

2. Audible alarm activated on failure of any surge diversion module.

2.05 ENCLOSURES

A. Reference Section 26 05 33 RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS for approved Enclosure Types.

2.06 SOURCE QUALITY CONTROL

A. Provide in accordance with Division 01 General Requirements.

PART 3 – EXECUTION

3.01 PANELBOARDS

A. Install panelboards and accessory items in accordance with NEMA PB 1.1,"General Instructions for Proper Installation, Operation, and Maintenance of Panelboards Rated 600 Volts or Less" and manufacturers' written installation instructions.

B. Mounting Heights: Top of trim shall be 6' 2" above finished floor, except as indicated.

C. Circuit Directory: Typed and reflective of final circuit changes required to balance panel loads. Obtain approval before installing. Number branch circuit devices accordingly to correspond to circuit directory.

D. After substantial completion, conduct load balancing measurements and circuit changes. Should the difference at any panelboard between phases exceed 20 percent, rearrange circuits in the panelboard to balance the phase loads within 20 percent. Take care to maintain proper phasing for multi-wire branch circuits.

E. Make equipment grounding connections for panelboards as indicated.

F. Provide ground continuity to main electrical ground bus indicated.

G. Electrical Tests: Include the following items performed in accordance with manufacturer's instructions:

1. Ground resistance test on system and equipment ground connections.

2. Test main and sub-feed overcurrent protective devices.

3.02 CLEANING

A. Upon completion of installation, inspect all panelboards and transformers. Remove paint splatters and other spots, dirt, and debris. Touch up scratches and marks of finish to match original finish.

3.03 FIELD QUALITY CONTROL

A. Provide in accordance with Division 01 General Requirements.

3.04 STARTUP & COMMISSIONING

A. Provide in accordance with Division 01 General Requirements.

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SECTION 26 24 19

MOTOR CONTROL CENTER (INTELLIGENT)

PART 1 – GENERAL

1.01 PROPRIETARY NOTIFICATION

A. The Owner has determined that it is in the Public interest to include in the Specifications for the Project, the requirement that the Intelligent Motor Control Center as described in this Section be a proprietary item, specifically Rockwell Automation/Allen Bradley, or approved equal. The reason for this determination is that the Town has standardized replacement parts for motor control centers manufactured by the same manufacturer, thus ensuring the quality and interchangeability of parts to simplify and reduce the cost of maintenance and repairs.

B. Should the Contractor request a substituted system, the Owner must evaluate and determine whether the requested substitution is equal based upon the following:

1. It is at least equal in quality, durability, appearance, strength and design.

2. It will perform at least equally the function imposed by the general design for the public Work being contracted for or the material being purchased.

3. It conforms substantially, even with deviations, to the detailed requirements, for the items included in this and related sections.

4. Should a substituted system be approved by the Owner, the Contractor shall be responsible for all costs of redesign, including efforts associated with review and approval of the substituted system, necessary to incorporate the substituted system into the existing facility and remaining aspects of the Project.

1.02 SUMMARY

A. Section Includes

1. The Contractor shall provide the labor, tools, equipment, and materials necessary to furnish and install a motor control center (MCC) in accordance with the plans and as specified herein.

1.03 PRICE AND PAYMENT PROCEDURES

A. Measurement and payment requirements: per Division 01 General Requirements.

1.04 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract apply to this section.

B. Related Sections

1. Division 26, Section 26 05 00 COMMON WORK RESULTS FOR ELECTRICAL

2. Division 26, Section 26 05 33 RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

3. Division 26, Section 26 05 26 GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

4. Division 26, Section 26 08 00 COMMISIONING OF ELECTRICAL SYSTEMS

5. Division 26, Section 26 29 13 ENCLOSED CONTROLLERS

6. Division 26, Section 26 29 23 VARIABLE FREQUENCY MOTOR CONTROLLERS

7. Division 26, Section 26 35 33 POWER FACTOR CORRECTION EQUIPMENT

8. Division 26: Section 26 43 00 SURGE PROTECTIVE DEVICES

1.05 REFERENCES

A. Reference Standards

1. NATIONAL ELECTRICAL CODE (NEC)

2. NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

   a. NEMA Standard ICS 2

3. UNDERWRITERS' LABORATORIES (UL)

   a. UL Standard 845

1.06 QUALITY ASSURANCE

A. Provide in accordance with Division 01 General Requirements.

1.07 GENERAL REQUIREMENTS

A. Connection Drawings shall be submitted showing the relations and connections of the following items by showing the general physical layout of all controls, the interconnection of one system (or portion of system) with another, and internal tubing, wiring, and other devices.

B. Certificates shall be submitted for circuit tests on similar motor-control or motor-circuit protector (MCP) units under actual conditions may be submitted in lieu of factory tests on the actual units provided.

C. The MCC shall have factory installed industrial Ethernet cabling integrated throughout the vertical sections across the entire lineup.

D. Each motor starter, electronic overload relay, power monitor, AC drive and soft starter unit in the MCC shall be supplied with a means to communicate via Ethernet/IP network.

1.08 ADMINISTRATIVE REQUIREMENTS

A. Coordination, Sequencing, and Scheduling: per Division 01 General Requirements.

1.09 SUBMITTALS

A. Submit in accordance with the Division 01 General Requirements.

B. Furnish manufacturer's product data, test reports, and material certifications as required.

C. The Contractor shall, after award of Contract and before installation, submit Shop Drawings, Owner’s Manuals and Operating Instructions for equipment to be furnished under this Contract. Shop Drawings shall be submitted outlining the following: (Shop Drawings are required prior to acceptance).

1. Voltage, phase, frequency

2. Horizontal and vertical bus capacity

3. Short circuit ratings

4. Main and feeder circuit breakers ratings

5. Types of motor controllers

6. Types of wiring (NEMA type wiring)

7. Enclosures

8. Sections

9. Motor size and overload heaters

10. Panels and transformers

11. Control components

12. Overcurrent protective devices

13. Metering components

14. Surge protection

15. Time-current curves for all circuit breakers in the MCC

D. Submit layout drawings of MCCs showing accurate scaled basic equipment sections including, but not limited to, motor controllers, device panels, and circuit breakers. Submit unit wiring diagrams. Clearly differentiate on wiring diagrams those conductors that are factory installed and those which are field installed.

E. Closeout and Maintenance Material Submittals: per Division 01 General Requirements.

1.10 DELIVERY, STORAGE AND HANDLING

A. Provide in accordance with Division 01 General Requirements.

B. The Contractor shall coordinate the appropriate shipping splits of the Motor-Control Centers with the MCC manufacturer for entry into the building.

C. The Contractor shall store the MCC in a clean and dry heated space until installation.

D. The Contractor shall protect the unit from dirt, water, construction debris and traffic.

E. The MCC shall be shipped with external lifting angles at the top and running continuously with each shipping split. Lifting eyelets are not acceptable.

1.11 WARRANTY

A. The MCC manufacturer shall provide their standard parts warranty for eighteen months from the date of shipment or twelve months from the date of being energized, whichever occurs first.

B. The manufacturer shall confirm the warranty as part of the submittal.

1.12 SPARE MATERIALS

A. Provide three of each size power fuse utilized.

B. Provide spares equal to 10 percent of the installed quantity for primary and secondary control power fuses.

C. Provide one can of touch-up spray paint.

1.13 SITE CONDITIONS

A. Existing Conditions: per Division 01 General Requirements.

PART 2 – PRODUCTS

2.01 MATERIALS

A. Acceptable Manufacturers

1. Rockwell Automation/Allen-Bradley

B. Configuration

1. Motor-control centers shall be NEMA ICS 2, Class I, Type B, totally enclosed, free-standing, dead-front distribution type with one or more vertical sections and with ratings as identified on the Drawings.

C. Enclosure

1. NEMA Type 1 Gasketed.

2. Removable end plates on each end of the MCC shall cover the horizontal bus and horizontal wireway openings.

3. The MCC shall include bottom plates.

4. Each section of the MCC shall be equipped with full metal side sheets to isolate each vertical section.

5. All interior and exterior surfaces shall be painted ANSI 49 medium light gray. The vertical wireways and unit back plates shall be painted high visibility gloss white.

6. All unpainted parts shall be plated for corrosion resistance.

D. Structure

1. The MCC shall be of dead front construction and shall consist of one or more vertical sections bolted together to form a rigid, free-standing

assembly. The complete system shall allow for the addition of future sections and to permit the interchanging of units. The overall length of the MCC shall not exceed the dimensions identified on the Drawings.

2. Vertical sections shall be rigid, free-standing structures. Vertical sections shall have internal mounting angles running continuously within the shipping block. Vertical sections shall be 90 inches high, 20 inches deep and 20 inches wide, except where larger dimensions are required or as indicated on the Contract Drawings. Vertical sections shall be provided with a removable steel lifting angle on all shipping blocks. The angle shall run the length of the shipping block.

3. Provide full depth horizontal wireways at the top and bottom of the MCC. The horizontal wireways shall be isolated from the bus, and shall have removable covers held in place by captive screws.

4. Provide a full height vertical wireway, independent of the plug-in units, in each standard vertical section. The vertical wireways shall be isolated from the horizontal and vertical buses, and shall be covered with a hinged and secured door. Wireway tie bars and isolation between the wireway and units shall be provided.

5. The minimum compartment height shall be 13 inches and shall be considered one space factor. One-half space factor compartments shall only be supplied when identified on the Contract Drawings.

6. NEMA size 5 starters and below shall be provided as plug-in units. Plug-in units shall consist of unit assembly, unit support pan and unit door assembly. Unit shall be supplied with removable doors, and the doors shall be fastened to the structure so that the doors can be closed when the unit is removed. A unit support pan shall be provided for support and guiding units, and shall remain in the structure when the units are removed to provide isolation between the units. A service position shall be provided for plug-in units that allows for the unit to be supported, but disengaged from the bus. The unit shall be capable of being padlocked in the service position.

7. Unit stabs for engaging the power bus shall be tin plated copper and provided with stainless back-up springs to provide and maintain a high pressure 4-point connection to the vertical bus. Wiring from the unit disconnecting means to the plug-in stabs shall not be exposed to the rear of the unit. A separate isolated pathway shall be provided for each phase to minimize the possibility of unit fault conditions reaching the power bus system. The power cable termination at the plug-in stab shall be maintenance-free crimp type.

8. Unit shall be provided with heavy-duty, industrial, flange mounted handle mechanism for control of each disconnect switch or circuit breaker. The

operator units may pivot in the vertical or horizontal plane. The on-off condition shall be indicated by the handle position, red and green colored indicators with the words ON and OFF, and the international symbols I and O along with a pictorial indication of the handle position. Handles shall be capable of being locked in the off position with up to three padlocks. The operator handle shall be interlocked with the unit door so that the disconnect cannot be switched to the on position unless the unit door is closed. A means shall be provided for purposely defeating the interlock during maintenance or testing. The operator handle shall be interlocked with the unit so that the unit cannot be inserted or withdrawn with the handle in the ON position.

9. Where specified, the units shall be provided with NEMA Type 4/13 watertight/oil tight pushbuttons, selector switches, or pilot lights. When three or less pilot devices are utilized, the devices shall be 30.5mm devices. When more then three devices are required, the use of 22.5mm devices are NOT permitted.

10. Control terminal blocks shall be pull-apart on all plug-in units for easy removal of the unit from the structure. Control terminal blocks on factory mounted units shall be fixed type. Provide power terminal blocks on starters rated NEMA size 3 and below. Power terminal bocks shall be pull-apart for NEMA size 1 and 2. Terminal blocks for NEMA size 3 starters shall be non-pull apart. Power terminal blocks shall not be required for NEMA size 4 and above. Terminal blocks shall not be located adjacent to or inside vertical wireways.

11. All MCC unit internal wiring shall be provided with heat shrink type wire markers.

E. Busbars

1. The horizontal bus shall be rated as identified on the Drawings, and shall be made of copper with tin plating. The horizontal bus shall be supported, braced and isolated from the vertical bus with a high strength, non-tracking glass polyester material. For standard sections, the horizontal bus shall be continuous within each shipping block and shall be braced within each section. Horizontal bus splices shall have at least two bolts on each side.

2. The vertical power bus shall have an effective rating of as indicated on the drawings. If a center horizontal bus construction is utilized, then the rating shall be 300 Amps above and below the horizontal bus for an effective rating of 600 Amps. If a top or bottom mounted horizontal bus is utilized, then the full bus must be rated for 600 Amps. The material of the vertical bus shall be copper with tin plating, and shall attach to the horizontal bus with at least two bolts. The vertical bus shall be continuously braced by a

high strength non-tracking glass-filled polyester material and sandwiched by a glass-filled polycarbonate molded cover.

3. Provide a ground bus system consisting of horizontal ground bus connected to vertical ground buses mounted in each section. Provide an unplated copper (0.25 inch by 2 inch) horizontal ground bus mounted in the bottom of the MCC unless specified otherwise on the Drawings. Provide a pressure type mechanical lug mounted on the ground bus in the incoming line section. Provide a unit ground stab on all unit inserts. The ground stabs shall establish unit insert grounding to the vetical ground bus before the plug-in power stabs engage the power bus. The grounding shall be maintained until after the plug-in power stabs are disengaged.

4. If a 4-wire system is specified, yet there are no neutral loads in the MCC, only a neutral connection plate is required in the MCC. If neutral loads are specified in the MCC, a full size neutral bus shall be provided. The neutral bus shall extend the width of the MCC, an incoming neutral lug pad in the incoming section, and neutral connection plates in sections as required.

F. Ethernet/IP Communication

1. The MCC shall have Ethernet wiring incorporated into its design.

   a. The MCC shall have factory installed industrial Ethernet cabling incorporated throughout the vertical section across the entire lineup.

   b. Each motor starter, electronic overload relay, power monitor, AC drive, and soft starter unit in the MCC shall be supplied with a means to communicate via EtherNet/IP network.

   c. Plug-in units shall be able to move around without impacting the network.

   d. Maintenance activities shall be able to be performed without impacting the network.

2. Industrial Ethernet Switch

   a. The MCC shall have a managed industrial Ethernet switch mounted in the top or bottom horizontal wireway or in fixed mounted units within the lineup.

   b. The managed industrial Ethernet switch shall deliver optimal network security, network resiliency (if needed), and flexibility. The functionality should include port based control/prioritization, switch-level ring support, VLAN segmentation, and other Layer-2 switch features.

3. Industrial Ethernet Cabling

   a. The Ethernet cable shall be 600V UL Category 5e PLTC rated.

   b. The use of a 300V rated cable is not acceptable.

   c. The industrial Ethernet cable shall connect each switch to one another in a linear topology.

   d. The industrial Ethernet cable through the MCC section shall be routed from the top or bottom horizontal wireways. To prevent accidental mechanical damage during MCC installation, the cable shall be located behind barriers to isolate the cable from the unit space and wireways.

   e. The EtherNet/IP device within each unit shall be factory connected to the industrial Ethernet switch directly by using a 600V-rated Ethernet cable.

4. Power Supplies

   a. The power supply shall provide 24V DC for the devices that require it.

   b. The MCC manufacturer shall ensure that adequate power supplies have been specified to conform with network requirements.

   c. Power supply output shall be rated 8 A, 24V DC.

   d. The power supply unit shall be provided with a buffer module to provide a minimum of 500 ms ride-through at full load.

   e. Up to four (4) 24V DV adapters shall be provided:

      1) In each vertical wireway of standard sections to simplify installation, relocation and addition of plug-in units.

      2) Each 24V DC adapter in the vertical wireway shall be connected to the power supply.

5. Programming and Testing

   a. The MCC manufacturer shall load the IP Address into each unit.

   b. The IP Address shall be as indicated on the contract drawings or as provided by the contractor/owner.

   c. The MCC manufacturer shall test the MCC to ensure that each unit communicates properly prior to shipment.

   d. Each unit shall have a label showing the IP Address for the devices within it.

   e. The MCC manufacturer shall provide a disk containing applicable electronic data sheet (EDS) files for the EtherNet/IP devices.

G. Disconnects

1. Main Disconnect

a. If no overcurrent protection is indicated, provide a main incoming-line lug compartment. Lugs shall accommodate the incoming power conductors as indicated on the Contract Drawings and shall be furnished by the MCC manufacturer.

2. Main Circuit Breaker Disconnect (if specified on drawings)

a. Lugs to accommodate the incoming power conductors as indicated on the contract drawings shall be provided by the MCC manufacturer.

b. Size the circuit breaker frame and trip rating as shown on the drawings.

c. The interrupting capacity rating shall meet or exceed the available fault current as shown on the contract drawings. Interrupting capacity based on a slash rating is not acceptable

d. Provide a circuit breaker with thermal magnetic trip unit for 250 A and smaller frames; provide electronic trip unit for 400 A and larger frames.

e. Provide a removable protective barrier to reduce the possibility of contact with the line terminals.

f. Provide one normally open and one normally closed circuit breaker auxiliary contact that follows the position of the circuit breaker main contacts for indication of ‘On’ or ‘Off/Tripped’.

g. For circuit breakers rated 1000 A and above, on Wye connected systems with a solidly grounded neutral, provide integrated ground fault protection with adjustable pick-up and adjustable time delay.

3. Feeder and Transformer Disconnects

a. The disconnecting means for feeders and transformers shall be thermal magnetic circuit breakers. The interrupting rating shall be greater than or equal to the bus bracing requirement. The minimum frame size shall be equal to 150 Amps. Provide one (1) normally open internally mounted auxiliary contact for indication of "ON", "OFF", and "Tripped".

b. Where required, fusible disconnect and circuit breaker feeder circuits shall have a Ethernet I/O Module containing at least two inputs and one output. The inputs of the modules shall be rated for 110-120VAC or 24VDC as specified on Contract Drawings.

4. Motor Starter Disconnects

    a. The disconnecting means for FVNR starters shall be motor circuit protectors. The short circuit rating shall be equal to or greater then the bus bracing requirement. Unit shall be supplied based upon the rules/requirements set forth by NEC, NEMA and UL standards. Unit shall be shipped at the lowest setting per UL standards. The Contractor shall field adjust the units based upon the particular motor application. The minimum frame size shall be equal to 150 Amps. Provide one normally open internally mounted auxiliary contact for indication of "ON" or "OFF/Tripped".

5. Variable Frequency Drives

    a. The disconnecting means for internally mounted variable frequency drives shall be motor circuit protectors. The short circuit current rating shall be equal to or greater than the bus rating requirement. Unit shall be supplied based upon the rules/requirements set forth by NEC, NEMA and UL standards. Unit shall be shipped at the lowest setting per UL standards. The Contractor shall field adjust the units based upon the particular motor application. The minimum frame size shall be equal to 150 Amps. Provide one normally open internally mounted auxiliary contact for indication of "ON" or "OFF/Tripped".

H. NEMA Rated Across the Line Starters

1. Starters shall be of NEMA design, not IEC. Starters shall have molded coils, replaceable contacts, and metal housing plate. NEMA rated/IEC designed starters are unacceptable.

2. Starters shall be provided with a 3-pole class 20 electronic overload relay with the following features:

    a. Ethernet communication

    b. LEDs for status indication

    c. Test/Reset button

    d. Selectable trip of NEMA Class 5 to 30. Unless indicated, the trip class shall be set for NEMA class 20 operation.

    e. General purpose I/O (minimum 4 discrete inputs / 2 discrete outputs), rated for 110-120VAC or 24VDC as specified on Contract Drawings.

    f. Protective functions

        3) Functions shall provide programmable trip level, warning level, time delay and inhibit window

4) Protective functions shall include thermal overload, phase loss, stall, jam, underload, current imbalance, remote trip, and PTC thermistor input.

5) Ground fault protection is not required. When required, the protection range shall be 1A to 5A for NEMA size 3 and smaller starters, and 20mA to 5A for NEMA size 4 and larger starters.

g. Current Monitoring Functions shall include Phase current, Average current, Full load current, Current imbalance percent, Percent thermal capacity utilized, and Ground fault current (if required)

h. Voltage, energy, and frequency measuring capabilities shall be provided.

i. Diagnostic Information shall include device status, warning status, time to reset, trip status, time to overload trip, and history of last five trips

j. Preventive maintenance information shall include Allowable starts per hour, required Time between starts, Starts counter, Starts available, Time until next start, total operating hours, and elapsed operating time

k. Overload relay shall include an on-board logic processor to allow basic logic to be performed within the overload relay based on network data and the status of the inputs to the overload relay

l. The overload relay shall support the following CIP messaging types: Polled I/O messaging, Change-of-state/cyclic messaging, Explicit messaging, Group 4 offline node recovery messaging, and Unconnected Message Manager (UCMM)

m. The overload relay shall provide the following functions to minimize network configuration time: Full parameter object support, Configuration consistency value, and Add-on Profile

3. Starters shall be provided with a minimum of two (2) normally open and one (1) normally closed auxiliary contact in addition to the hold-in contact and the auxiliary contacts shown on the Drawings up to a maximum of seven beyond the hold-in contact.

4. Starters shall be provided with a minimum of two (2) normally open and one (1) normally closed auxiliary contact in addition to the hold-in contact and the auxiliary contacts shown on the Drawings up to a maximum of six beyond the hold-in contact.

5. Provide a control power transformer with a rated secondary voltage of 120VAC and a VA rating of at least twice the sealed VA rating of the starter. Provide both primary and secondary fuse protection for the starter.

6. When indicated on the Contract Drawings, provide a door mounted selector switch for Hand/Off/Auto operation. The Hand Mode shall provide a local start control. In the Auto Mode, the start control shall be provided via a remote contact or via Ethernet communications as indicated on the Contract Drawings. Provide an extra set of contacts on the selector switch to monitor the AUTO switch position.

7. Provide door mounted 120VAC push-to-test LED pilot lights for ON (green) and OFF (Red) indication.

I. Internally Mounted Variable Frequency Drives

1. Provide internally mounted VFDs as indicated on the Contract Drawings. VFDs shall be provided in accordance with Section 26 29 23 VARIABLE FREQUENCY MOTOR CONTROLLERS.

1. The unit shall be provided with a 120V control power transformer. The control power transformer shall be provided with primary and secondary fusing.

2. For exterior mounted motor control centers, provide each VFD bucket with internally mounted space heater in accordance with Manufacturers recommendations.

3. Provide VFDs with 120VAC control interface.

4. When indicated on the Contract Drawings, provide a door mounted selector switch for Hand/Off/Auto operation. The Hand Mode shall provide a local start control. In the Auto Mode, the start control shall be provided via a remote contact or via Ethernet communications as indicated on the Contract Drawings. Provide an extra set of contacts on the selector switch to monitor the switch position.

5. Provide a door mounted full human interface module for programming, display and control.

8. Provide door mounted push-to-test LED pilot lights for ON (green) and OFF (Red) indication.

6. Unit shall be provided with input Line Reactor with an Impedance rating of 3% or 5% as indicated on the Drawings for voltage transient protection, and for a degree of protection from harmonic distortion.

7. Ethernet/IP communication interface shall be provided to allow for communication between the solid-state component and the Ethernet network.

J. Metering Compartment

1. MCC shall include an Allen Bradley Power Monitor 5000, or approved equivalent, plug-in metering compartment.

2. The unit shall include the following:

   a. Fusible disconnect with fuses.

   b. Fused control circuit transformer.

   c. Current Transformers shipped loose to be installed in the field.

   d. Power Monitor with door mounted display.

3. Power Monitor shall be capable of the following:

   a. Display current for all three phases with plus or minus 0.2 percent full-scale accuracy.

   b. Display average three phase current with plus or minus 0.2 percent full-scale accuracy.

   c. Display line-to-neutral and line-to-line voltage with plus or minus 0.2 percent full-scale accuracy.

   d. Display current and voltage unbalance.

   e. Display real, reactive, appartent and true power with plus or minus 0.4 percent full-scale accuracy.

   f. Display KWh, KVARh and KVAHnet.

   g. Display true RMS to the 45th harmonic.

   h. Display frequency at plus or minus 0.4 percent.

   i. The power monitor shall include min/max logs and trend logs with up to 45,867 data points.

   j. The power monitor shall be capable of distortion analysis with THD, Crest Factor (I, V) and distortion power factor.

   k. The power monitor shall include a RS-485 communication port as standard and shall have integral Ethernet communications. Unit shall be available with optional RS-232, DeviceNet, ControNet, and Remote I/O.

   l. The power monitor shall include two form-C relays.

K. Power Factor Correction System/ Active Harmonic Filter

   a. Provide Power Factor Correction System/ Active Harmonic Filter integral to MCC. Reference Division 26, Section 26 35 33 Power Factor Correction Equipment.

L. Intelligent Motor Control Center Software

1. The MCC shall be provided with pre-configured Intelligent Motor Control Center software. The software shall be capable of viewing multiple MCC line-ups.

2. The Intelligent Motor Control Center software communication driver shall allow the software to be installed and operated on Ethernet/IP, ControlNet, or DeviceNet network.

3. The Intelligent Motor Control Center software shall be capable of functioning as a stand-alone software package or as an ActiveX control in a Human Machine Interface (HMI).

4. The software shall be capable of displaying the following:

a. Elevation View

1) Dynamically displays status information based on reading data from devices in MCC line-up

2) Sizable view to allow ease of viewing multiple MCC line-ups

3) Unit nameplate information

4) Unit status indicators (ready, running, warning, fault, no communication)

b. Unit Monitor View

1) Pre-configured for a specific unit

2) Real time monitoring via analog dials and trending

3) Data configurable for customized viewing

4) Modifying device parameters

c. Spreadsheet View

1) User configurable for customized monitoring

2) Sorting and cascading functions

3) Custom user fields

d. Event Log

1) Track history of MCC unit

2) Automatic logging of trips, warnings and changes

3) Manual entry of events

e. Documentation

1) Front elevation drawings

2) Unit wiring diagrams

3) User manuals

4) Spare parts list

2.02 SOURCE QUALITY CONTROL

A. Provide in accordance with Division 01 General Requirements.

PART 3 – EXECUTION

3.01 FACTORY PROGRAMMING & TESTING

A. The IP address addresses shall be set for each unit per the drawings. All other parameters may be left at the factory default setting.

B. The Intelligent Motor Control Center shall be powered up, configured and tested in an ISO9001 facility to ensure each unit communicates properly prior to shipment.

3.02 INSTALLATION

A. Complete assembly shall be electrically and mechanically connected and assembled from coordinated subassemblies shipped in complete sections from the manufacturer. Installation shall be aligned, leveled, and secured to the supporting construction in accordance with the manufacturer's instructions.

B. Contractor shall tighten accessible bus connections and mechanical fasteners in accordance with the manufacturers torque requirements.

C. Contractor shall select and install fuses in fusible switches based upon field requirements.

D. Contractor shall adjust circuit breaker settings based upon the field requirements.

E. Contractor shall adjust solid state overloads to match installed motor characteristics.

F. The manufacturer of the MCC shall provide MCC start-up services as part of the supply of the MCC.

3.03 FIELD TESTING

A. Motor-control centers shall be subjected to continuity and insulation tests after the installation has been completed and before the motor-control center is energized.

B. Contractor shall provide test equipment, labor, and personnel to perform the tests required. Continuity tests shall be conducted using a dc device with bell or buzzer.

C. Motor-control centers shall be completely isolated from extraneous electrical connections. Substation feeder breakers, circuit breakers in switchboards, and other disconnecting devices shall be used to isolate the motor-control center under test.

D. Insulation tests on 600-volt motor-control centers shall be conducted using a 1,000-volt insulation-resistance test set. Readings shall be recorded every 15 seconds for the first minute and every minute thereafter for 10 minutes. Resistance between phase conductors and between phase conductors and ground shall be not less than 50 megohms.

E. Insulation tests on motor-control centers 480 volts or less shall be conducted using a 500-volt insulation-resistance test set. Readings shall be recorded every 15 seconds for the first minute and every minute thereafter for 10 minutes. Resistance between phase conductors and between phase conductors and ground shall be not less than 25 megohms.

F. Prior to final acceptance the motor control center shall be energized and loaded (to the maximum load possible, but not less than 10 percent of expected full load) for a minimum of 10 minutes and the temperature measured, with a non-contact device, to verify connection integrity. The temperature detector shall be accurate within 0.5°C. Each phase temperature of 3 phase circuits and individual connections compared to other similarly loaded connections shall be within 3°C of each other. Temperatures outside these values warrant investigation.

G. Phase-rotation tests shall be conducted on all three-phase circuits using a phase-rotation indicating instrument. Phase rotation of electrical connections to motors and other connected equipment shall be clockwise.

H. Test data shall be recorded and shall include location and identification of motor-control centers and megohm readings versus time.

I. Final acceptance shall depend upon the satisfactory performance of the motor-control centers under test. No motor-control center shall be energized until recorded test data have been approved by the Engineer. Final test reports shall be provided to the Owner and Engineer. Reports shall have a cover letter/sheet clearly marked with the System name, Date, and the words "Final MCC Test Reports".

3.04 START-UP AND TRAINING

A. Start-up, Warranty and Training services shall be provided by the manufacturers authorized field service professional during standard working hours. Work may be completed during overtime or premium hours at additional charge. The Field Service Professional will provide the following during the start-up. This service includes hands-on training for the customer's service technician(s).

B. Physical inspection and verification of proper drive and motor installation practices prior to the application of power.

C. Verification of external control wiring.

D. Confirmation of drive cabling to Motor, Line Feed, Isolation Transformer (if applicable).

E. Incoming line and drive output grounding checks.

F. Voltage Application, Checkout, Calibration and Testing of the drive as appropriate for the application.

G. Tune-up of drive internal regulating loops as appropriate for the application.

H. Adjustment of operation parameters, within drive and motor design limitations, to values as appropriate for the application

I. Operation of drive through speed range to verify proper performance.

J. Loading of network parameters in drive.

K. Documentation of drive and motor nameplate information, application information, drive settings and operating parameters

3.05 INTELLIGENT MOTOR CONTROL CENTER SOFTWARE TRAINING

A. The Field Service Professional will provide the following assistance to the customers during the start-up portion of the MCC:

1. Load Software and Data CD on end users designated PC.

2. Review functionality of Intelligent Software with End users staff.

3.06 FIELD QUALITY CONTROL

A. Provide in accordance with Division 01 General Requirements.

3.07 STARTUP & COMMISSIONING

A. Provide in accordance with Division 01 General Requirements.

3.08 CLOSEOUT ACTIVITIES

A. Provide in accordance with Division 01 General Requirements.

END OF SECTION

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SECTION 26 27 26

WIRING DEVICES

PART 1 - GENERAL

1.01 SUMMARY

A. The Contractor shall provide the labor, tools, equipment, and materials necessary to furnish and install wiring devices in accordance with the plans and as specified herein.

B. This section includes the following:

1. Flush Wiring Devices
2. Control Relays
3. Motor Control Relays/Contactors
4. Control Stations
5. Door Intrusion Switches
6. Thermostats
7. Stand Alone Smoke and Heat Detectors

1.01 PRICE AND PAYMENT PROCEDURES

A. Measurement and payment requirements: per Division 01 General Requirements.

1.02 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. Related Sections

1. Division 26, Section 26 05 00 COMMON WORK RESULTS FOR ELECTRICAL
2. Division 26, Section 26 05 19 LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES
3. Division 26, Section 26 05 26 GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

4. Division 26, Section 26 05 34 RACEWAYS, BOXES & SUPPORTING DEVICES

1.03 REFERENCES

A. Reference Standards

1. NATIONAL ELECTRICAL CODE (NEC)

2. UNDERWRITER'S LABORATORIES, INC. (UL)

3. NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

1.02 ADMINISTRATIVE REQUIREMENTS

A. Coordination, Sequencing, and Scheduling: per Division 01 General Requirements.

1.04 SUBMITTALS

A. Furnish manufacture’s product data, test reports, and materials certifications in accordance with Division 01 General Requirements.

1.03 QUALITY ASSURANCE

A. Provide in accordance with Division 01 General Requirements.

1.04 SITE CONDITIONS

A. Existing Conditions: per Division 01 General Requirements.

PART 2 - PRODUCTS

2.01 FLUSH WIRING DEVICES

A. Wall Switches

1. Wall Switches shall be specifications grade, toggle operated, quiet type alternating current (ac) switches, NEMA heavy duty class, rated at 20 ampere, 120/277 v. Provide matching two pole, 3-way or 4-way switches as indicated. Switches shall be white in color. Comply with UL 20 and NEMA Standards.

2. Where two or more switches are to be installed at the same location, they shall be mounted in one-piece ganged switch boxes, with appropriate gang cover plate.

3. Provide waterproof switches where indicated.

4. Explosion Proof Switches: Explosion Proof/Dust-Ignition Proof Wall Switches shall be specifically approved by Underwriters' Laboratories, Inc., or Factory Mutual for particular "Class," "Division," and "Group" of hazardous locations involved. Switches shall be tumbler operated equal to Appleton EDS Series, Crouse Hinds, or approved equal. Switches shall be factory sealed specifically designed to a U.L. standard so that any arcing devices are within a chamber which contains any explosions. Switches shall be approved for installation without any additional external sealing fittings. Switches shall be specifically designed to accept conduit sizes indicated on the Contract Drawings.

B. Receptacles

1. Convenience receptacles for interior use shall be specification grade, industrial heavy duty type, 20-ampere, 125-volt ac, 2-pole, 3-wire, back wiring, metal plaster ears, single, duplex (as indicated) grounded, conforming to NEMA FB 11, NEMA WD 1 and to the 5-20R configuration in NEMA WD 6. Receptacles shall be white in color. Provide waterproof in-use covers where indicated and required.

2. Ground Fault Interrupter (GFI) Receptacles shall be specification grade. Provide 20 ampere, "feed through" type ground fault circuit interrupter, with integral heavy duty NEMA 5 20R duplex receptacles arranged to protect connected downstream receptacles on same circuit. Provide unit designed for installation in a 2 3/4 inch deep outlet box without adapter, grounding type, Class A, Group 1. Receptacles shall be white in color. Provide waterproof in-use covers where indicated and required.

3. Locking receptacles shall conform to NEMA WD 6. One (1) plug shall be furnished with each locking receptacle.

4. Receptacles shall meet the requirements for retention of plugs, overload, temperature, and assembly security in accordance with NEMA WD 1.

5. Special purpose outlets: NEMA heavy duty class, grounding type with matching plug. Coordinate NEMA type with equipment manufacturer.

6. Explosion Proof Receptacles: Explosion Proof/Dust-Ignition Proof Receptacles shall be specifically approved by Underwriters' Laboratories, Inc., or Factory Mutual for particular "Class," "Division," and "Group" of hazardous locations involved. Receptacles installed in hazardous locations shall be factory sealed as provide by Appleton Contender U-Line Series, Crouse Hinds, or approved equal. Receptacles shall be 20 amp rated designed with dead front construction. To operate, a matching plug shall be utilized. When the plug is inserted and rotated, the receptacle shall be activated. Receptacles shall be approved for installation without any additional external sealing fittings. Receptacle enclosures shall be

constructed of copper-free aluminum and malleable iron. Provide each receptacle with matching 20-amp plug. Plugs shall be constructed of thermoplastic polyester specifically designed for use where moisture and corrosion may be present. Plugs shall be designed for use with general purpose receptacles in non-classified locations. Provide each receptacle with two (2) spare matching plugs.

C. Device Plates

1. Wall plates for flush wall switches and receptacles shall be the appropriate type and size and shall match the wiring devices for which they are intended. Dimensions for openings in wall plates shall be in accordance with NEMA WD 1.

2. Process area: Plates in process areas for receptacles, telephone, etc., shall Galvanized steel, smooth rolled outer edge sized to fit box.

3. Device plates in general areas for receptacles shall be stainless steel.

4. Device Plates in finished spaces (office) shall be impact resistant plastic, white in color.

D. Weatherproof Device Plates

1. Provide weatherproof device plates where indicated and required.

2. Interior and Exterior Wet Locations: Device plates for interior and exterior wet locations shall be die-cast aluminum, gasket, with corrosion resistant screws to match plate cover finish. Provide weatherproof receptacles with vertical “in-use” covers for complete weatherproofing when plug is inserted.

2.02 CONTROL RELAYS

A. Control Relays: Allen Bradley Bulletin 700-H Series, Square D or equal.

B. 120V coil as required or as indicated.

C. Number of poles as indicated or required.

D. Electrically Held, except as noted.

E. Enclosure shall be NEMA-1, except as noted.

2.03 MOTOR CONTROL RELAYS/CONTACTORS

A. Allen Bradley, Square D or equal.

B. 120V and 277V coils as required or as indicated

C. Number of poles as indicated or required.

D. Horsepower rated for connected motor.

E. Electrically Held, except as noted.

F. Enclosure shall be NEMA-1, except as noted.

G. 600V Rated.

2.04 CONTROL STATIONS

A. All control stations shall be industrial, heavy duty type, with oil-tight construction and clearly marked legend plates. Enclosures shall be provided based upon location in accordance with NEMA requirements and as required for the area classifications as indicated and NEMA rating to meet environmental conditions of installed location.

B. Enclosures shall be common or grouped mounted for devices in the same location. Devices shall include front mounted nameplates identifying function.

C. Subject to compliance with requirements, provide control stations by one of the following:

1. Allen Bradley Company

2. Appleton Electric Company

3. Crouse-Hinds Company

4. Approved equal

D. Selector Switches

1. Selector Switches shall be non-illuminated, standard knob operated rated for use at 120VAC. The knob operator insert shall be white in color. Units shall be rotary type with round or oval handles and positioning device to securely hold switch in selected position. Where shown on the Drawings selector switches shall be key type.

2. Provide compatible nameplate for each selector switch identifying intended functions: (I.E. "HAND/OFF/AUTO", "LOCAL/OFF/REMOTE", “JOG/OFF/AUTO”, ETC.) as indicated on the Contract Drawings.

3. Units shall be 30.5mm selector switches.

E. Pushbuttons

4. Switches shall be non-illuminated momentary or maintained type rated for use at 120 VAC. Switches shall green in color for "START" pushbuttons, and shall be red in color for "STOP" pushbuttons.

5. Provide compatible nameplate for each pushbutton identifying intended functions (I.E. "STOP", "START", ETC.).

6. Equipment stop and emergency stop operators shall be mushroom style, 2-position push-pull type, with number of contacts as indicated on the Contract Drawings. Stations shall be provided with push-pull padlocking attachment and legend plate reading: "Push to Stop, Pull to Start."

7. Units shall be 30.5mm pushbuttons.

2.05 THERMOSTATS

A. Analog Thermostats

1. Analog thermostats shall be of wall mount design with integral wall mounting bracket/mounting plate. The temperature transmitter shall have a temperature range of -40 to 150°C (-40 to 302°F). The transmitter shall have a 4-20mA (0-10vdc) output for monitoring via the facilities SCADA control panel. Unit power shall be 8-32vdc. Unit shall be equal to IFM Efector600, Model TN2531, or approved equal.

2.06 DOOR INTRUSION SWITCHES

A. Door intrusion switches shall be non-contact interlock position switches with a switching voltage of 120 VAC, 0.2A. Switch shall be UL listed and have a nominal break range of 1.2 inches, minimum lead lengths of 12", conduit connection of ½" NPT, and a hermetically sealed N.O. contact configuration. Enclosure shall be Nylon 6/6 and NEMA rating of 4X. Intrusion switches shall have a load rating of 84W. Intrusion switch shall be as manufactured by GE, Allen Bradley or approved equal.

B. Odor Control Room and Wet Well intrusion switch shall be rated NEMA 7.

2.07 STAND ALONE SMOKE DETECTORS

A. Stand Alone Smoke Detectors shall be powered by 120vac with available battery backup. An LED power on indicator shall be provided for verification that the unit is active.

B. Unit shall be provided with test switch which shall electronically activate the chamber to simulate smoke and check for proper operation. Unit shall be provided

with electronic horn with a level of 85 decibels at 10 feet. Unit shall meet the requirements of U.L Standard 217.

C. Unit shall be provided with form C dry-contact for alarming to the facilities SCADA control panel.

2.08 STAND-ALONE HEAT DETECTOR

A. Stand Alone Heat Detectors shall be powered by 120vac with available battery backup. An LED power on indicator shall be provided for verification that the unit is active.

B. Unit shall be provided with test switch which shall electronically activate the detector and check for proper operation. Unit shall be provided with electronic horn with a level of 85 decibels at 10 feet. Unit shall meet the requirements of U.L Standard 217.

C. Heat detectors located in classified spaces shall be NEMA 7 rated.

D. Unit shall be provided with form C dry-contact for alarming to the facilities SCADA control panel.

2.09 SOURCE QUALITY CONTROL

A. Provide in accordance with Division 01 General Requirements.

PART 3 - EXECUTION

3.01 WIRING DEVICES

A. Wall Switches and Receptacles

1. Wall switches and receptacles shall be so installed that when device plates are applied, the plates will be aligned vertically to within 1/16-inch.

2. Ground terminal of each flush-mounted receptacle shall be bonded to the outlet box with an approved green bonding jumper.

B. Device Plates

1. Device plates and receptacle cover plates for receptacles and light switches shall be suitably labeled, identifying the circuit number and the panel name; for example: RP1-12.

2. Device plates shall be identified on the inside of the plate by circuit number and panelboard.

C. Control Stations

1. Mount equipment so that sufficient access and working space is provided for ready and safe operation and maintenance.

2. Securely fasten equipment to walls or other surfaces on which they are mounted. Provide independent galvanized steel supports where no wall or other surface exists.

3. Install in conformance with National Electrical Code.

3.02 FIELD QUALITY CONTROL

A. Provide in accordance with Division 01 General Requirements.

3.03 STARTUP & COMMISSIONING

A. Provide in accordance with Division 01 General Requirements.

3.04 CLOSEOUT ACTIVITIES

A. Provide in accordance with Division 01 General Requirements.

END OF SECTION

SECTION 26 28 16

ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 – GENERAL

1.01 SUMMARY

A. This Section includes individually mounted enclosed switches and circuit breakers used for the following:

1. Service disconnecting means.

2. Feeder and branch-circuit protection.

3. Motor and equipment disconnecting means.

1.02 PRICE AND PAYMENT PROCEDURES

A. Measurement and payment requirements: per Division 01 General Requirements.

1.03 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, Section 26 05 00 COMMON WORK RESULTS FOR ELECTRICAL

C. Division 26, Section 26 05 26 GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination, Sequencing, and Scheduling: per Division 01 General Requirements.

1.05 SUBMITTALS

A. Product Data: For each type of switch, circuit breaker, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.

B. Shop Drawings: For each switch and circuit breaker

1. Dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Show tabulations of installed devices, equipment features, and ratings. Include the following:

a. Enclosure types and details

b. Current and voltage ratings

c. Short-circuit current rating

d. UL listing for series rating of installed devices

e. Features, characteristics, ratings, and factory settings of individual over-current protective devices and auxiliary components

f. Time-current curves, including selectable ranges for each type of circuit breaker

2. Wiring Diagrams: Power, signal, and control wiring. Differentiate between manufacturer-installed and field-installed wiring.

C. Field Test Reports: Submit written test reports and include the following:

1. Test procedures used.

2. Test results that comply with requirements.

3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

D. Manufacturer's field service report.

E. Maintenance Data: For enclosed switches and circuit breakers and for components to include in maintenance manuals specified in Division 01 and as follows:

1. Routine maintenance requirements for components.

2. Manufacturer's written instructions for testing and adjusting switches and circuit breakers.

3. Time-current curves, including selectable ranges for each type of circuit breaker.

1.06 QUALITY ASSURANCE

A. 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.

B. Comply with NEMA AB 1 and NEMA KS 1.

C. Comply with UL #98, Enclosed Switches and UL #508, Industrial Control Equipment.

D. Federal Specification W-S-865- Heavy Duty Switches

E. Comply with NFPA 70.

F. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.

1.07 PROJECT CONDITIONS

A. Environmental Limitations: Rate equipment for continuous operation under the following conditions, unless otherwise indicated:

B. Ambient Temperature: Not less than minus 22°F (minus 30°C) and not exceeding 104°F (40°C)

C. Altitude: Not exceeding 6600 feet (2000 m)

1.08 COORDINATION

A. Coordinate layout and installation of switches, circuit breakers, and components with other construction, including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

1.09 SITE CONDITIONS

A. Existing Conditions: per Division 01 General Requirements.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Square D Co.

2. Eaton Corp.; Cutler-Hammer Products

3. General Electric Co.; Electrical Distribution & Control Division

4. Approved Equal

2.02 ENCLOSED SWITCHES

A. Enclosed, Non-fusible Switch: NEMA KS 1, heavy duty type with lockable handle.

B. Rating: Voltage and number of poles as required for motor or equipment circuits being disconnected. Switches used for service entrance equipment shall bear a UL label and be rated for service entrance equipment.

C. Enclosed, Fusible Switch, 800A and Smaller: NEMA KS 1, heavy duty type with clips to accommodate specified fuses, lockable handle with two padlocks, and interlocked with cover in closed position.

D. Double Throw Safety Switches shall be unfused double throw with center OFF position, quick make, quick break mechanism, visible blades in the OFF position and safety handle. Rating, voltage and number of poles as required for the circuits being disconnected

2.03 ENCLOSED CIRCUIT BREAKERS

A. Molded-Case Circuit Breaker: NEMA AB 1, with interrupting capacity to meet available fault currents. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable instantaneous, magnetic trip setting for circuit-breaker frame sizes 150 Amp through 400 Amp.

B. Molded-Case Circuit-Breaker Features and Accessories: Standard frame sizes, trip ratings, and number of poles. Lugs shall be mechanical style suitable for number, size, trip ratings, and material of conductors.

C. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HACR for heating, air-conditioning, and refrigerating equipment.

D. Electronic Trip Unit Circuit Breakers (Frame sizes 400 Amp and larger): RMS sensing, interchangeable harmonic trip unit, LED trip indicators with the following field-adjustable settings:

1. Long-time pickup levels and adjustments (L)

2. Short-time pickup levels adjustments (S)

3. Instantaneous trip adjustments (I)

4. Ground fault pickup level, time delay, I2t response and adjustments (G)

E. The circuit breaker operating handle shall be externally operable with the operating mechanism being an integral part of the box, not the cover. Provisions for padlocking the circuit breaker in the OFF position shall be provided.

Enclosures shall have a dual cover interlock mechanism to prevent unintentional opening of the enclosure cover when the circuit breaker is ON and prevent turning the circuit breaker ON when the enclosure cover is open. The cover interlock mechanism shall have an externally operated override but the override shall not permanently disable the interlock mechanism. The tool used to override the cover interlock mechanism shall not be required to enter the enclosure in order to override the interlock.

2.04 DOUBLE THROW SAFETY SWITCHES

A. Unfused, double throw with center OFF position, quick make, quick break mechanism, visible blades in the OFF position and safety handle. Rating, voltage and number of poles as required for the circuits being disconnected.

2.05 ENCLOSURES

A. NEMA AB 1 and NEMA KS 1 to meet environmental conditions of installed location.

1. Reference Section 26 05 33 RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS for approved enclosure types.

2.06 FACTORY FINISHES

A. Manufacturer's standard prime-coat finish ready for field painting.

B. Finish: Manufacturer's standard grey paint applied to factory-assembled and -tested enclosures before shipping.

PART 3 – EXECUTION

3.01 EXAMINATION

A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Mount equipment so that sufficient access and working space is provided for ready and safe operation and maintenance.

B. Securely fasten equipment to walls or other structural surfaces on which they are mounted. Provide independent galvanized steel supports where no wall or other structural surface exists

C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

D. Install in conformance with National Electrical Code.

3.03 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Division 26.

B. Enclosure Nameplates: Label each enclosure with engraved metal or laminated-plastic nameplate mounted with corrosion-resistant screws.

C. For double throw switches identify source of each service identify source of each service.

3.04 CONNECTIONS

A. Install equipment grounding connections for switches and circuit breakers with ground continuity to main electrical ground bus.

B. Install power wiring Install wiring between switches and circuit breakers, and control and indication devices.

C. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.05 FIELD QUALITY CONTROL

A. Testing: After installing enclosed switches and circuit breakers and after electrical circuitry has been energized, demonstrate product capability and compliance with requirements.

B. Procedures: Perform each visual and mechanical inspection and electrical test indicated in NETA ATS, Section 7.5 for switches and Section 7.6 for molded-case circuit breakers. Certify compliance with test parameters.

C. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

3.06 CLEANING

A. On completion of installation, inspect interior and exterior of enclosures. 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.

3.07 CLOSEOUT ACTIVITIES

A. Provide in accordance with Division 01 General Requirements.

END OF SECTION

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SECTION 26 29 23

VARIABLE FREQUENCY DRIVES (PROCESS)

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes

1. The Contractor shall provide the labor, tools, equipment, and materials necessary to furnish and install variable frequency drives.

2. Provide field programming and testing of each VFD. Program each VFD based on the actual motor sizes and ratings in the field. Provide adjustments to VFD parameters to account for European motors (if necessary).

1.02 PRICE AND PAYMENT PROCEDURES

A. Measurement and payment requirements: per Division 01 General Requirements.

1.03 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 specification sections, apply to work of this section.

B. Related Sections

1. Division 26, Section 26 05 00 COMMON WORK RESULTS FOR ELECTRICAL

2. Division 26, Section 26 05 26 GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

1.04 REFERENCES

A. Reference Standards

1. NATIONAL ELECTRICAL CODE (NEC)

2. UNDERWRITERS LABORATORIES, INC. (UL)

a. UL 198C High-Interrupting Capacity Fuses; Current Limiting Type

b. UL 198E Class R Fuses

3. NATIONAL ELELCTRICAL CONTRACTORS ASSOCIATION

   a. NECA "Standard of Installation"

4. NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

   a. NEMA AB 1 Molded Case Circuit Breakers

   b. NEMA ICS 2 Industrial Control Devices, Controllers, and Assemblies

   c. NEMA ICS 6 Enclosures for Industrial Controls and Systems

   d. NEMA KS 1 Enclosed Switches

1.05 ADMINISTRATIVE REQUIREMENTS

A. Coordination, Sequencing, and Scheduling: per Division 01 General Requirements.

1.06 QUALITY ASSURANCE

A. Provide in accordance with Division 01 General Requirements.

B. Qualifications

1. Firms regularly engaged in manufacture of variable frequency drives of types and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years, or as indicated.

2. Variable Frequency Drives shall be provided by Rockwell Automation, or prior approved equal. Substitutions must be submitted in writing three (3) weeks prior to original bid date with supporting documentation demonstrating that the alternative manufacturer meets all aspects of the specification herein.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Provide in accordance with Division 01 General Requirements.

1.08 SITE CONDITIONS

A. Existing Conditions: per Division 01 General Requirements.

1.09 SUBMITTALS

A. Provide in accordance with Division 01 General Requirements.

B. Furnish manufacturer's product data, test reports, and materials certifications as required.

C. Submit the following in accordance with conditions of contract and Division 1 specification sections:

1. Product Data: Submit manufacturer's data and installation instructions.

2. Wiring Diagrams: Submit power and control wiring diagrams for g connections to electrical power panels, feeders, and equipment. Differentiate between portions of wiring which are manufacturer installed and portions, which are field installed.

3. Motor Overloads: Submit for approval motor overload sizes for each new VFD furnished. Overload size shall be based on actual motor nameplate data and power factor correction size; where applicable. Include thermal overload compensation sizing information where motor(s) are operated at temperatures different than the motor controller.

D. Closeout and Maintenance Material Submittals: per Division 01 General Requirements.

PART 2 – PRODUCTS

2.01 VARIABLE FREQUENCY DRIVES (VFD)

A. Variable Frequency Drives shall be equal to Allen Bradley Powerflex 753, 755, or approved equal.

B. The VFD shall convert the input AC main power to an adjustable frequency and voltage as defined in the following sections. The VFD shall be UL Listed and labeled as a complete unit, and shall include all accessories and requirements as described in this section and as identified on the Drawings.

C. Each drive shall have a rating in horsepower (HP) equal to or greater than the motor name plate horsepower and each drive shall have a continuous output current rating equal to or greater than the motor full load amperes (FLA).

D. Input Power

1. The drive is available in two ranges and is self-adjustable to accept an input voltage range between; 380-500 V AC, three phase +/-10%, 525-690 V AC, three phase +/-10%.

2. Displacement power factor 0.98, lagging, over the entire speed range. The efficiency of the drive is a minimum of 97.5% at full load and speed.

E. Environment

1. Storage ambient temperature range: -40ºC to 60ºC (-40º to 140ºF).

2. Operating ambient temperature range without derating: IP21 / Type 10ºC to 40ºC (0º to 104ºF).

3. The relative humidity range is 5% to 95% non-condensing.

4. Operating elevation: up to 1000 Meters (3,300ft) without derating.

5. Shock: 15G peak for 11ms duration

6. Vibration: 2.0 mm (0.0787 inches) displacement, 1G peak, EN50178 / EN60068-2-6

F. Output Power

1. The output voltage is adjustable from 0 to rated motor voltage (400 V, 460 V, 575 V or 690 V). The output frequency range is adjustable from 0 to 320Hz. The inverter section will produce a pulse width modulated (PWM) waveform using latest generation IGBTs.

G. Motor and Application Data

1. The AC drives shall have the ability to operate variable or constant torque loads. The speed range shall be from a minimum speed of 1.0 Hz to a maximum speed of 60 Hz. The normal duty drive overload current shall be 100% continuous, 110% for 1 minute, and 150% for 3 seconds. The heavy duty drive overload current shall be 100% continuous, 150% for 1 minute, and 200% for 3 seconds.

H. Hardware

1. The drive hardware employs the following power components:

a. Diode or fully gated bridge on the input.

b. AC line reactor on input for all ratings.

c. Switching logic power supply operating from the DC bus.

d. MOV protection available on Frame 9 only - phase to phase and phase to ground with ability to remove the phase to ground unit when applicable.

e. Common Mode Capacitors available on all units. For use on ungrounded systems Frame 9 is orderable without and Frame 10 and higher removable by jumper.

f. Gold plated plug-in connections on printed circuit boards.

g. Microprocessor based inverter logic isolated from power circuits.

h. Latest generation IGBT inverter section.

i. Customer Interface common for all horsepower ratings. LCD digital display standard with choices for programming keypad and operator keys options.

j. The Main Control Board is the same for all ratings to optimize spare parts stocking and exchange.

k. Common control connection for all ratings.

l. Optimized for 2kHz carrier frequency.

m. Device Peripheral Interface (DPI) for connection to common options.

n. Power LED viewable through the control box cover.

o. Status LEDs for communications status, including embedded DPI status, adapter health and communications network status, viewable at HIM mounting plate.

I. Control Logic

1. The drive is programmable or self-adjusting for the following:

a. Operating the drive with motor disconnected.

b. Controlled shut down, when properly fused, with no component failure in the event of an output phase to phase or phase to ground short circuit and annunciation of the fault condition.

c. Adjustable PWM carrier frequency within a range of 1-6 kHz.

d. Selectable Sensorless Vector or V/Hz mode.

e. Suitable for use on both Normal Duty and Heavy Duty loads.

f. Multiple programmable stop modes including - Ramp, Coast, DC-Brake, Ramp-to-Hold and S-curve.

g. Multiple acceleration and deceleration rates.

h. All adjustments to be made with the door closed.

i. Adjustable output frequency up to 320Hz.

J. Terminal Blocks

1. Separate terminal blocks are provided for control and power wiring. Power terminal blocks are rated a minimum of 90 ºC and marked for both inputs and outputs (L1, L2, L3 and U/T1, V/T2, W/T3).

K. Power Conditioning

1. The drive is designed to operate on an AC supply source that may contain line notching and up to 10% harmonic distortion. An input isolation transformer is not required for protection from normal line transients. If line conditions dictate the use of a transformer, the K factor should be 4.0 or less.

L. Operator Interface

1. Interface to the drive is provided via a removable Human Interface Module (HIM) with integral display. This unit is a 7 line by 21-character backlit LCD display with graphics capability. It is used to display drive operating conditions, fault / alarm indications and programming information with full text support in multiple languages, including but not limited to English, German, French, Italian, Spanish, Portuguese and Dutch.

2. The keypads for these include programming keys, drive operating keys (Start, Stop, Direction, Jog and Speed Control), numeric keys for direct entry and an ALT (alternate function) key to allow some of the more common drive programming or operating functions to be accessed directly without knowledge of programming structure. These ALT functions include S.M.A.R.T. Start for fast and easy commissioning, View selection, Auto Manual operation, HIM removal under power, and device selection for programming.

M. Input/Output Capabilities (Control Interface)

1. Analog Inputs/Outputs:

a. Two (2) differential, +/-10V (bi-polar) / 20mA analog inputs, 11 bit plus sign, 160V common mode noise rejection. Both inputs shall be fully user programmable for a variety of uses including frequency command, process loop inputs, and others. Inputs are programmable for function, scaling, offset, signal loss detect and square root.

b. Two (2) single-ended +/-10V (bi-polar) / 20mA analog output, 11 bit plus sign. Both shall be fully user programmable to be proportional to one of 25 process parameters including output frequency, output current, encoder feedback, output power, and others. Programming is available to select either absolute or signed values of these parameters.

c. Input for motor protection thermistor (1.8k Ohm PTC). Drive will provide fault protection if temperature exceeds protection value.

2. Digital Inputs/Outputs

a. Six (6) digital inputs 24Vdc or 120Vac as shown. Inputs shall be configurable as sink or source. All inputs are individually programmable for functions from a list of 57 that include Start(3-wire control, Run(2-wire control), Stop, External fault, Speed select, Jog, Process PU functions, Level-sensitive Run, and others. 24V inputs draw 10mA each and require a 20V minimum for "ON" state and a maximum for 5V "OFF" state. 115Vac inputs draw 5mA each and require a 100V minimum for "ON" state and a maximum of 30V for "OFF" state.

b. One input shall able to be set by a jumper to be a Hardware Enable. In this state, no microprocessor control is involved with disabling the drive outputs.

c. Three (3) relay outputs, (1 form-C, 1 form-B, 1 form-A). Contact output ratings 240Vac/30Vdc, and require a 10mA minimum clearing current. Relays are programmable to 57 different conditions. All outputs shall have timers that control the amount of time before an output changes state. All outputs shall have an on-delay and off-delay timers relative to the function assigned to the input.

N. Features

1. Acceleration/Deceleration: Accel/Decel settings provide separate adjustments to allow either setting to be adjusted from 0.0 seconds to 3276.7 seconds. A second set of remotely selectable Accel/Decel settings is accessible through digital inputs. Programming capability allows the user to produce acc/dec profiles with linear or "S-Curve" characteristics that provide changing accel/decel rates. S-Curve profiles are adjustable.

2. Adjustments: The digital interface is used for all set-up, operation and adjustment settings. All adjustments are stored in nonvolatile memory (EEPROM). No potentiometer adjustments are used. The drive provides EEPROM memory for factory default values and user stored drive configurations.

3. Auto Economizer: This feature automatically reduces the output voltage when the drive is operating in an idle mode (drive output current less than programmed motor FLA). The voltage is reduced to minimize flux current in a lightly loaded motor thus reducing kW usage. If the load increases, the drive will automatically return to normal operation.

4. Auto / Manual Mode: The HIM can utilize the ALT function key to transfer the drive from Automatic mode to Manual mode and back. When in Auto mode, the drive receives its frequency command from the programmed source. When in Manual mode, control of the frequency

command is transferred to the HIM speed control keys (or potentiometer). The user has the choice of preloading the HIM with the current "auto" frequency reference before transferring control to allow for smooth transitions without speed "jumps".

5. Auto Restart: The drive provides up to nine automatic fault reset and restarts following a fault condition before locking out and requiring manual restart. The automatic mode is not applicable to a ground fault, shorted output faults and other internal microprocessor faults. The time between restarts is adjustable from 0.5 seconds to 30.0 seconds.

6. Bus Regulation: DC Bus regulation is available to reduce the possibility of drive overvoltage trips due to regenerative conditions. The drive's reaction to a Bus voltage increase is programmable to one of 4 options.

7. Communications Interface: The drive has the capability for either internally mounted or externally mounted communications interface cards. Internal cards use drive power and can operate at higher speeds. Externally mounted cards are separately powered and connected to the drive via a cable. The following should be available:

    a. Ethernet communications shall be available.

8. Control Mode: Programming provides the ability to select either Sensorless Vector or V / Hz mode. The sensorless vector mode uses motor nameplate data plus motor operating data such as IR drop, nominal flux current and flux up time to tune the motor / drive for optimum torque performance. The volts per hertz mode can be programmed straight line, preprogrammed fan curve or full custom patterns.

9. Current Limit: Programmable current limit from .1 amps to 150% of drive rated amps. Current limit is active for all drive states; accelerating, constant speed and decelerating. Both the source of the current limit value and the gain for responsiveness adjustment are programmable. The drive employs PI regulation with an adjustable gain for smooth transition in and out of current limit.

10. Fault Memory: The last eight fault codes with respective times are stored in the fault buffer. In addition, information about the drive's condition at the time of the last fault such as operating frequency, output current, dc bus voltage and 28 other status conditions are stored at the time of fault. Information is maintained in the event of a power loss. A power up marker is also provided at each power up time to aid in analyzing fault data. The last eight alarm codes are also stored, without time stamp for additional troubleshooting reference.

11. Flying Start: The drive is capable of determining the speed and direction of a spinning motor and adjusts its output to "pick-up" the motor at the rotating speed.

12. Inertia Ride Through: The drive can respond to a loss of AC input power by adjusting the output frequency to create a regenerative situation in the motor. This regenerated energy recaptures the mechanical energy and converts it to electrical energy to power the drive logic during the power outage. This allows the drive to retain control of the motor during the power outage. Performance is based on the amount of system inertia and the length of the outage. The bus voltage level required to trigger inertia ride through is adjustable. Inertia Ride Through can be enabled or disable via programming.

13. Memory Storage: The drive stores the factory default settings in non-volatile memory (EEPROM) so that the user can return the drive to a known state. Additional memory storage locations in the drive, known as User Sets can also be stored in the drive's non-volatile memory. Three User Set locations are offered. The user can name the sets per the process application and recall the configuration to active drive memory as needed.

14. Motor Overload Protection: The drive will provide Class 10 motor overload protection investigated by UL to comply with N.E.C. Article 430. Overload protection is speed sensitive and adjustable. To accommodate a variety of motors with different speed range capabilities, the frequency at which the overload begins to derate is programmable. A parameter is available to directly read the level of accumulated overload.

15. Process PI Control: The internal process PI regulator has proportional and integral gain adjustments as well as error inversion and output clamping functions. The feedback can be configured for normal or square root functions. If the feedback indicates that the process is moving away from the setpoint, the regulator will adjust the drive output until the feedback equals the reference. Process control can be enabled or disabled with a hardwired input. Transitioning in and out of process control can be tuned for faster response by preloading the integrator. Protection is provided for a loss of feedback or reference signal. A signal can also be provided to indicate that excess error exists.

16. Ride Through: The control logic is capable of "riding through" a power outage of at least 2 seconds in duration. The inverter section is shut off after an 28% drop in bus voltage to conserve power for the drive logic. The ride through method and trigger point are adjustable by the user.

O. VFD Enclosures

1. VFDs shall be installed within MCC Buckets as indicated on the Contract Drawings.

2. Where Enclosed Drives are required or specified, the following requirements shall be met.

3. Unit shall be wall or floor mountable and be NEMA type 1G rated.

4. Unit shall be provided with lockable Main Input Circuit Breaker.

5. The enclosures shall be provided with an input Line Reactor with an Impedance rating of 5% for voltage transient protection, and for a degree of protection from harmonic distortion.

6. Units shall be provided with door mounted HAND/OFF/REMOTE selector switch. The HAND Mode shall provide a local start control. In the REMOTE Mode, the start control shall be provided via a remote contact in the SCADA control panel. Provide an extra set of contacts on the selector switch to monitor the switch position via the facilities SCADA control panel.

7. Provide door mounted 120VAC push-to-test LED pilot lights for ON (green) and OFF (Red) indication.

8. Enclosure shall be provided with a door mounted Operator Interface as follows:

   a. Interface to the drive is provided via a removable Human Interface Module (HIM) with integral display. This unit is a 7 line by 21-character backlit LCD display with graphics capability. It is used to display drive operating conditions, fault / alarm indications and programming information with full text support in multiple languages, including but not limited to English, German, French, Italian, Spanish, Portuguese and Dutch.

   b. The keypads for these include programming keys, drive operating keys (Start, Stop, Direction, Jog and Speed Control), numeric keys for direct entry and an ALT (alternate function) key to allow some of the more common drive programming or operating functions to be accessed directly without knowledge of programming structure. These ALT functions include S.M.A.R.T. Start for fast and easy commissioning, View selection, Auto Manual operation, HIM removal under power, and device selection for programming.

9. Where indicated and specified, VFD enclosures shall be furnished with integral Passive Harmonic Filters as follows:

a. The harmonic filter shall be a Passive Filter as manufactured by MTE Corporation, General Electric, TCI or approved equal. The filter shall be physically sized to meet all requirements as shown on the Contract Drawings, and be furnished within a panel rated appropriately for the environment being installed.

b. The harmonic filter shall treat all characteristic low frequency harmonics generated by a three phase full wave converter load (5^{th}, 7^{th}, 11^{th}, 13^{th}, etc.).

c. The characteristic harmonics shall be suppressed without need for individual tuning or the requirement to phase shift against other harmonic sources.

d. The harmonic filter shall be a passive series connected low pass filter consisting of an inductor capacitor network. Active electronic components shall not be used.

e. The harmonic filter model supplied shall be capable of feeding a three phase input rectifier with or without line reactors, with or without a DC link choke, with or without a combination line reactor and DC link choke.

f. The harmonic filter shall not resonate with the power distribution system, nor attract harmonics from other sources.

g. The filter shall be suitable for use with either a single nonlinear load or multiple nonlinear loads.

h. The filter shall be listed per UL-508.

i. In the operating range from full load to half load the power factor shall be .98 lagging to .95 leading.

j. The harmonic filter in combination with the variable frequency drive shall meet all requirements specified in IEEE 519 for individual and total harmonic voltage and current distortion. The PCC for all voltage and current harmonic calculations and measurements shall be the input terminals of the harmonic filter.

k. Total Demand Distortion (TDD) of the current at the input terminals of the harmonic filter shall not exceed the limits defined in Table 10-3 of IEEE 519.

l. Total Harmonic Voltage Distortion (THVD) shall meet the requirements of Table 10-2 of IEEE-519. The harmonic filter supplier shall not be responsible for pre-existing voltage distortion caused by other harmonic sources.

m. The harmonic filter shall suppress the characteristic harmonics to the levels specified provided that the line voltage unbalance is between 0% and 1%. If the line voltage unbalance is between 1% and 3% per ANSI C84.1-1995 the total harmonic input current

distortion at any reduced load or speed condition shall not exceed the full load THID by more than 50% (i.e. if 5% THID required at full load, then not more than 7.5% THID at reduced load when voltage unbalance is more than or equal to 1% and less than or equal to 3%)

n. The full load efficiency of the harmonic filter shall be greater than 98%.

o. When fed from a power distribution system operating at the nominal distribution voltage, the harmonic filter output voltage at no load shall not be more than 4.6% of the nominal RMS and peak distribution voltage.

p. When fed from a power distribution system operating at the nominal distribution voltage, the harmonic filter output voltage at full load shall not be less than the nominal RMS utilization voltage.

q. All wiring shall be copper.

r. At no load the harmonic filter shall not cause the voltage at the PCC to rise by more than 2%.

s. To assure that the voltage source PWM inverters do not experience over voltage trips, the harmonic filter shall not cause the inverter bus voltage to increase by more than 5% when the filter is operating from the nominal distribution voltage.

t. To assure that the filter will not reduce the life of a voltage source inverters bus capacitor, the output current waveform of the harmonic filter and the input current waveform of the inverter shall be consistent with the input waveform of an inverter fed from a drive equipped with a 3% minimum impedance line reactor.

u. The harmonic filter shall be furnished will an integral output contactor. The output contactor shall have a 120Vac coil, and be energized upon the startup of the associated VFD.

v. The harmonic filter shall be handled, stored, and installed in accordance with the manufacturer's recommended installation practices as found in the manufacturer's User Manual. Installation shall comply with all applicable local codes.

w. To assure quality control and proper performance, the filter shall be manufactured by an ISO9001:2000 supplier in the supplier's own manufacturing facility, and not by a contract manufacturer. Filters shall be fully tested prior to shipment.

x. The harmonic filter shall be warranted to be free of defects in materials and workmanship for a period of one year from the date of shipment when applied in accordance with the manufacturer's recommended installation procedures.

2.02 SOURCE QUALITY CONTROL

A. Provide in accordance with Division 01 General Requirements.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Examine areas and conditions under which VFDs are to be installed, and notify the Engineer in writing of conditions detrimental to proper completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to the Engineer.

B. Per NEMA ICS 3.1, install equipment in accordance with the approved manufacturer's printed installation drawings, instructions, wiring diagrams, and as indicated on project drawings and the approved shop drawings. A field representative of the VFD manufacturer shall supervise the installation of all equipment, and wiring.

C. Certified factory start-up shall be provided for each VFD provided. Service Engineers shall be employed by the manufacturer or be certified by the manufacturer and provide start-up services including physical inspection of drive and connected wiring and final adjustments to meet specified performance requirements.

D. Make equipment grounding connections for each VFD in accordance with all applicable codes and as recommended by the manufacturer.

E. Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values for equipment connectors. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL Standards 486A and B, and the MEC.

F. Wall-mount the enclosures using spacers or standoffs (1/4 inch minimum).

G. The VFD’s shall be warranted by the manufacturer for a period of one year, or the contracted period of any extended warrantee agreed upon by the Owner, after successful completion of the acceptance test. Any component failing to perform its function as specified and documented shall be repaired or replaced by the Contractor at no additional cost to the Owner.

3.02 FIELD QUALITY CONTROL

A. Provide in accordance with Division 01 General Requirements.

B. Prior to energizing motor controller equipment, check with ground resistance tester, phase to phase and phase to ground insulation resistance levels to ensure requirements are fulfilled.

C. Prior to energizing, check circuitry for electrical continuity, and for short circuits.

3.03 STARTUP & COMMISSIONING

A. Provide in accordance with Division 01 General Requirements.

3.04 CLOSEOUT ACTIVITIES

A. Provide in accordance with Division 01 General Requirements.

END OF SECTION

SECTION 26 32 13.13

DIESEL-ENGINE-DRIVEN GENERATOR SETS (LOW-VOLTAGE)

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes

1. The intent of this specification is to secure a generator set and automatic transfer switch from a single Manufacturer. The Transfer switch shall be prototype tested, factory built, production tested, and site tested. A transfer switch with the number of poles, voltage, and current ratings shown on the plans and specified herein shall be provided.

1.02 PRICE AND PAYMENT PROCEDURES

A. Measurement and payment requirements: per Division 01 General Requirements.

1.03 REFERENCES

A. Reference Standards

1. The generator set covered by these specifications shall be designed, tested, rated, assembled and installed in strict accordance with all applicable standards below.

2. UNDERWRITERS' LABORATORIES (UL)

   a. UL 508 Standard for Industrial Control Equipment

   b. UL 2200 Standard for Stationary Engine Generator Assemblies

   c. UL 142 Standard for Steel Aboveground Tanks for Flammable and Combustible Liquids

3. CANADIAN STANDARDS ASSOCIATION (CSA)

   a. CSA C22.2 No14 Industrial Control Equipment

   b. CSA 282 Emergency Electrical Power Supply for Buildings

   c. CSA 100 Motors and Generators

4. INTERNATIONAL ELECTROTECHNICAL COMMISSION (IEC)

   a. EN61000-6

   b. EN55011

   c. IEC61000

5. FEDERAL COMMUNICATIONS COMMISSION (FCC)

   a. FCC Part 15 Subpart B

6. INTERNATION ORGANIZATION FOR STANDARDIZATION (ISO)

   a. ISO8528 Reciprocating Internal Combustion Engine Driven Alternating Current Generating Sets

7. Designed to allow for installed compliance to NFPA 70, NFPA99 and NFPA 110

8. The automatic transfer switch shall conform to the requirements of:

   a. UL 1008: Underwriters Laboratories standard for automatic transfer switches

   b. CSA C22.2 No. 178 certified at 600VAC

   c. IEC: 947-6-1 certified at 480VAC

   d. NFPA 70: National Electrical Code including use in emergency and standby systems in accordance with Articles 517, 700, 701, 702

   e. NFPA 99: Essential electrical systems for health care facilities

   f. NFPA 101: Life safety code

   g. NFPA 110: Standard for emergency and standby power systems

   h. IEEE 241: I.E.E.E. recommended practice for electrical power systems in commercial buildings

   i. IEEE 446: I.E.E.E. recommended practice for emergency and standby power systems

   j. NEMA ICS10: AC automatic transfer switch equipment (supersedes ICS2-447)

   k. UL 50/508: Enclosures

   l. ICS 6: Enclosures

   m. ANSI C33.76: Enclosures

   n. NEMA 250: Enclosures

   o. IEEE 472: (ANSI C37.90A): Ringing wave immunity

   p. EN55022 (CISPR11): Conducted and radiated emissions (Exceeds EN55011 & MILSTD 461 Class 3)

   q. EN61000-4-2: (Level 4): ESD immunity test Class B

   r. EN61000-4-3: (ENV50140): Radiated RF, electromagnetic field immunity test

   s. EN61000-4-4: Electrical fast transient/burst immunity test

t. EN61000-4-5: IEEE C62.41: Surge immunity test (1.2 x 50µs, 5 & 8kV)

u. EN61000-4-6: (ENV50141): Conducted immunity test

v. EN61000-4-11: Voltage dips and interruption immunity

w. IEE-693-2005: Seismic certified at high level with 2.5 amplification factor

x. IBC-2003: At Ip=1.5 for z/h less than or equal to 1 (in accordance with ICC-ES AC156)

1.04 RELATED SECTIONS

A. Division 26, Section 26 05 00 COMMON WORK RESULTS FOR ELECTRICAL

B. Division 26, Section 26 05 33 RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

C. Division 26, Section 26 05 26 GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

D. Division 26, Section 26 08 00 COMMISSIONING OF ELECTRICAL SYSTEMS

E. Division 26, Section 26 36 23 AUTOMATIC TRANSFER SWITCHES

1.05 ADMINISTRATIVE REQUIREMENTS

A. Coordination, Sequencing, and Scheduling: per Division 01 General Requirements.

1.06 WORK INCLUDED

A. Installation

1. The Work includes furnishing and installing a complete integrated generator system. The system consists of a diesel generator set with related component accessories, and automatic transfer switch.

B. Fuel System

1. Contractor shall provide a full tank of diesel fuel for the completion of all testing as specified in the contract documents.

C. System Test

1. A complete system load test shall be performed after all equipment is installed. Guidelines in the Start-up Section.

D. Requirements, Codes and Regulations

1. The equipment supplied and installed shall meet the requirements of the NEC with Connecticut Amendments and all applicable local codes and regulations. All equipment shall be of new and current production by a Manufacturer who has 25 years of experience building this type of equipment. Manufacturer shall be ISO9001 certified.

1.07 ACCEPTABLE MANUFACTURERS

A. Caterpillar

B. Cummins Power Generation

C. Kohler

D. Approved Equal

1.08 SUBSTITUTION

A. Proposed deviations from the specifications shall be treated as follows:

1. Substitution Time Requirement

a. Requests for substitutions shall be made a minimum of ten (10) days prior to bid date. Manufacturers catalog data shall accompany each request and authorized acceptance shall be addenda only.

2. Substitution Responsibility

a. The power system has been designed to the specified manufacturer's electrical and physical characteristics. The equipment sizing, spacing, amounts, electrical wiring, ventilation equipment, fuel, and exhaust components have all been sized and designed around a single manufacturer’s supplied equipment. Should any substitutions be made, the Contractor shall bear responsibility for the installation, coordination and operation of the system as well as any engineering and redesign costs, which may result from such substitutions.

1.09 SUBMITTALS

A. Submit in accordance with the Division 01 General Requirements.

B. Engine-generator submittals shall include the following information:

1. Factory published specification sheet

2. Manufacturer's catalog cut sheets of all auxiliary components such as battery charger, control panel, enclosure, fuel system filter, etc.

3. Dimensional elevation and layout drawings of the generator set, enclosure and transfer switchgear and related accessories

4. Weights of all equipment

5. Concrete pad recommendation, layout and stub-up locations of electrical and fuel systems

6. Interconnect wiring diagram of complete emergency system, including generator, switchgear, battery charger, control panel, and remote alarm indications

7. Engine mechanical data, including heat rejection, exhaust gas flows, combustion air and ventilation air flows, fuel consumption, etc.

8. Generator electrical data including temperature and insulation data, cooling requirements, excitation ratings, voltage regulation, voltage regulator, efficiencies, waveform distortion, and telephone influence factor

9. Generator resistances, reactance's and time constants

10. Generator locked rotor motor starting curves

11. Manufacturer's documentation showing maximum expected transient voltage and frequency dips, and recovery time during operation of the generator set at the specified site conditions with the specified loads

12. Manufacturer's and dealer's written warranty

C. Closeout and Maintenance Material Submittals: per Division 01 General Requirements.

1.10 SYSTEM RESPONSIBILITY

A. Generator Set Distributor

1. The completed engine generator set shall be supplied by the Manufacturer's authorized distributor only.

B. Requirements, Codes, and Regulations

1. Equipment supplied and installed shall meet the requirements of NEC and all-applicable local codes and regulations. All equipment shall be new, of current production. There shall be one source responsibility for warranty; parts and service through a local representative with factory trained service personnel.

C. Automatic Transfer Switch

1. Automatic transfer switch shall be supplied by the generator set manufacturer in order to establish and maintain a single source of system responsibility and coordination.

1.11 WARRANTY

A. Two Year Standby (ISO 8528-1: ESP) Generator Set Warranty

1. The manufacturer's standard warranty shall in no event be for a period of less than two (2) years from date of initial start-up of the system and shall include repair parts, labor, reasonable travel expense necessary for repairs at the job site, and expendables (lubricating oil, filters, antifreeze, and other service items made unusable by the defect) used during the course of repair. Running hours shall be limited to 500 hours annually for the system warranty by both the manufacturer and servicing distributor. Submittals received without written warranties as specified will be rejected in their entirety.

1.12 QUALITY ASSURANCE

A. Provide in accordance with Division 01 General Requirements.

1.13 DELIVERY, STORAGE, AND HANDLING

A. Provide in accordance with Division 01 General Requirements.

1.14 SITE CONDITIONS

A. Existing Conditions: per Division 01 General Requirements.

1.15 PARTS AND SERVICE QUALIFICATIONS

A. Service Facility

1. The engine-generator supplier shall maintain 24-hour parts and service capability within 100 miles of the project site. The distributor shall stock parts as needed to support the generator set package for this specific project. The supplier must carry sufficient inventory to cover no less than 80% parts service within 24hrs and 95% within 48 hours.

B. Service Personnel

1. The dealer shall maintain qualified factory trained service personnel.

C. Product Support

1. Total Maintenance and Repair Agreement

a. The authorized Manufacturer's dealer shall provide a total maintenance and repair agreement using qualified factory trained service personnel for a period of 5 years minimum. The dealer shall provide genuine Manufacturer parts and filters, shall provide all recommended fluids, dealer labor, travel labor and travel mileage to complete the suggested preventive maintenance and overhauls as defined in the manufacturer's Operation and Maintenance Manual. The dealer shall also provide all genuine Manufacturer parts and filters, recommended fluids, dealer labor, travel labor and travel mileage to complete all unscheduled repairs and component replacements during the agreement period.

PART 2 – PRODUCTS

2.01 GENERAL REQUIREMENTS

A. Genset Requirements

1. The generator set shall be Standby Duty rated at 250kW, 312.5kVA, 376Amps, 1800RPM, 0.8 power factor, 480/277V, 3-Phase, 60Hz, including radiator fan and all parasitic loads. Generator set shall be sized to operate at the specified load at a maximum ambient of 77ºF (25ºC) and altitude of 500 feet (152.4m). The engine generator set shall be capable of reliably starting the connected loads in the order listed in the table below. This shall be accomplished without exceeding the voltage and frequency specifications listed below:

MAX ALLOWABLE STARTING VOLTAGE DIP	MAXIMUM ALLOWABLE PEAK VOLTAGE DIP	MAXIMUM ALLOWABLE FREQUENCY DIP
15%	15%	5%

LOAD NAME	LOAD RATING (HP/KVA)	STARTING METHOD
Step 1:		
Panel P1	15 kVA	General Loads
Step 2:		
Odor Control Unit	3 hp	FVNR
Unit Heater	5 kVA	Resistive
Unit Heater	2.5 kVA	Resistive
Step 3:		
Grinder	10 hp	FVNR
Step 4:		
Sewage Pump 1	85 hp	VFD
Step 5:		
Sewage Pump 2	85 hp	VFD

2. Standby Power Rating

a. Power is available for the duration of an emergency outage

b. Average Power Output = 75% of standby power

c. Load = Varying

d. Typical Hours/Year = 200 Hours

e. Maximum Expected Usage = 500 hours/year

f. Typical Application = Standby

B. Material and Parts

1. All materials and parts comprising the unit shall be new and unused.

C. Engine

1. The engine shall be diesel fueled, four (4) cycle, water-cooled, while operating with nominal speed not exceeding 1800RPM. The engine will utilize in-cylinder combustion technology, as required, to meet applicable EPA non-road mobile regulations and/or the EPA NSPS rule for stationary reciprocating compression ignition engines. Additionally, the engine shall comply with the State Emission regulations at the time of installation/commissioning. Actual engine emissions values must be in compliance with applicable EPA emissions standards per ISO 8178 – D2 Emissions Cycle at specified ekW/bHP rating. Utilization of the "Transition Program for Equipment Manufacturers" (also known as "Flex Credits") to achieve EPA certification is not acceptable. The in-cylinder engine technology must not permit unfiltered exhaust gas to be introduced into the combustion cylinder. Emissions requirements/certifications of this package: EPA Tier 2.

2. Engine Governing

a. The engine governor shall be an electronic Engine Control Module (ECM) with 24-volt DC Electric Actuator. The ECM shall be enclosed in an environmentally sealed, die-cast aluminum housing which isolates and protects electronic components from moisture and dirt contamination. Speed droop shall be adjustable from 0 (isochronous) to 10%, from no load to full rated load. Steady state frequency regulation shall be +/- 6RPM. Speed shall be sensed by a magnetic pickup off the engine flywheel ring gear. A provision for remote speed adjustment shall be included. The ECM shall adjust fuel delivery according to exhaust smoke, altitude and cold mode limits. In the event of a DC power loss, the forward acting actuator will move to the minimum fuel position.

2.02 GENERATOR

A. Generator Specifications

1. The synchronous three phase generator shall be a single bearing, self-ventilated, drip-proof design in accordance with NEMA MG 1 and directly connected to the engine flywheel housing with a flex coupling. The generator shall meet performance class G2 of ISO 8528. The excitation system shall enable the alternator to sustain 300% (250% for 50Hz) of rated current based on the 125C (Class H) or 105C (Class F) rise rating for ten seconds during a fault condition and shall improve the immunity of the voltage regulator to non-linear distorting loads. The excitation system shall be of brushless construction and be independent of main stator windings (either permanent magnet or auxiliary windings).

B. Voltage Regulator

1. Digital Voltage Regulator

a. The digital voltage regulator shall be microprocessor based with fully programmable operating and protection characteristics. The regulator shall maintain generator output voltage within +/- 0.25% for any constant load between no load and full load. The regulator shall be capable of sensing true RMS in three phases of alternator output voltage, or operating in single phase sensing mode. The voltage regulator shall include a VAR/Pf control feature as standard. The regulator shall provide an adjustable dual slope regulation characteristic in order to optimize voltage and frequency response for site conditions. The voltage regulator shall include standard the capability to provide generator paralleling with reactive droop compensation and reactive differential compensation.

b. The voltage regulator shall communicate with the Generator Control Panel via a J1939 communication network with generator voltage adjustments made via the controller keypad. Additionally, the controller shall allow system parameter setup and monitoring, and provide fault alarm and shutdown information through the controller. A PC-based user interface shall be available to allow viewing and modifying operating parameters in a windows compatible environment

C. Motor Starting

1. Provide locked rotor motor starting capability of 816.3skVA at 30% instantaneous voltage dip as defined per NEMA MG 1. Sustained voltage dip data is not acceptable.

2.03 CIRCUIT BREAKER

A. Circuit Breaker Specifications

1. Provide a generator mounted 100% rated circuit breaker, molded case, manually operated, 800A frame, 3 pole, NEMA 1/IP22. Breaker shall utilize a solid state microelectronic trip unit, with adjustable LSI functions. The breaker shall be UL/CSA Listed, connected to engine/generator safety shutdowns. Breaker shall be housed in an extension terminal box which is isolated from vibrations induced by the generator set. Mechanical type lugs, sized for the circuit breaker feeders shown on drawing, shall be provided by the installation contractor.

2.04 CONTROLS - GENERATOR SET MOUNTED

A. Provide a fully solid-state, microprocessor based, generator set control. The control panel shall be designed and built by the engine manufacturer. The control shall provide all operating, monitoring, and control functions for the generator set.

B. The generator controller shall be capable of communicating via MODBUS RTU.

C. Environmental

1. The generator set control shall be tested and certified to the following environmental conditions:

a. –40°C to +70°C Operating Range

b. 95% humidity non-condensing, 30°C to 60°C

c. IP22 protection for rear of controller; IP55 when installed in control panel

d. 5% salt spray, 48 hours, +38°C, 36.8V system voltage

e. Sinusoidal vibration 4.3G's RMS, 24-1000Hz

f. Electromagnetic Capability (89/336/EEC, 91/368/EEC, 93/44/EEC, 93/68/EEC, BS EN 50081-2, 50082-2)

g. Shock: withstand 15G

D. Functional Requirements

1. The following functionality shall be integral to the control panel:

a. The control shall include a 33 x 132 pixel, 24mm x 95mm, positive image, transflective LCD display with text based alarm/event descriptions.

b. Audible horn for alarm and shutdown with horn silence switch

c. Standard ISO labeling

d. Multiple language capability

e. Remote start/stop control

f. Local run/off/auto control integral to system microprocessor

g. Cooldown timer

h. Lamp test

i. Push button emergency stop button

E. Digital Monitoring Capability

1. The controls shall provide the following digital readouts for the engine and generator. All readings shall be indicated in either metric or English units.

a. Engine

1) Engine oil pressure

2) Engine coolant temperature

3) Engine RPM

4) Battery volts

b. Generator

1) Generator AC volts (Line to Line, Line to Neutral, and Average)

2) Generator AC current (Average and Per Phase)

3) Generator AC Frequency

F. Alarms and Shutdowns

1. The control shall monitor and provide alarm indication and subsequent shutdown for the following conditions. All alarms and shutdowns are accompanied by an engine hour stamp that is stored by the control panel for first and last occurrence.

2. Engine Alarm/Shutdown

a. Low oil pressure alarm/shutdown

b. High coolant temperature alarm/shutdown

c. Loss of coolant shutdown

d. Overspeed shutdown

e. Overcrank shutdown

f. Emergency stop depressed shutdown

g. Low coolant temperature alarm

G. Inputs and Outputs

1. Programmable Digital Inputs

a. The Controller shall include the ability to accept eight (8) total with six (6) programmable digital input signals. The signals may be programmed for either high or low activation using programmable Normally Open or Normally Closed contacts.

2. Programmable Relay Outputs

a. The control shall include the ability to operate eight (8) total with six (6) form A (normally open) programmable relay output signals, integral to the controller. Relay shall be rated for a maximum of 2A @ 30VDC.

b. Two sets of contacts rated for a maximum of 2A @ 30VDC shall be made available for each of the following statuses:

1) Generator Running

2) Generator Fail

H. Maintenance

1. All engine, voltage regulator, control panel, and accessory units shall be accessible through a single electronic service tool. The following maintenance functionality shall be integral to the generator set control:

a. Engine running hours display

b. 20 events are stored in control panel memory

2.05 COOLING SYSTEM

A. The generator set shall be equipped with a rail-mounted, engine-driven radiator with blower fan and all accessories. The cooling system shall be sized to operate at full load conditions and 110ºF ambient air entering the room or enclosure (If an enclosure is specified). The generator set supplier is responsible for providing a properly sized cooling system based on the enclosure static pressure restriction.

2.06 FUEL SYSTEM

A. Fuel System

1. The fuel system shall be integral with the engine. In addition to the standard fuel filters provided by the engine manufacturer, there shall also

be installed a primary fuel filter/water separator in the fuel inlet line to the engine. All fuel piping shall be black iron or flexible fuel hose rated for this service. No galvanized piping will be permitted. Flexible fuel lines shall be minimally rated for 300°F and 100psi.

B. Fuel Sub Base Tank

1. Provide a double wall sub-base tank constructed to meet all local codes and requirements. A fuel tank base of 48-hour capacity, based upon generator loads noted in Table 2.01 (A) (1.), shall be provided as an integral part of the enclosure. It shall be contained in a rupture basin with 110% capacity. The tank shall meet UL142 standards. A locking fill cap, a mechanical reading fuel level gauge, low fuel level alarm contact, and fuel tank rupture alarm contact shall be provided.

2.07 EXHAUST SYSTEM

A. Silencer

1. A critical grade silencer, companion flanges, and flexible stainless steel exhaust fitting properly sized shall be furnished and installed according to the manufacturer's recommendation. Mounting shall be provided by the contractor as shown on the drawings. 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 backpressure does not exceed the maximum limitations specified by the engine manufacturer.

2. The complete exhaust system shall be internal to the sound attenuated enclosure. Units with roof mounted or externally exposed silencers are not acceptable.

2.08 STARTING SYSTEM

A. Starting Motor

1. A DC electric starting system with positive engagement shall be furnished. The motor voltage shall be as recommended by the engine manufacturer.

B. Jacket Water Heater

1. Jacket water heater shall be provided and shall be sized to insure that genset will start within the specified time period and ambient conditions.

C. Batteries

1. Batteries - 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.

D. Battery Charger

1. Battery Charger - A current limiting battery charger shall be furnished to automatically recharge batteries. The charger shall be dual charge rate with automatic switching to the boost rate when required. The battery charger shall be mounted on the genset package or inside the genset enclosure/room.

2.09 ENCLOSURE

A. Sound Attenuated Enclosure

1. The complete diesel engine generator set, including generator control panel, engine starting batteries, and fuel oil tank, shall be enclosed in a factory assembled, sound attenuated enclosure mounted on the fuel tank base.

a. A weather resistant, sound attenuated enclosure of steel with electrostatically applied powder coated baked polyester paint. The enclosure shall have a resulting sound level of 72dba @7m with the genset running under full load. It shall consist of a roof, side walls, and end walls. Fasteners shall be either zinc plated or stainless steel.

b. The sound attenuated enclosure shall reduce the sound of the generator as required to meet all local, state and federal laws, codes, regulations, and standards.

c. Enclosure Sound Attenuation: Acoustical foam shall be provided between all supports and inside doors and sound baffles on air intake and air discharge.

2.10 PERFORMANCE AND CONSTRUCTION – ATS

A. The automatic transfer switch shall be of double throw construction operated by a reliable solenoid driven mechanism. There shall be a direct mechanical coupling to facilitate transfer in 6 cycles or less.

B. The normal and emergency contacts shall be mechanically interlocked such that failure of any coil or disarrangement of any part shall not permit a neutral position.

C. For switches installed in systems having ground fault protective devices, and/or wired so as to be designated a separately derived system by the NEC, a 4th pole

shall be provided. This additional pole shall isolate the normal and emergency neutrals. The neutral pole shall have the same withstand and operational ratings as the other poles and shall be arranged to break last and make first to minimize neutral switching transients. Add-on or accessory poles that are not of identical construction and withstand capability will not be considered.

D. The contact structure shall consist of a main current carrying contact, which is a silver alloy with a minimum of 50% silver content. The current carrying contacts shall be protected by silver tungsten arcing contacts on all sizes above 400 Amps.

E. The transfer switch manufacturer shall submit test data for each size switch, showing it can withstand fault currents of the magnitude and the duration necessary to maintain the system integrity. Each ATS shall be in strict accordance and listed to UL 1008 withstand standards, including "Any Breaker" ratings. Minimum UL listed withstand and close into fault ratings shall be as indicated in Table 2.10A below. ATS's which offer only "specific coordinated breaker" ratings (as opposed to "any breaker" ratings) do not meet this specification and are not acceptable.

TABLE 2.10A – MINIMUM UL LISTED WITHSTAND AND CLOSE INTO FAULT RATINGS

SIZE (AMPS)	"ANY BREAKER" RATING	CURRENT LIMITING FUSE
40 to 150	10,000	200,000
225 to 400	35,000	200,000
600 to 1200	65,000	200,000
1600 to 4000	100,000	200,000
(all values at 480V RMS symmetrical, less than 20% power factor)		

F. A dielectric test at the conclusion of the withstand and closing tests shall be performed.

G. The automatic transfer switch manufacturer shall certify sufficient arc interrupting capabilities for 50 cycles of operation between a normal and emergency source that are 120 degrees out of phase at 480 volts, 600% of rated current at .50 power factor. This certification is to ensure that there will be no current flow between the two isolated sources during switching.

H. All relays shall be continuous duty industrial type with wiping contacts. Coils, relays, timers and accessories shall be readily front accessible. The control panel and power section shall be interconnected with a harness and keyed disconnect plugs for maintenance.

I. Main and arcing contacts shall be visible without major disassembly to facilitate inspection and maintenance.

J. A manual handle shall be provided for maintenance purposes with the switch de-energized. An operator disconnect switch shall be provided to defeat automatic operation during maintenance, inspection or manual operation.

K. Switches composed of molded case breakers, lighting contactors or components thereof will not be acceptable.

L. The current rating shall be a continuous rating when the switch is installed in an enclosure, and shall conform to NEMA temperature rise standards.

M. The unit shall be rated based on all classes of loads, i.e., resistive, tungsten, ballast and inductive loads. Switches rated 400 amperes or less shall be UL listed for 100% tungsten lamp load.

N. Temperature rise tests in accordance with UL 1008 shall have been conducted after the overload and endurance tests to confirm the ability of the units to carry their rated currents within the allowable temperature limits.

O. Unless specified otherwise on the drawings, the switch shall be mounted in a NEMA 1 enclosure.

P. The automatic transfer switch must be equipped with a solenoid production scheme that removes any attempts of operating the solenoids after (3) consecutive trials until manual intervention by an operator.

2.11 CONTROLS - ATS

A. The control panel shall be opto-isolated from electrical noise and provided with the following inherent control functions and capabilities: Easy-to-view, backlit LCD display with long lasting LED indicators

1. Control panel shall display voltage and frequency of both sources.

2. The user shall be able to view the last 16 recorded events.

3. Capability for external communication and network interface

4. Adjustments to all settings shall be made from the front of the panel without opening the door.

B. The transfer switch shall be equipped with a microprocessor based control panel. The control panel shall perform the operational and display functions of the transfer switch. The display functions of the control panel shall include ATS position, source availability, sequence indication and diagnostics.

C. All programmable and control functions shall be pass code protected and accessible through the keypad.

D. The control panel shall be provided with a simple user interface for transfer switch monitoring, control and field changeable functions and settings.

E. Touch pad test switch with Fast Test/Load/No Load selection capability to simulate a normal source failure.

F. The controller shall include a built in synchroscope to display the phase angle differential and ensure disturbance-free transfer operation between sources.

G. The controller shall provide digital timer adjustments with 1-second resolution. Voltage and Frequency shall be adjustable to 1% resolution to facilitate accurate transfer.

H. To ensure reliable and consistent user operation the controls must be equipped with nonvolatile memory and allow automatic daylight savings time adjustment.

I. A single controller capable of all transfer modes, open/delayed/closed and bypass isolation, shall be provided. Real time display of transfer status and active timers must be supplied.

2.12 SEQUENCE OF OPERATION

A. The ATS shall incorporate adjustable three phase under/over voltage and frequency sensing on the normal source.

B. When the voltage of any phase of the normal source is reduced to 80% of nominal voltage, for a period of 0-10 seconds (programmable) a pilot contact shall close to initiate starting of the engine generator.

C. The ATS shall incorporate adjustable three phase under/over voltage and frequency sensing on the emergency source.

D. When the emergency source has reached a voltage value of +/- 10% of nominal and achieved frequency within +/- 5% of the rated value, the load shall be transferred to the emergency source after a programmable time delay.

E. When the normal source has been restored to not less than 90% and not more than 105% of nominal voltage on all phases, the load shall be retransferred to the normal source after a time delay of 0 to 60 minutes (programmable; set at 30 minutes). The generator shall run unloaded for 5 minutes (programmable) and then automatically shut down. The generator shall be ready for automatic operation upon the next failure of the normal source.

F. If the engine generator should fail while carrying the load, retransfer to the normal source shall be made instantaneously upon restoration of proper voltage (90%) on the normal source.

G. Inspection and operational tests shall be conducted by the contractor in the presence of the engineer, to indicate that the switch satisfies the specifications.

H. The transfer switch shall be equipped with a microprocessor based control panel. The control panel shall perform the operational and display functions of the transfer switch. The display functions of the control panel shall include ATS position and source availability.

I. The digital display shall be accessible without opening the enclosure door and shall be provided with a 4 line by 20-character LCD display screen with touch pad functions and display menus. The programming functions shall be pass code protected.

J. The control panel shall be provided with menu driven display screens for transfer switch monitoring, control and field changeable functions and settings.

K. The control panel shall be opto-isolated from electrical noise and provided with the following inherent control functions and capabilities:

1. Multipurpose display for continuous monitoring and control of the ATS functions and settings: All field changeable functions shall be pass code protected and accessible through the keypad.

2. Built-in diagnostic display that includes the capturing of historical data, such as number of transfers and time on emergency power source, for ease of troubleshooting

3. Capability for external communication and network interface through an RS485 serial port

4. Touch pad test switch with Fast Test/Load/No Load positions to simulate a normal source failure

5. Time delay to override momentary normal source failure prior to engine start: Field programmable 0-10 seconds (adjustable by increments of 0.1 second) factory set at 3 seconds

6. Time delay on retransfer to normal source, programmable 0-60 minutes (adjustable by increments of 0.1 minute) factory set at 30 minutes: If the emergency source fails during the retransfer time delay, the transfer switch controls shall automatically bypass the time delay and immediately retransfer to the normal position.

7. Time delay on transfer to emergency, programmable 0-5 minutes, factory set at 1 second

8. An in-phase monitor shall be provided. The monitor shall compare the phase angle difference between the normal and emergency sources and be

programmed to anticipate the zero crossing point to minimize switching transients.

9. Auxiliary contacts (1 N.O.) shall be provided to indicate normal and emergency source availability.

10. A load/no load clock exerciser shall be incorporated within the microprocessor and shall be programmable to start the engine generator set and transfer the load (when selected) for exercise purposes on a weekly basis. The exerciser shall contain a lithium battery for memory retention during an outage.

11. A timed auxiliary contact (1 N.C.) adjustable 0-60 seconds shall be provided to allow motor loads to be disconnected prior to transfer in either direction.

12. Provide a momentary pushbutton to bypass the time delays on transfer and retransfer and programmable commit/no commit control logic.

2.13 ATS FEATURES

A. In addition to the operational elements required to satisfy the sequence of operation and other functions specified herein, the following ATS features shall be provided:

1. Adjustable time delay to override momentary normal source failure prior to engine start: Field programmable 0-10 seconds factory set at 3 seconds.

2. Adjustable time delay on retransfer to normal source, programmable 0-60 minutes factory set at 30 minutes: If the emergency source fails during the retransfer time delay, the transfer switch controls shall automatically bypass the time delay and immediately retransfer to the normal position.

3. A time delay on transfer to emergency, programmable 0-5 minutes, factory set at 1 second

4. An in-phase monitor shall be provided. The monitor shall compare the phase angle difference between the normal and emergency sources and be programmed to anticipate the zero crossing point to minimize switching transients.

5. An exerciser timer with momentary test pushbutton shall be incorporated within the microprocessor and shall be capable of starting the engine generator set and transferring the load (when selected) for exercise purposes on a daily, weekly or monthly basis. The exerciser shall contain a battery for memory retention during an outage.

6. Provide a momentary pushbutton to bypass the time delays on transfer and retransfer and programmable commit/no commit control logic.

7. A set of customer contacts shall be provided to indicate both emergency and normal source position.

8. An adjustable over/under frequency and voltage sensor for both emergency and normal sources

9. Visual indication of switch position and source acceptability shall be provided for both emergency and normal sources.

10. An engine start contact with an adjustable cool down timer

11. A three phase Voltage Imbalance Monitor shall detect an imbalance and initiate a transfer to the alternate source. Adjustable 5-20% of nominal with a time delay of 10-30 seconds for nuisance conditions.

12. Heater and Thermostat (HT) – Recommended for NEMA 3R applications

13. Communications interface card RS-485 Modbus

14. Test Switch (6A) – Maintained

15. Digital Meter (M90) - Measures and displays true RMS volts, amps, frequency, kW, kVA, kVAR and PF w/Modbus RS485

16. Digital Meter (M91) Measures and displays true RMS volts, amps, frequency, kW, kVA, kVAR, PF and THD w/Modbus RS485

17. Additional Auxiliary Contacts (A4) - Closed when the transfer switch is in Source 1 position.

18. Alarm panel (CTAP) – Alarm on transfer to emergency w/silence button & light

19. Disconnect Switch (DS) - Inhibits transfer in either direction when in inhibit. (Std on 600A and above)

20. Protective Cover (OCVR) - Lockable see-through microprocessor and meters cover for NEMA 3R or 12.M

21. Battery Charger (B9) – 5 amp float charger. Specify input/output voltage

22. Fan Contact (F) – Contact closes when engine runs

23. Analog Metering - Individual 2% ammeter, voltmeter or frequency meters with selector switches as specified

24. Inhibit transfer (Q3) – Provides additional relay (specify voltage) to inhibit transfer to Emergency

25. Inhibit transfer (Q7) – Provides additional relay (specify voltage) to inhibit transfer to Normal

26. Load Shed (R15) – Provisions to transfer source 2 or Emergency to normal or neutral (delayed switches only) position. Specify voltage

27. Engine Mode Switch (SW1) – Three-position engine selector switch (auto/test/off)

28. Keyed Engine Mode Switch (SW1K) – Three position keyed engine selector switch (auto/test/off)

29. Prime Source Selector (SW3) – Provide a source selector switch that selects source 1 or source 2 as the preferred source

30. Prime Source Selector (SW3K) – Provide a keyed source selector switch that selects source 1 or source 2 as the preferred source

31. Automatic or Manual Selector (S5) – Provide ability to manually transfer to Normal source

32. Automatic or Manual Selector (S12) – Provide ability to manually transfer to Normal or Emergency sources

33. Additional Auxiliary Contact (A3) - Closed when the transfer switch is in Source 2 position

34. Additional Auxiliary Contact (A4) - Closed when the transfer switch is in Source 1 position

35. Programmable Clock Exerciser (CDP) – This will replace the timer exerciser and allow for a 365 day cycle

36. Peak Shave/Remote Test (Q2) - The controller shall accept a remote peak shave or test input to signal the transfer switch to the emergency position

37. Phase Rotation Sensing (R16) – Rotation shall be monitored on both sources

2.14 SOURCE QUALITY CONTROL

A. Provide in accordance with Division 01 General Requirements.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Install equipment in accordance with manufacturer's recommendations, the project drawings and specifications, and all applicable codes.

3.02 SERVICE

A. The supplier of the ATS shall be the same as that of the engine generator set and shall maintain a national service organization that is factory trained and certified for transfer switch equipment. In addition, the genset dealer organization shall be available 24 hours per day, 365 days per year.

3.03 START-UP AND TESTING

A. The transfer switch manufacturer shall perform a complete functional test on the switch, controller and accessories prior to shipping from the factory. A certified test report shall be available upon request.

B. Coordinate all start-up and testing activities with the Engineer and Owner. After installation is complete and normal power is available, the manufacturer's local dealer shall perform the following: Perform a 4 hour load bank test at a 1.0PF at full nameplate rating. Load bank, cables and other equipment required for this test to be supplied by the generator set supplier.

3.04 OPERATION AND MAINTENANCE MANUALS

A. Provide two (2) sets of operation and maintenance manuals covering the generator, switchgear, and auxiliary components. Include final as-built wiring interconnect diagrams and recommended preventative maintenance schedules.

3.05 TRAINING

A. On-Site Training

1. Provide on-site training to instruct the owner's personnel on the proper operation and maintenance of the equipment. Review operation and maintenance manuals, parts manuals, and emergency service procedures.

2. Training shall be provided in two (2) complete separate sessions to accommodate plant staff of varying shifts.

3. The instruction shall be dedicated and intensive and shall be provided by competent instructors fully familiar with the equipment.

4. The instructions shall be presented in an eight hour session. The Field Service engineer will provide Instructions on the operation and

maintenance of the generator engine, alternator, battery system, circuit breaker, control system, and appurtenances.

5. The Owner will provide a suitable classroom environment on site for the instruction session.

6. The owner may elect to record the training sessions for future reference.

7. Training shall be scheduled with at least seven (7) working days advance notice.

8. Provide both classroom training and hands-on equipment operation covering the following:

   a. Safety precautions

   b. Features and construction of generator and accessories

   c. Routine inspection, test and maintenance procedures

   d. Routine cleaning

   e. Routine preventative maintenance

   f. Interpretation of readings of indicating and alarm devices

   g. Review operating and maintenance manuals

   h. Review troubleshooting operations

3.06 WARRANTY

A. The automatic transfer switch shall be warranted against defective workmanship for a period of two years, including both parts and labor.

3.07 FIELD QUALITY CONTROL

A. Provide in accordance with Division 01 General Requirements.

3.08 STARTUP & COMMISSIONING

A. Provide in accordance with Division 01 General Requirements.

3.09 CLOSEOUT ACTIVITIES

A. Provide in accordance with Division 01 General Requirements.

END OF SECTION

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SECTION 26 35 33

POWER FACTOR CORRECTION EQUIPMENT

PART 1 – GENERAL

1.01 SUMMARY

A. This specification defines the electrical and mechanical characteristics and requirements for power correction systems in order to meet 5% total demand distortion (TDD), <5% total harmonic voltage distortion [THD(V)], and specific displacement power factor levels at selected points within the electrical system in accordance with this Section and applicable reference standards.

B. Related Documents

1. Division 26: Section 26 05 00 COMMON WORK RESULTS FOR ELECTRICAL

2. Division 26: Section 26 05 33 RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

3. Division 26: Section 26 05 26 GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

1.02 PRICE AND PAYMENT PROCEDURES

A. Measurement and payment requirements: per Division 01 General Requirements.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Coordination, Sequencing, and Scheduling: per Division 01 General Requirements.

1.04 SUBMITTALS

A. Submit in accordance with Division 01 General Requirements.

1.05 QUALITY ASSURANCE

A. Provide in accordance with Division 01 General Requirements.

B. The power correction systems shall be designed in accordance with the applicable sections of the following documents.

1. INSTITUTE OF ELECTRICAL AND ELECTRONIC ENGINEERS (IEEE)

a. IEEE std C62.41-1991

b. IEEE std 519-1992

2. CANADIAN STANDARDS ASSOCIATION (CSA)

a. CSA 22.2, No. 14 & 66

3. UNDERWRITERS' LABORATORIES, INC. (UL) COMPLIANCE

a. UL 508C

C. The products shall include third party approvals by UL or CSA.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Provide in accordance with Division 01 General Requirements.

1.07 SITE CONDITIONS

A. Existing Conditions: per Division 01 General Requirements.

1.08 SYSTEM DESCRIPTION

A. System Description

1. Voltage: 208 to 480 Volts, 380 to 600 Volts, 50/60 Hz, 3-phase, 3-wire plus ground.

2. Output Load Capacity: Rated capacity shall be the specified current capacity at the voltage required as indicated.

3. Field Installable Capacity Upgrade: Additional power correction capacity shall be added by installing additional units in parallel to previously installed power correction systems. A maximum of 5 units shall be installed in parallel per set of current transformers.

4. Current Transformers:

a. Split core type current transformers shall be installed as defined herein.

b. Three current transformers per power correction system location are required and mounted on phases A, B and C.

c. Current ratings of the current transformers shall be according to full load current of the circuit on which installed 500 to 5A secondary acceptable.

d. Current transformers rated for 400 hertz shall be used.

B. Modes of Operation

1. The power correction system shall be designed to electronically inject harmonic current to cancel the load-produced harmonic current such that the upstream power harmonic current and voltage are reduced to below 5% TDD and 5% THD(V). TDD as used herein refers to the total load demand of the applied circuit. The applied circuit may be a single nonlinear load, an entire distribution-bus load, or the facility load at the point-of-common coupling (PCC) with the power source.

2. Reactive current compensation (aka displacement power factor correction) shall be activated via a digital keypad/display mounted on the door of the enclosure. When reactive current compensation is activated, the power correction system shall first perform harmonic current correction and then use the remaining capacity to inject reactive current compensation to attain the specified level herein defined.

C. Performance Requirements

1. Input Power

a. Voltage: automatically adapted to 208 - 480V, 380-600V, 3-phase plus ground

b. Voltage Tolerance: +/- 10% of nominal

c. Frequency: automatically adapted to 50 or 60 Hz, +/- 3 Hz

d. Surge Withstand Capability: ANSI/IEEE std C62.41-1991 without damage

e. Input Fuses: Rated at 200,000 AIC (amperes interrupting capacity), Class T

2. Output Performance

a. Performance of the power correction system shall be independent of the impedance of the power source. All performance levels shall be attained whether on the AC lines, backup generator, or output of UPS.

3. Harmonic Correction

a. Limit the 2nd through 50th order harmonic current to <5% TDD at each installed location indicated herein. Harmonic levels for individual harmonic orders shall comply with respective levels established in ANSI/IEEE std 519-1992, Table 10.3.

b. Limit the THD(V) added to the electrical system immediately upstream of the power correction system location(s) to less than or equal to 5%. The power correction system shall not correct for utility supplied voltage distortion levels.

4. Reactive Current Compensation

   a. To .95 lagging displacement power factor. Leading power factor is not permitted.

5. Current Transformers

   a. Current transformers shall be rated for the total rated rms current of the total load at each installed location or higher.

   b. Three (3) current transformers, mounted on phases A, B and C, are to be installed per location.

   c. Each current transformer shall have a current output of 5 amperes. Current capacity of each current transformer shall be 500 Ampere primary as required for the electrical system where installed. No other ratings are acceptable.

   d. Each current transformer shall be rated for 400 Hertz.

1.09 ENVIRONMENTAL CONDITIONS

A. 1.5.1. The power correction system shall be able to withstand the following environmental conditions without damage or degradation of operating characteristics or life:

   a. Operating Ambient Temperature: 00C (320F) to 400C (1040F).

   b. Storage Temperature: -40degC (-40degF) to 65degC (149degF).

   c. Relative Humidity: 0 to 95%, non-condensing.

   d. Altitude: Operating to 1000 meters (3300 ft). De-rated for higher elevations.

   e. Audible Noise: Generated by power correction system not to exceed 65 db measured at 1 meter from surface of unit.

PART 2 – PRODUCTS

2.01 ENCLOSURE

A. Power correction unit shall be furnished integral to the Motor Control Center. Reference 26 24 19 Motor Control Center (Intelligent).

B. Wall mount units shall be disconnected from the power source by a disconnect device or circuit breaker contained in the power distribution center as defined by local and national codes for branch circuit protection.

C. Wall mount units weighing more than 80 pounds shall have lifting lugs.

D. All units shall include 200,000 AIC rated fuses with Class T actuation.

E. All units shall be provided with a grounding lug. Grounding by the contractor is to be performed according to local and national standards.

F. The paint shall be the manufacturer's standard type and color.

2.02 OPERATOR CONTROLS AND INTERFACE

A. All units shall include a digital interface model (DIM) that includes an alphanumeric display consisting of 2-lines with 20 characters per line. All information shall be in English. Display shall be easily viewed under all lighting conditions, including sunlight, as found inside buildings.

B. Operator controls shall include run, stop, setup, enter, and up/down scroll.

C. The display shall provide operating data while functioning. Standard operating parameters available for display are AC line voltage, total rms load current, harmonic current of load, reactive current of load, and output harmonic and reactive current of power correction system.

D. When the output of the power correction unit is at full rated capacity, the display shall indicate at-maximum capacity and actuate an at-maximum capacity relay.

E. All fault conditions shall be displayed as they occur. Diagnostic information shall be provided in English and clearly indicate the nature of the fault.

F. The run pushbutton shall include a green LED. LED shall be lit when unit is operating.

G. Contacts shall be provided for operator information for power-on, run, fault and at-maximum capacity. Each contact shall be rated for 1 Ampere at 120/240 volts. One form C contact shall be provided for each relay.

H. A RS485 serial communication port shall be provided for remote control and diagnostic information.

2.03 DESIGN

A. All power correction units shall be defined as a power electronic device consisting of power semiconductors that switch into the AC lines to modulate its output and? to cancel detrimental harmonic and/or reactive currents. A DC bus shall store power for power semiconductor switching. A microprocessor shall control the operation of the power converter.

B. Each unit shall be designed with a current limiting function to protect the semiconductors. When this level is attained, a message shall be displayed indicating the output capacity is at-maximum capacity and actuate the at-maximum capacity relay. Operation shall continue indefinitely at this level without trip off or destruction of the power correction unit.

C. Each unit shall incorporate an over-temperature output roll back that reduces the total output current in order to maintain maximum current correction within the electrical system.

D. Two distinct levels of faults shall be employed. Non-critical level faults will provide automatic restart and a return to normal operation upon automatic fault clearance. Critical level faults stop the function of the unit and await operator action.

1. Faults such as AC line over voltage, AC line under-voltage, AC line power loss, and AC line phase imbalance shall be automatically restarted. Upon removal of these fault conditions, the power correction system shall restart without user action. Automatic restart will not occur if 5 faults have occurred in less than 5 minutes. During the fault condition, except line loss, the display shall state the type of fault and indicate that automatic restart will occur. The run relay and run LED shall be disabled. The fault relay shall not be enabled unless time out occurs. Upon AC line loss, the power-on relay shall be disabled, and no display shall be provided.

2. All other types of faults shall be considered critical and shall stop the power correction system. The display shall indicate the fault condition and "stop." The run LED and relay shall be disabled and the fault relay enabled. User shall be required to initiate a power reset (turn power off and on) to restart the power correction system.

E. The logic of the power correction system shall monitor the load current by utilizing three (3) current transformers (CTs) mounted on phases A, B and C to direct the function of the power electronic converter. The ratio of the CTs must be entered into the logic via the digital keypad/display to calibrate the operation of the power correction system. The output of the current transformers shall be 5 Amperes.

F. Up to 5 power correction units may be installed in parallel to inject current according to the information received from one set of CTs. The units will function independently. If one unit is stopped or faulted, the remaining units will adjust accordingly to maintain optimum harmonic cancellation levels up to the capacity of the remaining units.

2.04 ACCEPTABLE MANUFACTURERS

A. Schneider Electric

B. General Electric

C. Eaton Electric

2.05 SOURCE QUALITY CONTROL

A. Provide in accordance with Division 01 General Requirements.

PART 3 – EXECUTION

3.01 FIELD QUALITY CONTROL

A. Provide in accordance with Division 01 General Requirements.

B. The manufacturer suggested inspection and test procedures shall be performed by factory certified field service personnel during startup.

3.02 STARTUP & COMMISSIONING

A. Provide in accordance with Division 01 General Requirements.

B. The manufacturer shall provide start up and commissioning assistance (remote or on-site) to initialize all equipment. A 3-phase harmonic analyzer shall be used to measure TDD and THD (V) levels to verify performance to the specifications defined herein. Test reports shall be prepared for each point of test. Test reports shall be documented, signed, and dated. All tests shall be submitted to the site manager.

END OF SECTION

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SECTION 26 43 00

SURGE PROTECTIVE DEVICES

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes

1. This section describes the materials and installation requirements for an integrated Surge Protective Device (SPD), in a Low Voltage Motor Control Centers (MCC's), Low Voltage Switchboards, Low Voltage Switchgear, and Panelboards, and other equipment as indicated. These devices are used to protect AC electrical circuits from the effect of lightning induced currents, substation switching transients and internally generated transients resulting from inductive and or capacitive load switching

B. Related documents

1. Division 26, Section 26 05 00 COMMON WORK RESULTS FOR ELECTRICAL

2. Division 26, Section 26 05 33 RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

3. Division 26, Section 26 05 26 GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

4. Division 26, Section 26 23 00 LOW-VOLTAGE SWITCHGEAR

5. Division 26, Section 26 24 13 SWITCHBOARDS

6. Division 26, Section 26 24 16 PANELBOARDS

7. Division 26, Section 26 24 19 MOTOR CONTROL CENTER

1.02 PRICE AND PAYMENT PROCEDURES

A. Measurement and payment requirements: per Division 01 General Requirements.

1.03 REFERENCES

A. UL 1449 Second Edition 2005 - Transient Voltage Surge Suppressors

B. UL 1283 - Electromagnetic Interference Filters

C. ANSI/IEEE C62.41.1-2002 - IEEE Guide on the Surge Environment in Low Voltage (1000 V and Less) AC Power Circuits; C62.41.2-2002 - IEEE Recommended Practice on Characterization of Surge Voltages in Low Voltage AC Power Circuits; and C62.45-2002 - IEEE Recommended Practice on Surge Testing for Equipment Connected to Low-Voltage AC Power Circuits

D. NEC 2005, Article 285

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination, Sequencing, and Scheduling: per Division 01 General Requirements.

1.05 SUBMITTALS

A. Submit in accordance with Division 01 General Requirements.

1.06 QUALITY ASSURANCE

A. Provide in accordance with Division 01 General Requirements.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Provide in accordance with Division 01 General Requirements.

1.08 SITE CONDITIONS

A. Existing Conditions: per Division 01 General Requirements.

PART 2 – PRODUCTS

2.01 SURGE PROTECTIVE DEVICE

A. Internal SPD

1. SPD shall be Listed in accordance with UL 1449 Second Edition 2005 and UL 1283, Electromagnetic Interference Filters.

2. Integrated surge protective devices (SPD) shall be Component Recognized in accordance with UL 1449 Second Edition, Revision 2/9/2005 Section 37.3 and 37.4 at the standard's highest short-circuit current rating (SCCR) of 200 kA, including intermediate level of fault current testing that will be effective 2/9/2007.

3. SPD shall be tested with the ANSI/IEEE Category C High exposure waveform (20kV-1.2/50□s, 10kA-8/20□s).

4. SPD shall provide suppression for all modes of protection: L-N, L-G, and N-G in WYE systems.

5. The manufacturer of the SPD shall be the same as the manufacturer of the service entrance and distribution equipment in which the devices are installed and shipped. Also, this distribution equipment shall be fully tested and certified to the following UL standards:

   a. UL 67 - Panelboards

   b. UL 845 - Motor Control Centers

   c. UL 857 - Busway

   d. UL 891 - Switchboards

   e. UL 1558 - Low Voltage Switchgear

6. Recommended SPD ratings

   a. Minimum surge current ratings per phase of equipment shall be as follows:

EQUIPMENT	SURGE RATING
Switchgear	200kA
Switchboards	160kA
Power Panels	160kA
Lighting Panels	160kA
Receptacle Panels	120kA

TABLE 2.01A – MINIMUM SURGE CURRENT RATINGS

   b. UL 1449 clamping voltage must not exceed the following:

VOLTAGE	L-N	L-G	N-G
240/120	800/400V	800/400V	400V
208/120	400V	400V	400V
480/277	800V	800V	800V
600/347	1200V	1200V	1200V

TABLE 2.01B – MAXIMUM CLAMPING VOLTAGE LIMITS

   c. Pulse life test: Capable of protecting against and surviving 5000 ANSI/IEEE Category C High transients without failure or degradation of clamping voltage by more than 10%.

7. SPD shall be designed to withstand a maximum continuous operating voltage (MCOV) of not less than 115% of nominal RMS voltage.

8. SPD shall be constructed of one self-contained suppression module per phase.

9. Visible indication of proper SPD connection and operation shall be provided. The indicator lights shall indicate which phase as well as which module is fully operable. The status of each SPD module shall be monitored on the front cover of the enclosure as well as on the module. A push-to-test button shall be provided to test each phase indicator. Push-to-test button shall activate a state change of dry contacts for testing purposes.

10. SPD shall be equipped with an audible alarm which shall activate when any one of the surge current modules has reached an end-of-life condition. An alarm on/off switch shall be provided to silence the alarm. The switches and alarm shall be located on the front cover of the enclosure.

11. A connector shall be provided along with dry contacts (normally open or normally closed) to allow connection to a remote monitor or other system. The output of the dry contacts shall indicate an end-of-life condition for the complete SPD or module.

12. Terminals shall be provided for necessary power and ground connections.

13. The SPD shall be equipped the following items:

    a. A transient voltage surge counter shall be located on the diagnostic panel on the front cover of the enclosure. The counter shall be equipped with a manual reset and battery backup to retain memory upon loss of AC power.

    b. A remote monitoring device shall be provided to directly connect to the SPD with a dry contact connector for simple installation. The device will have indicator lights and an audible alarm to monitor for normal and fault conditions.

B. SPD shall have a warranty for a period of ten (10) years from date of invoice. Warranty shall be the responsibility of the electrical distribution equipment manufacturer and shall be supported by their respective field service division.

2.02 MANUFACTURER

A. Acceptable manufacturers are as follows:

1. Square D/Schneider Electric

2. General Electric Co.

3. Siemens

4. Eaton/Cutler Hammer

5. Approved Equal

2.03 SOURCE QUALITY CONTROL

A. Provide in accordance with Division 01 General Requirements.

PART 3 – EXECUTION

3.01 FIELD QUALITY CONTROL

A. Provide in accordance with Division 01 General Requirements.

3.02 STARTUP & COMMISSIONING

A. Provide in accordance with Division 01 General Requirements.

END OF SECTION

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SECTION 26 51 00

INTERIOR LIGHTNING

PART 1 – GENERAL

1.01 SUMMARY

A. The Contractor shall provide the labor, tools, equipment, and materials necessary to furnish and install lighting fixtures in accordance with the plans and schedules as specified herein.

B. Provide a complete lighting system as indicated. Lighting control equipment shall include, if indicated: light fixtures, control modules, power packs, dimming ballasts, occupancy sensors, and light level sensors.

C. Section includes the following:

1. Light Emitting Diode (LED)
2. Luminaires and lamp holders
3. Exit signs
4. Emergency lighting units
5. Lamps
6. Dimming systems
7. Occupancy sensor systems
8. Photocell controls
9. Time switch

1.02 PRICE AND PAYMENT PROCEDURES

A. Measurement and payment requirements: per Division 01 General Requirements.

1.03 REFERENCES

A. Reference Standards

1. ILLUMINATING ENGINEERING SOCIETY OF NORTH AMERICA (IESNA)
    a. IESNA HB-9 (2000) Lighting Handbook

2. INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

a. IEEE C2 (2002) National Electrical Safety Code

3. NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

a. NFPA 70 (2005) National Electrical Code

1.04 RELATED REQUIREMENTS

A. Division 26, Section 26 05 00 COMMON WORK RESULTS FOR ELECTRICAL

B. Division 26, Section 26 05 33 RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

C. Division 26, Section 26 05 26 GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

D. Division 26, Section 26 56 00 EXTERIOR LIGHTING

1.05 APPLICABLE PUBLICATIONS

A. Publications listed below (including amendments, addenda, revisions, supplements and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by designation only.

B. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

1. C635-07: Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings

C. ENVIRONMENTAL PROTECTION AGENCY (EPA)

1. 40 CFR 261: Identification and Listing of Hazardous Waste

D. FEDERAL COMMUNICATIONS COMMISSION (FCC)

1. CFR Title 47, Part 15: Radio Frequency Devices

2. CFR Title 47, Part 18: Industrial, Scientific, and Medical Equipment

E. ILLUMINATING ENGINEERING SOCIETY (IES)

1. LM-79-08: Electrical and Photometric Measurements of Solid-State Lighting Products

2. LM-80-08: Measuring Lumen Maintenance of LED Light Sources

3. LM-82-12: Characterization of LED Light Engines and LED Lamps for Electrical and Photometric Properties as a Function of Temperature

F. INSTITUTE OF ELECTRICAL AND ELECTRONIC ENGINEERS (IEEE)

1. C62.41-91: Surge Voltages in Low Voltage AC Power Circuits

G. INTERNATIONAL CODE COUNCIL (ICC)

1. IBC-12: International Building Code

H. NATIONAL FIRE PROTECTION ASSOCIATION (NFPA):

1. 70-11 National Electrical Code (NEC)

2. 101-12 Life Safety Code

I. NATIONAL ELECTRICAL MANUFACTURER'S ASSOCIATION (NEMA)

1. SSL-1-10: Electronic Drivers for LED Devices, Arrays, or Systems

J. UNDERWRITERS LABORATORIES, INC. (UL):

1. 496-08: Lampholders

2. 844-12: Luminaires for Use in Hazardous (Classified) Locations

3. 924-12: Emergency Lighting and Power Equipment

4. 1029A-06: Ignitors and Related Auxiliaries for HID Lamp Ballasts

5. 1598-08: Luminaires

6. 1574-04: Track Lighting Systems

7. 2108-04: Low-Voltage Lighting Systems

8. 8750-09: Light Emitting Diode (LED) Light Sources for Use in Lighting Products

1.06 ADMINISTRATIVE REQUIREMENTS

A. Coordination, Sequencing, and Scheduling: per Division 01 General Requirements.

1.07 SUBMITTALS

A. Submit in accordance with the Division 01 General Requirements.

B. Submit shop drawings, product data, test data, warranties, and other information as appropriate for the following:

1. Light Emitting Diode (LED), submit US DOE LED Lighting Facts label, and IES L70 rated life.

2. Luminaires and lamp holders

3. Exit signs

4. Emergency lighting units

5. Lamps

6. Ballasts

7. Dimmers

8. Dimming systems

9. Occupancy sensors

10. Photocell controls

11. Time switch

C. Shop Drawings: Indicate construction details for products which are not manufacturer's standard, when product data does not adequately describe fixture physical characteristics, or upon request by Engineer.

D. Product Data: Provide product data for each luminaire and lighting unit.

E. Submit written warranty for extended warranty items such as batteries and ballasts.

F. Submit luminaire shop drawings in booklet form with a separate sheet for each luminaire type. Indicate clearly on each sheet the proposed luminaire "type" designation, manufacturer, luminaire, lamp, and ballast designation.

G. Submittals shall indicate materials, finishes, metal gauges, overall and detail dimensions, sizes of electrical and mechanical connections, fasteners, welds, joints, end conditions, provisions for the work of others and similar information.

H. A photometric test report showing photometric candlepower distribution, brightness, coefficients of utilization, and paint reflectance shall be included for all fluorescent and HID fixtures. Photometric reports shall be prepared for actual fixture, lamp, lens, and ballast combination. Certify data as that taken under National Bureau of Standards calibrated test conditions according to standards of

the Illuminating Engineering Society; upon request, submit photometric test of proposed fixture prepared by an independent testing laboratory such as ETL.

I. The submittals shall state whether or not the fixture, as an assembly, has been UL tested and approved.

J. Upon request, submit sample products for inspection. Provide luminaires identical with approved samples; retain approved samples at site for comparison until after all other luminaires have been shipped to site and installed. Transportation charges for samples shall be paid by Contractor. Unapproved samples will be returned at Contractor's expense. Upon notification of disapproval, immediately submit new samples that meet contract requirements.

K. Upon request by Engineer, provide computerized illumination calculation data for specified interior or exterior areas in digital or isofootcandle format and in such detail as requested.

L. Operating and Maintenance Instructions: Provide maintenance and operating instructions for battery powered lighting units. Include technical data sheets and parts ordering information for components used in all luminaires.

M. Closeout and Maintenance Material Submittals: per Division 01 General Requirements.

1.08 QUALITY ASSURANCE

A. Provide in accordance with Division 01 General Requirements.

B. Warrant all lighting and components for one year after acceptance of the work and at no additional cost to the Owner. Promptly provide and install replacements for luminaires or components which are defective in materials or workmanship or repair installed equipment at the job site as necessary to restore first class operating condition. For any time during the warranty period that luminaires are not fully functional due to defects in materials or workmanship, provide, install and remove suitable temporary lighting. Warrant replacement luminaires in a similar manner for a period of one year following replacement including replacement of defective replacements.

C. Warrant ballasts, batteries, and occupancy sensors as further specified herein.

D. Provide products of firms regularly engaged in the manufacture of interior luminaires or components of similar types and ratings to those required. Such products shall have been in satisfactory use in similar applications for not less than two years.

1.09 DELIVERY, STORAGE AND HANDLING

A. Provide in accordance with Division 01 General Requirements

B. Deliver luminaires and their components to job site, factory assembled and wired to the greatest extent practical, in strict accordance with approved shop drawings, samples, certificates and catalog cuts.

C. Protect exposed finishes during manufacture, transport, storage and handling; replace damaged materials.

D. Luminaires shall be stored under cover, above the ground, in clean, dry areas and shall be tagged and/or marked as to type and site destination.

1.10 SITE CONDITIONS

A. Existing Conditions: per Division 01 General Requirements.

PART 2 – PRODUCTS

2.01 GENERAL

A. Provide lighting fixtures as listed on the Lighting, Lamping, and Fixture Schedule on the drawings and as specified herein that meet the physical, performance and quality standard exhibited by that fixture. Substitutes shall be equal in all respects including mechanical, electrical, physical, performance, photometric and quality characteristics except minor variances in construction details, which do not affect overall quality or performance, are permitted.

B. Accessories: Provide required accessories for mounting and operation of each luminaire as indicated.

1. Recessed Luminaires: Provide trim type suitable for ceiling system in which luminaire is installed; design fixtures to operate in a 140°F environment.

2. Thermal Protection: Provide thermal protection devices to meet NFPA 70 requirements.

3. Disconnecting Means: Provide disconnecting means in fluorescent luminaires that utilize double-ended lamps and contain ballast(s) that can be serviced in place.

4. Surface Luminaires: Provide spacers and brackets required for mounting; design for a minimum ambient temperature of 92°F.

5. Pendant Luminaires: Provide swivel hangers, pendant rods, tubes, chains and other hardware as required and/or indicated to install luminaire at appropriate height.

2.02 HID LUMINAIRES

A. Exterior Housing: Die cast aluminum with five-stage polyester powder paint finish, electrical components solidly heat-sink mounted to housing, type as described on the drawings.

A. Ballast: High power factor, energy efficient UL 1029 and ANSI C82.4, constant wattage autotransformer (CWA) or regulator, high power factor type, designed to operate on the voltage system to which they are connected.

1. For outdoor installations, provide single lamp ballasts with a minimum starting temperature of -20°F. Construct so that open circuit operation will not reduce its rated life.

2. High Pressure Sodium (HPS) ballasts shall have a solid state igniter/starter with an average life in the pulsing mode of 10,000 hours at the intended ambient temperature. Igniter case temperature shall not exceed 90°C in any mode. Average life is defined as the time after which 50 percent will have failed and 50 percent will have survived under normal conditions.

B. Optics: High efficiency, spun or hydro formed aluminum or glass refractor similar to specified fixture, minimum photometric performance in accordance with fixtures listed on Lighting Fixture Schedule.

2.03 LED LIGHT FIXTURES

A. General

1. LED light fixtures shall be in accordance with IES, NFPA, UL, as shown on the drawings, and as specified.

2. LED light fixtures shall be Reduction of Hazardous Substances (RoHS)-compliant.

3. LED drivers shall include the following features unless otherwise indicated:

a. Minimum efficiency: 85% at full load

b. Minimum Operating Ambient Temperature: -20˚ C. (-4˚ F)

c. Input Voltage: 120 - 277V (±10%) at 60 Hz

d. Integral short circuit, open circuit, and overload protection

e. Power Factor: ≥ 0.95

f. Total Harmonic Distortion: ≤ 20%

g. Comply with FCC 47 CFR Part 15

4. LED modules shall include the following features unless otherwise indicated:

   a. Comply with IES LM-79 and LM-80 requirements.

   b. Minimum CRI 80 and color temperature 3000˚ K unless otherwise specified in LIGHTING FIXTURE SCHEDULE.

   c. Minimum Rated Life: 50,000 hours per IES L70

   d. Light output lumens as indicated in the LIGHTING FIXTURE SCHEDULE.

B. LED Downlights

1. Housing, LED driver, and LED module shall be products of the same manufacturer.

C. LED Troffers

1. LED drivers, modules, and reflector shall be accessible, serviceable, and replaceable from below the ceiling.

2. Housing, LED driver, and LED module shall be products of the same manufacturer.

2.04 EXIT SIGNS

A. LED Exit Sign with Battery Backup

1. Lamps: Manufacturer's standard, light emitting diode (LED) type designed to NFPA 101 and 70 marking of egress requirements. Warrant lamps for 5 years full replacement.

2. Input Voltage: 120 volts for normal power, equip with self-contained battery, solid state charger with brown out protection, and test switch.

3. Battery: Sealed nickel cadmium, warrant for five years full replacement, plus additional 7 years prorata. prorated?

B. Construction

1. Housing: High strength cast aluminum, equipped with low profile canopy mount.

2. Housing and Lens in High Abuse Areas: Injection molded polycarbonate.

3. Face: Aluminum or white painted steel stencil face with red letters, 6" high x 3/4" stroke.

4. Directional Arrows: Universal type for field adjustment.

5. Mounting: Universal, for field selection.

6. Mounting in High Abuse Areas: Ceiling or wall as indicated.

2.05 EMERGENCY LIGHTING UNITS

A. Self-Contained Emergency Lighting Unit:

1. Input Voltage: 120 volts.

2. Battery: Lead calcium maintenance free type, 3 year full, plus 7 year prorated (total 10 year) warranty. Gelled electrolyte batteries are not permitted.

3. Battery Charger: Dual rate type, solid state, with low voltage and brown out protection.

4. Lamps and Lamp holder: LH3-12V halogen, 12 watt.

5. Housing: Steel with manufacturer's standard finish.

B. Indicators and Controls: AC ON, RECHARGING; TEST switch, battery charge voltmeter.

C. Electrical Connection: Hardwired

2.06 OCCUPANCY SENSOR SYSTEMS

A. Acceptable Manufacturers

1. Watt Stopper

2. Unenco

3. Approved Equal

B. General

1. All sensors, control units, transformers, power packs, switchpacks and relays of the systems shall be UL listed under Section 508 Industrial Control Equipment and shall conform to applicable portions of the National Electrical Code to provide automatic operation of lights in response to space occupancy, like devices produced by Watt-Stopper or approved equal.

2. Provide sensors that will be able to detect typical motion (eg. walking in corridors, writing and computer use in offices) throughout the accessible portions of spaces lighted by controlled luminaires. Provide additional sensors at no extra cost as needed to provide the required coverage.

3. Rate system for operation in ambient temperatures up to 115EF.

4. Time delay, (after occupants are no longer present before lights are automatically switched off), shall be a linear adjustment with a range including at least 30 seconds to 15 minutes. Sensitivity to motion shall be a linear adjustment.

5. Calibration, time or sensitivity adjustments shall be accomplished using common hand tools and not require the use of separate keys or pins.

6. Units that allow light to be forced on during periods of no occupancy shall do so by means of a covered, concealed switch within the unit to prevent access by unauthorized personnel.

7. All occupancy sensors shall include an LED, clearly visible throughout sensor coverage range, which flashes each time the unit senses motion.

8. Units shall be capable of operating the fluorescent ballasts in the luminaires being controlled and shall switch all fluorescent and compact fluorescent lamp types without noticeable delay.

9. Occupancy sensors and system components shall have a minimum 3-year warranty.

10. The switching capacity of occupancy sensing units or systems shall exceed the ballast input wattage of the lighting system to be switched.

11. Select components and locate so as to avoid false triggering by heating or cooling systems, computers and VDTs, adjacent spaces and windows.

12. Units shall be equipped to allow adjustment of field of view, as required to prevent false triggering due to adjacent spaces, corridors, etc.

13. Large areas requiring multiple sensing units and/or the use of switching relays or power packs shall use 10 to 24 volt DC class 2 wiring between sensing and controlling units.

14. Design wall mounted sensing units to fit in single or two gang switch boxes at a height of 3 to 5 feet.

15. Design ceiling mounted sensing units to be mounted at a height of 8 feet or more.

16. Design sensors to permit running low voltage sensor wires (use 600 volt rating) in same conduit as 120 volt supply and load wires, or provide separate conduit run for control wires.

C. Corridor/Stairwell Applications

1. All units shall be the fail-safe type so that in the event of an occupancy sensor unit or system failure lights will turn on or remain on.

2. Corridor applications shall use units designed and manufactured specifically for linear coverage (not area) in one, two, or three directions, as appropriate.

3. Sensing units shall be placed so that motion is detected at all points in the corridor or stairwell.

4. Sensor control shall exclude designated, constant-burn sources so that minimal illumination required by applicable codes is provided after occupancy sensors have switched off primary lighting.

D. Infrared Occupancy Sensors

1. Install so that all points where occupants might be stationary in the space are in the direct field of view of the sensor.

E. Automatic Occupancy Sensors

1. Occupancy sensors and systems shall switch lights on and off automatically depending on the state of the local manual switches. Turning off manual switches will turn off lights. If manual switches are left on, the occupancy sensor will turn off the lights when no occupancy is sensed. If the manual switches are off, they must be turned on when entering an area. If the manual switches are left on, the occupancy sensor will switch on the lights when entering an area.

F. Calibration and Troubleshooting

1. Occupant sensor calibration shall be performed by the Contractor prior to system turnover and rechecked and recalibrated three months later (or as recommended by sensor manufacturer). Contractor shall first arrange for and receive on-site training by a representative of the system manufacturer in a number of spaces representing the range of applications (wall mounted, ceiling mounted, open office, small office, rest room, ambient sensing, etc.) on the project. Training shall include appropriate maintenance personnel from the building operations staff.

2. Specific instructions for calibration and troubleshooting shall be provided as part of the O&M manual which represents the range of applications (wall mounted, ceiling mounted, open office, small office, rest room, photocell sensing, etc.) on the project.

2.07 PHOTOCELL SWITCH

A. UL 773 or UL 773A, hermetically sealed cadmium-sulphide cell rated 240 volts ac, 60 hertz with single-throw contacts rated 1000 watts, and 600 volts.

B. Mount switch in a cast weatherproof aluminum housing, with swivel arm mount, in a high impact resistant, non-corroding and non-conductive molded plastic housing, with an EEI-NEMA locking-type receptacle.

C. The switch shall turn on below 3 footcandles and off at 3 to 10 footcandles. A time delay shall prevent accidental switching from transient light sources. Mount a directional lens in front of the cell to prevent fixed light sources from creating a turnoff condition. Aim switch according to manufacturer's recommendations.

2.08 TIME SWITCH

A. Digital multi-purpose, 120 volts, 1 channel, 24 hour time switch. Provide switch with battery backup to maintain accurate time for a minimum of 72 hours following power failure. Provide time switch with a manual on-off bypass switch. Housing for the time switch shall be surface mounted, NEMA 1 enclosure conforming to NEMA ICS 6.

2.09 SOURCE QUALITY CONTROL

A. Provide in accordance with Division 01 General Requirements.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Electrical installations shall conform to IEEE C2, NFPA 70, and to the requirements specified herein.

B. Examine adjacent surfaces to determine that surfaces are ready to receive work.

C. Install wiring in accordance with Section 26 05 19 LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES.

D. Install luminaires and accessories in accordance with manufacturer's instructions, as indicated, with equipment, materials, parts, attachments, devices, hardware, hangers, cables, supports, channels, frames and brackets necessary to make a safe, complete and fully operative installation.

E. Install luminaires plumb, square and level with ceiling and walls, in alignment with adjacent luminaires, and secure in accordance with manufacturers' directions and approved shop drawings. Conform to the requirements of National Electrical Code ANSI/NFPA 70.

1. Specified or indicated mounting heights are to be to the bottom of each luminaire for suspended and ceiling mounted luminaires, and to the center of each luminaire for wall mounted luminaires. Obtain approval of exact mounting for luminaires on the job before installation is commenced and, where applicable, after coordinating with type, style, and pattern of ceiling being installed.

2. Provide pendant accessory to mount suspended luminaires and exit signs at height indicated. Use swivel hanger on sloped ceilings.

3. Support surface mounted luminaires from ceiling grid tee structure; provide auxiliary support laid across top of ceiling tees and fasten to prohibit movement.

4. Install recessed luminaires to permit removal from below and install earthquake clips.

5. For lighting fixtures mounted in or on suspended ceilings, provide two support hangers per fixture so that each is independently supported from the building structure.

6. Provide two support hangers for the minimum security fixtures so that each is independently supported from the building structure.

7. Install lamps in luminaires and lamp holders.

8. Ground non-current carrying parts of electrical equipment in accordance with UL and NEC provisions.

F. Install lighting fixtures where indicated on the plans; plans may be scaled for approximate locations; minor adjustments are permitted to avoid conflicts. Fixture placement that does not conform to the layout indicated shall be corrected; if in doubt about correct placement consult Engineer prior to roughing in. Install all lighting so that it is securely fastened, rows are uniformly spaced and in alignment, and fixture rests flat on mounting surface.

G. Install ballasts and fixtures to avoid amplifying hum. Any ballast or fixture which develops an excessive hum within one year shall be replaced.

H. Where multilevel switching is indicated, all outer lamps shall be switched together and all inner lamps together.

I. Install 2 x 2 fixtures for consistent lamp orientation within each room.

J. Perform insulation resistance and ground continuity test.

3.02 ADJUSTING AND CLEANING

A. Align luminaires and clean lenses and diffusers at completion of work.

B. Aim adjustable luminaires and lamp holders as indicated or as directed.

C. Adjust directional arrows on exit signs to meet approval of authority having jurisdiction.

D. Clean paint splatters, dirt and debris from installed luminaires.

E. Touch up luminaire and pole finish at completion of work.

F. Re-lamp luminaires which have failed lamps at completion of work.

3.03 OWNER INSTRUCTION

A. Provide on-site training of Owner’s personnel in operation of controls systems by a factory trained manufacturer's representative. Include instruction in programming time controls to obtain required control functions. Provide one follow-up visit if necessary.

3.04 FIELD QUALITY CONTROL

A. Provide in accordance with Division 01 General Requirements.

3.05 STARTUP & COMMISSIONING

A. Provide in accordance with Division 01 General Requirements.

3.06 CLOSEOUT ACTIVITIES

A. Provide in accordance with Division 01 General Requirements.

END OF SECTION

SECTION 26 56 00

EXTERIOR LIGHTING

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes

1. Luminaires and lamp holders
2. Lamps
3. Time switch
4. Photocell controls

B. Related Documents

1. Division 26, Section 26 05 00 COMMON WORK RESULTS FOR ELECTRICAL
2. Division 26, Section 26 05 33 RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS
3. Division 26, Section 26 05 26 GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS
4. Division 26, Section 26 51 00 INTERIOR LIGHTING

1.02 PRICE AND PAYMENT PROCEDURES

A. Measurement and payment requirements: per Division 01 General Requirements.

1.03 REFERENCES

A. Furnish products listed by Underwriters Laboratories, Inc., ETL Testing Laboratories, or other testing firm acceptable to the Owner.

B. Conform to requirements of ANSI/NFPA 70.

C. Conform to requirements of NFPA 101.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination, Sequencing, and Scheduling: per Division 01 General Requirements.

1.05 SUBMITTALS

A. Submit in accordance with the Division 01 General Requirements.

B. Submit shop drawings, product data, test data, warranties, and other information as appropriate for the following:

1. Luminaires

2. Lamps

3. Time switch

4. Photocell controls

C. Shop Drawings: Indicate construction details for products which are not manufacturer's standard, when product data does not adequately describe fixture physical characteristics, or upon request by Engineer.

D. Product Data: Provide product data for each luminaire and lighting unit.

E. For LED lighting fixtures, submit US DOE LED Lighting Facts label, and IES L70 rated life.

F. Submit luminaire shop drawings in booklet form with a separate sheet for each luminaire type. Indicate clearly on each sheet the proposed luminaire "type" designation, manufacturer, luminaire lamp, and ballast designation.

G. Submittals shall indicate materials, finishes, metal gauges, overall and detail dimensions, sizes of electrical and mechanical connections, fasteners, welds, joints, end conditions, provisions for the work of others and similar information.

H. A photometric test report showing photometric candlepower distribution, brightness, coefficients of utilization, and paint reflectance shall be included for all fixtures. Photometric reports shall be prepared for actual fixture, lamp, lens, and ballast combination. Certify data as that taken under National Bureau of Standards calibrated test conditions according to standards of the Illuminating Engineering Society; upon request, submit photometric test of proposed fixture prepared by an independent testing laboratory such as ETL.

I. The submittals shall state whether or not the fixture, as an assembly, has been UL tested and approved.

J. Upon request, submit sample products for inspection. Provide luminaires identical with approved samples; retain approved samples at site for comparison until after all other luminaires have been shipped to site and installed. Transportation charges for samples shall be paid by Contractor. Unapproved samples will be returned at Contractor's expense. Upon notification of disapproval, immediately submit new samples that meet contract requirements.

K. Upon request by Engineer, provide computerized illumination calculation data for specified interior or exterior areas in digital or isofootcandle format and in such detail as requested.

L. Operating and Maintenance Instructions: Provide maintenance and operating instructions for battery powered lighting units. Include technical data sheets and parts ordering information for components used in all luminaires.

M. Closeout and Maintenance Material Submittals: per Division 01 General Requirements.

1.06 QUALITY ASSURANCE

A. Provide in accordance with Division 01 General Requirements.

B. Warranty all lighting and components for one year after acceptance of the work and at no additional cost to the Owner, promptly provide and install replacements for luminaires or components which are defective in materials or workmanship; or repair installed equipment at the job site as necessary to restore first class operating condition. For any time during the warranty period that luminaires are not fully functional due to defects in materials or workmanship, provide, install, and remove suitable temporary lighting. Warrant replacement luminaires in a similar manner for a period of one year following replacement including replacement of defective replacements.

C. Warrant ballasts, batteries, and occupancy sensors as further specified herein.

D. Provide products of firms regularly engaged in the manufacture of interior luminaires or components of similar types and ratings to those required. Such products shall have been in satisfactory use in similar applications for not less than two years.

1.07 DELIVERY, STORAGE AND HANDLING

A. Provide in accordance with Division 01 General Requirements.

B. Deliver luminaires and their components to job site, factory assembled and wired to the greatest extent practical, in strict accordance with approved shop drawings, samples, certificates and catalog cuts.

C. Protect exposed finishes during manufacture, transport, storage and handling; replace damaged materials.

D. Luminaires shall be stored under cover, above the ground, in clean, dry areas, and be tagged and/or marked as to type and site destination.

1.08 SITE CONDITIONS

A. Existing Conditions: per Division 01 General Requirements.

PART 2 – PRODUCTS

2.01 GENERAL

A. Provide lighting fixtures as listed on the Lighting, Lamping, and Fixture Schedule on the drawings and as specified herein that meet the performance and quality standard for that fixture. Substitutes shall be equal in all respects including mechanical, electrical, physical, performance, photometric, and quality characteristics except minor variances in construction details which do not affect overall quality or performance are permitted.

B. Accessories: Provide required accessories for mounting and operation of each luminaire as indicated.

2.02 LUMINAIRES

A. Luminaires shall be weatherproof, heavy duty, outdoor types designed for efficient light utilization, adequate dissipation of lamp and ballast heat, and safe cleaning and re-lamping.

B. Illumination distribution patterns, BUG ratings and cutoff types as defined by the IESNA shall be as shown on the drawings.

C. Incorporate ballasts in the luminaire housing, except where otherwise shown on the drawings.

D. Lenses shall be frame-mounted, heat-resistant, borosilicate glass, with prismatic refractors, unless otherwise shown on the drawings. Attach the frame to the luminaire housing by hinges or chain. Use heat and aging-resistant, resilient gaskets to seal and cushion lenses and refractors in luminaire doors.

E. Lamp sockets for high intensity discharge (H.I.D) fixture shall have locking-type porcelain enclosures in conformance to the applicable requirements of ANSI C81.61-09 and UL 496-08.

F. Pre-wire internal components to terminal strips at the factory.

G. Bracket-mounted luminaires shall have leveling provisions and clamp-type adjustable slip-fitters with locking screws.

H. Materials shall be rustproof. Latches and fittings shall be non-ferrous metal.

I. Provide manufacturer's standard finish, as scheduled on the drawings. Where indicated on drawings, match finish process and color of pole or support materials.

J. Luminaires shall carry factory labels, showing complete, specific lamp and ballast information.

2.03 LAMPS

A. LED sources shall meet the following requirements:

1. Operating temperature rating shall be between -40°C (-40°F) and 50°C (120°F).

2. Correlated Color Temperature (CCT): 3500K

3. Color Rendering Index (CRI): ≥ 85.

4. The manufacturer shall have performed reliability tests on the LEDs luminaires complying with Illuminating Engineering Society (IES) LM79 for photometric performance and LM80 for lumen maintenance and L70 life.

2.04 LED DRIVERS

A. LED drivers shall meet the following requirements:

1. Drivers shall have a minimum efficiency of 85%

2. Starting Temperature: -40°C (-40°F)

3. Input Voltage: 120 to 480 (±10%) volt

4. Power Supplies: Class I or II output

5. Surge Protection: The system must survive 250 repetitive strikes of "C Low" (C Low: 6kV/1.2 x 50 μs, 10kA/8 x 20 μs) waveforms at 1-minute intervals with less than 10% degradation in clamping voltage. "C Low" waveforms are as defined in IEEE/ASNI C62.41.2-2002, Scenario 1 Location Category C.

6. Power Factor (PF): ≥ 0.90

7. Total Harmonic Distortion (THD): ≤ 20%

8. Comply with FCC Title 47 CFR Part 18 Non-consumer RFI/EMI Standards.

9. Drivers shall be reduction of hazardous substances (ROHS)-compliant.

B. Construction

1. Housing: High strength cast aluminum, with high impact polycarbonate cover and tamper proof screws.

2. Face: Aluminum or white painted steel stencil face with green letters, 6" high x 3/4" stroke.

3. Mounting: Wall mounted as indicated.

2.05 TIME SWITCH

A. Digital multi-purpose, 277 volts, 2 channel, 7 day, 365 day advance single and block holiday time switch. Provide switch with battery backup to maintain accurate time for a minimum of 72 hours following power failure. Provide time switch with a manual on-off bypass switch. Housing for the time switch shall be surface mounted, NEMA 1 enclosure conforming to NEMA ICS 6.

2.06 PHOTOCELL SWITCH

A. UL 773 or UL 773A, hermetically sealed cadmium-sulphide cell rated 240 volts ac, 60 hertz with single-throw contacts rated 1000 watts, and 600 volts.

B. Mount switch in a cast weatherproof aluminum housing, with swivel arm mount, in a high impact resistant, noncorroding and nonconductive molded plastic housing, with an EEI-NEMA locking-type receptacle.

C. The switch shall turn on below 3 footcandles and off at 3 to 10 footcandles. A time delay shall prevent accidental switching from transient light sources. Mount a directional lens in front of the cell to prevent fixed light sources from creating a turnoff condition. Aim switch according to manufacturer's recommendations.

2.07 SOURCE QUALITY CONTROL

A. Provide in accordance with Division 01 General Requirements.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Grounding: Ground noncurrent-carrying parts of equipment, including metal poles. Where the copper grounding conductor is connected to a metal other than copper, provide specially treated or lined connectors suitable for this purpose.

B. Field Tests: Upon completion of installation, conduct an operating test to show that the equipment operates in accordance with the requirements of this specification section.

3.02 ADJUSTING AND CLEANING

A. Clean lenses and diffusers at completion of work.

B. Aim adjustable luminaires and lampholders as indicated or as directed.

C. Clean paint splatters, dirt, and debris from installed luminaires.

D. Touch up luminaire and pole finish at completion of work.

E. Re-lamp luminaires which have failed lamps at completion of work.

3.03 FIELD QUALITY CONTROL

A. Provide in accordance with Division 01 General Requirements.

3.04 STARTUP & COMMISSIONING

A. Provide in accordance with Division 01 General Requirements.

3.05 CLOSEOUT ACTIVITIES

A. Provide in accordance with Division 01 General Requirements.

END OF SECTION

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SECTION 31 20 00

EARTHWORK

PART 1 – GENERAL

1.01 SUMMARY OF WORK

A. Provide all excavation, filling, back filling, removal of materials, surface repair and related appurtenances for the Work as specified and as indicated on the Drawings. Earthwork for utilities is included in this section.

1.02 REFERENCES

A. NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

1. NFPA 495: Code for the Manufacturer, Transportation, Storage, and Use of Explosive Materials.

1.03 SUBMITTALS

A. In accordance with Division 01 General Requirements.

B. Reports

1. Provide test reports for all materials which are used as part of the Work. Include material gradations from a certified testing laboratory for all materials.

2. Provide field compaction testing results for fill areas, paved subgrade areas, utility trenches, etc. as specified and as directed by the Engineer for an independent testing laboratory.

1.04 REGULATORY REQUIREMENTS

A. Conform to applicable codes & NFPA 495 for explosive disintegration of rock.

B. Obtain permits from authorities having jurisdiction before explosives are brought to the project site or drilling is started.

1.05 PROTECTION

A. Do not operate equipment on paved surfaces which will cause damage.

B. Maintain excavations with approved barricades, lights, and signs to protect life and property until excavation is filled and graded to a condition acceptable to the Engineer.

C. Protect structures, utilities, sidewalks, pavement, and other facilities from damage caused by settlement, lateral movement, undermining, washout and other hazards created by earthwork operations.

1.06 EXISTING SITE CONDITIONS

A. Data on indicated subsurface conditions are not intended as representations or warranties of accuracy or continuity between soil borings. It is expressly understood that Owner will not be responsible for interpretations or conclusions drawn therefrom by the Contractor. Data is made available for convenience of Contractor. Additional test borings and other exploratory operations may be made by Contractor at no additional cost to the Owner.

B. Demolish and completely remove from the site, all existing underground utilities indicated to be demolished or removed. Provide services of utility companies for shut-off of utilities, services and related systems if lines are active.

C. Provide test pits where shown on the Drawings or as directed by the Engineer. Comply with all requirements of this section and the Contract Documents. Refer to Division 01 regarding measurement and payment procedures for test pits.

D. The use of explosives is not permitted.

PART 2 – PRODUCTS

2.01 GENERAL

A. Suitable Materials: As shown on the Drawings or as specified.

B. Unsuitable Materials: Material containing excessive plastic clay, vegetation, organic matter, debris, pavement, stones or boulders over 6 inches in greatest dimension, frozen material, concrete, pavement, CMU, demolition debris and material which, according to the Engineer, will not provide a suitable foundation or subgrade.

C. On-Site Material: Any suitable material from on-site excavation.

D. Material for embankments and general fills may contain pieces of excavated ledge having a greatest dimension of up to 6 inches if approved by the Engineer.

E. Inspection: The Engineer may inspect off-site sources of materials and order tests of these materials to verify compliance with these Specifications.

F. Materials shall comply with the stricter requirements of City of Portsmouth, NH DOT, or this specification.

2.02 AGGREGATE BASE

A. Hard durable gravel containing only particles passing the 3-inch sieve and equal to NH DOT Item No. 304.3. The material shall have the following sieve analysis by weight:

Sieve Size	% Passing by Weight
3-inch	100
2-inch	95-100
1-inch	55-85
No. 4	27-52
No. 200	0-12

2.03 AGGREGATE SUBBASE (GRAVEL)

A. Hard, durable stone with coarse to fine sand equal to NH DOT Item No. 304.2. All particles shall pass the 6-inch sieve and shall have the following sieve analysis by weight:

Sieve Size	% Passing by Weight
6-inch	100
No. 4	25-70
No. 200	0-12

2.04 SAND

A. All sand shall by per NH DOT Section 209 and meet the following sieve analysis by weight:

Sieve Size	% Passing by Weight
3”	100
No. 4	70-100
No. 200	0-12

2.05 ¾" CRUSHED STONE

A. Durable, clean angular rock fragments obtained by breaking and crushing rock material per NH DOT Section 703 - #67. Sieve analysis by weight shall be as follows:

Sieve Size	% Passing by Weight
1 - inch	100
¾-inch	90-100
3/8-inch	25-55
No. 4	0-10
No. 200	0-5

2.06 2" CRUSHED STONE

A. Durable, clean angular rock fragments obtained by breaking and crushing rock material per NH DOT Section 703 - #357. Sieve analysis by weight shall be as follows:

Sieve Size	% Passing by Weight
2 1/2-inch	100
2-inch	90-100
1-inch	35-70
½-inch	10-30
No. 4	0-5

2.07 REFILL MATERIAL

A. Provide ¾ inch crushed stone for refilling excavation below grade or rock excavation unless otherwise directed by the Engineer.

2.08 COMMON BORROW

A. Earth suitable for embankment construction free from frozen material, perishable rubble, peat and other unsuitable material.

2.09 MOISTURE CONTENT

A. Moisture content shall be sufficient to provide required compaction and stable embankment but not exceeding 4% above optimum as determined using AASHTO T180, method C or D.

2.10 SELECT BACKFILL

A. Use aggregate base as specified above.

2.11 GRANULAR FILL

A. Soil material free from organics, frozen material and other deleterious substances per NH DOT Section 209 and meeting the following gradation:

Sieve Size	% Passing by Weight
3-inch	95-100
No. 4	25-70

2.12 STRUCTURAL FILL

A. Soil for placement adjacent to building foundations (interior and exterior) and exterior foundations and structures shall be a clean, free draining, granular material per NH DOT Section 508 and meeting the following gradation:

Sieve Size	% Passing by Weight
3-inch	100
2-inch	95-100
1-inch	55-85
No. 4	27-52
No. 200	0-12

2.13 RIP RAP

A. Provide sound, durable rock, which will not disintegrate due to exposure to water or weather; angular in shape such as rough, unhewn quarry stone or fragments obtained by blasting, breaking or crushing natural rock. Rounded boulders or cobbles shall not be permitted.

B. Rip Rap: Stone size shall conform to a grain diameter of D_{50} = 6-inch, with a maximum stone size of 12-inch. That is, 50% of the stone, by weight, shall be larger than 6 inches in diameter and 50% of the stone by weight shall be small than 6 inches in diameter.

C. Heavy Rip Rap: Minimum weight of 500 pounds each and at least 50 percent of the stones, by volume, shall exceed 1,000 pounds each.

2.14 WOVEN FILTER FABRIC

A. Provide woven geotextile for applications for subgrade separation and confinement of base materials. Filter fabric shall be composed of high-tenacity polypropylene yarns, which are woven into a stable network such that the yarns retain their relative position. Geotextile shall be inert to biological degradation and resistant to naturally encountered chemicals, alkalis, and acids.

2.15 NON-WOVEN FILTER FABRIC

A. Provide a needle-punched nonwoven geotextile composed of polypropylene fibers, which are formed into a stable network such that the fibers retain their relative position. Geotextile shall be inert to biological degradation and resists naturally encountered chemicals, alkalis, and acids. The geotextile shall meet AASHTO M288-06 Class 2.

B. Provide separation non-woven separation filter fabric as indicated on the Drawings for State Road pipe trench work. Fabric shall be a product of the following manufacturer:

1. TenCate Geosynthetics Americas – Mirafi 160N

2. US Fabrics, Inc. – US 160NW

3. Thrace-Linq – 150EX

PART 3 – EXECUTION

3.01 EXCAVATION – GENERAL

A. Remove all materials encountered to the limits shown on the Drawings, or designated in the Specifications.

B. Do not perform rock excavation or excavation of unsuitable materials until material to be excavated has been cross-sectioned and classified by the Engineer. Predrilling and blasting of bedrock through overburden will not be allowed. However, if this method is used, the rock excavation quantities will be adjusted downward in proportion to the ground swell from this blasting method.

3.02 EARTH EXCAVATION

A. Removal and disposal of pavements and other obstructions visible on ground surface, underground structures and utilities indicated to be demolished and removed, and other materials encountered that are not classified as rock excavation or unauthorized excavation.

3.03 EXCAVATION FOR STRUCTURES

A. Conform to elevations and dimensions shown within a tolerance of plus or minus 0.10', 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. In excavating for footings and foundations, take care not to disturb bottom of excavation. Excavate by hand to final grade just before concrete reinforcement is placed. Trim bottoms to required lines and grades to leave solid base to receive other Work.

3.04 ROCK EXCAVATION

A. Removal and disposal of materials that cannot be excavated without drilling and blasting, or requiring use of special equipment, except such materials that are classified as earth excavation.

1. Typical materials classified as rock are solid rock, rock in ledges, and rock hard cementitious aggregate deposits.

2. Intermittent drilling or ripping performed to increase production and not necessary to permit excavation of material encountered will be classified as earth excavation.

3. Rock excavation shall not include; removal of material which can be removed with a hand pick or power shovel or loose or previously blasted rock or broken stone in rock fills or elsewhere.

B. Rock excavation payment limits shall be in accordance with the following unless otherwise specified or indicated on the Drawings:

1. Two feet outside of concrete Work for which forms are required, except footings and base slabs.

2. Manholes & Precast Concrete Structures: As shown on the Drawings for manholes and precast structures.

3. Pipe & Utility Trenches: As shown on the drawings for piping, utilities including pipe and bedding materials.

4. Concrete Work (No Forms): Neat outside dimensions of concrete Work where no forms are required.

5. Slabs on Grade: 6 inches below bottom of concrete slabs unless otherwise specified or as shown on the Drawings.

3.05 EXCAVATION IN PAVED AREAS

A. Saw cut pavement prior to excavation to provide a clean, uniform edge. Minimize disturbance of remaining pavement. Cut and remove the minimum amount of pavement required to do the Work. Use shoring and bracing where sides of excavation will not stand without undermining pavement.

3.06 EXCAVATION FOR TRENCHES

A. Produce an evenly graded flat trench bottom at the subgrade elevation required for installation of pipe and bedding material. Load excavated material directly into trucks unless otherwise permitted by the Engineer. Place backfill material

directly into trench or excavation. Do not stockpile material to be used as backfill in roadways or along edges of trenches.

3.07 UNAUTHORIZED EXCAVATION

A. Removal of materials beyond indicated subgrade elevations or dimensions without specific direction of the Engineer. Unauthorized excavation, as well as all remedial Work directed by the Engineer including refilling, shall be at the Contractor's expense.

3.08 REFILLING UNAUTHORIZED EXCAVATIONS

A. Trenches: Use crushed stone or gravel as directed by Engineer.

B. Elsewhere, backfill and compact unauthorized excavations as specified for authorized excavations of same classification, unless otherwise directed by the Engineer.

3.09 EXCAVATION OF UNSUITABLE MATERIALS

A. When excavation has reached required subgrade elevations, notify the Engineer who will make an inspection of conditions. If unsuitable bearing materials are encountered at required subgrade elevations, carry excavations deeper as directed by the Engineer and replace excavated material with select backfill.

3.10 MATERIAL STORAGE

A. Stockpile and maintain suitable surplus excavated materials for re-use as backfill anywhere within the Project limits as directed by the Engineer. Place, grade and shape stockpiles for proper drainage. Locate and retain soil materials away from edge of excavations.

3.11 BLASTING

A. Not Applicable.

3.12 STABILITY OF EXCAVATIONS

A. General: Slope sides of excavations to comply with OSHA Regulations and Local Codes. Shore and brace where sloping is not possible due to space restrictions or stability of material excavated. Maintain sides and slopes of excavations in safe condition until completion of backfilling.

B. Refer to Section 31 40 00 SHORING & BRACING for additional shoring and bracing requirements.

3.13 RIPRAP PLACEMENT

A. Place required rip-rap to full depth shown on the Drawings in one operation without special handwork. Depth shall be measured perpendicular to the face of the slope to obtain a uniform appearance true to line and grade. Place larger stones at bottom of slope. Place stones in close contact, with interlocking of face stones and backing stones. Fill openings between stones with smaller rocks or coarse gravel

3.14 BACKFILL AND FILL

A. General: Place acceptable soil material in layers to required elevations as shown on the Drawings and as listed below. Fill, backfill, and compact to produce minimum subsequent settlement of the material and provide adequate support for the surface treatment or structure to be placed on the material. Place material in approximately horizontal layers of beginning at lowest area to be filled. Do not impair drainage.

B. Ground Surface Preparation: Remove vegetation, debris, unsatisfactory soil materials, obstructions, and deleterious materials from ground surface prior to placement of fills. Scarify surfaces so that fill material will bond with existing surface. When existing ground surface has a density less than that specified under "Compaction" for particular area classification, break up ground surface, pulverize, moisture-condition to optimum moisture content, and compact to required depth and percentage of maximum density.

C. Place backfill and fill materials in layers not more than 12 inches in loose depth for material compacted by heavy compaction equipment, and not more than 6" in loose depth for material compacted by hand-operated tampers.

D. Do not place backfill or fill material on surfaces that are muddy, frozen, or contain frost or ice.

E. Place backfill and fill materials evenly adjacent to structures, to required elevations. Take care to prevent wedging action of backfill against structures by carrying material uniformly around structure to approximately same elevation in each lift.

F. Do not allow heavy machinery within 5 feet of structures during backfilling and compacting

G. Backfill excavations as promptly as Work permits, but not until completion of the following:

1. Acceptance of construction of below grade finishes including but not limited to, damp proofing, waterproofing, perimeter insulation, pipe insulation, insulation jacket, etc.

2. Inspection and recording locations of underground utilities.

3. Removal of concrete formwork.

4. 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 approved by the Engineer.

5. Removal of trash and debris.

6. Permanent or temporary horizontal bracing is in place on horizontally supported walls.

7. Backfill cast-in-place concrete structures when the concrete has developed adequate strength. Refer to Division 03 for concrete curing and backfilling requirements.

8. Use care in backfilling to avoid damage or displacement of underground structures and pipe.

9. Backfill under all existing utility pipes crossed by sewer construction with 3/4" crushed stone. The crushed stone back- fill will extend continuously from the bedding of the new sewer to the utility pipe crossed, including a 6" thick envelope of crushed stone all around the existing utility pipes.

10. The 3/4" crushed stone backfill shall stand at its own angle of repose. No "haunching" or "forming" with common fill will be allowed.

H. Backfilling of Trenches shall be in accordance with the trench details on the Drawings. Bed pipe in accordance with details on the Drawings and as specified for the applicable type of pipe. Limits of bedding and requirements for remaining trench backfill shall be as described in the applicable pipe specification or as indicated on the Drawings.

I. Trenches in cross-country runs shall receive surface restoration to existing conditions prior to construction unless otherwise specified or indicated on the Drawings. Mound trench 6 inches above existing grade if required by the Engineer.

J. Replacement of unsuitable materials shall be as previously specified for below normal grade conditions. In above normal grade conditions, replace unsuitable material with suitable stored onsite material. All excess suitable on-site material shall be used before additional off-site material is used. If additional material is required provide Select Backfill.

3.15 COMPACTION

A. Methods: Utilize methods which produce the required degree of compaction throughout the entire depth of material placed without damage to new or existing facilities and which are approved by the Engineer. Adjust moisture content of soil as required. Remove and replace material which is too wet to compact to required density. Compact each horizontal layer of till and slopes as Work progresses.

B. Degree of Compaction: Compact to the following minimum densities unless otherwise specified or indicated on the Drawings:

Fill and Backfill Location	Density (% of maximum, see below)
Under structure foundations	95%
2 feet under pavement and above	95%
2 feet under pavement and below	92%
Trenches through unpaved areas	90%
Embankments (including slopes)	90%
Pipe bedding	92%
Beside structure walls, foundation walls, retaining walls, tank walls	90%
Under pipes through structure fills	90%

1. Maximum Density: ASTM D1557, modified

2. Field Density Tests: ASTM D1556 (sand cone) or ASTM D2167 (rubber balloon), or ASTM D2922 (nuclear methods)

3.16 DENSITY TESTING

A. Determine actual in place densities using field tests as directed by the Engineer. Tests shall be made by an independent laboratory. Perform additional Work to obtain proper compaction if in-place densities do not meet the specified densities. Retesting may be required by the Engineer and shall be at no additional cost to the Owner.

B. The Minimum Number of Tests shall be in accordance with the following criteria:

1. Paved Areas and Building Subgrade: Provide at least one field density test of subgrade for every 2,000 sq. ft. of paved area or building slab, but in no case less than 3 tests.

2. Other Fill Areas: In each compacted fill layer, make one field density test for every 2,000 sq. ft. of overlaying building slab or paved area, but in no case less than 3 tests per fill area.

3. Pipe Trenches: At least one test per 100 linear feet of trench per fill layer.

3.17 GRADING

A. Grading: Provide uniform grading of areas within limits as specified or as indicated on the Drawings, including adjacent transition areas. Smooth finished surface within specified tolerances, compact with uniform levels or slopes between points where elevations are shown, or between such points and existing grades.

B. Grading Outside Structure Lines: Grade areas adjacent to structure lines to drain away from structures and to prevent ponding.

C. Finish surfaces free from irregular surface changes, and as follows:

1. Lawn or Unpaved Areas: Finish areas to receive topsoil to within not more than 0.10' above or below required subgrade elevations.

2. Pavements: Shape surface of areas under pavement to line, grade and cross-section, with finish surface not more than ½ inch above or below required subgrade elevation.

3. Fill Under Slabs: Grade smooth and even, free of voids, compacted as specified, and to required elevation. Provide final grades within a tolerance of ½ inch when tested with a 10 foot straightedge.

D. Compaction: After grading, compact subgrade surfaces to the percentage of maximum density for each area classification.

3.18 MAINTENANCE

A. Protection of Graded Areas: Protect newly graded areas from traffic and erosion. Keep free of trash and debris. Repair and re-establish grades in settled, eroded, and rutted areas to specified tolerances.

B. Reconditioning Compacted Areas: Where completed compacted areas are disturbed by subsequent construction operations or adverse weather, scarify surface, re-shape, and compact to required density prior to further construction.

3.19 DISPOSAL OF EXCESS MATERIALS

A. Remove excess excavated material, and dispose of it in approved spoils areas. Provide removal and disposal of all excess material from the project site.

B. Grade material to the satisfaction of the Engineer and Owner of the property on which the material is deposited.

C. Keep roads free of debris. Use suitable watertight vehicles for hauling wet materials over roads and streets. Clean up materials dropped from or spread by vehicles promptly or when directed by the Engineer.

END OF SECTION

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SECTION 31 40 00

SHORING & BRACING

PART 1 – GENERAL

1.01 DESCRIPTION OF WORK

A. Provide shoring and bracing to protect existing buildings, utilities, structures and other improvements. Provide shoring and bracing to prevent excavations against caving due to unstable soils. Provide shoring and bracing in accordance with OSHA safety requirements of shoring and bracing. Provide measures to dispose of water in excavations accordance with all local, state, and federal regulations. Provide removal and disposal of all shoring and bracing unless otherwise specified or indicated on the Drawings.

B. Shoring and bracing systems include, but are not limited to, movable boxes and sheet piling. Provide movable box systems where a shoring system is required but sheet piling is not called for. Provide sheet piling where a shoring system is required but a moveable box is not sufficient.

1.02 SUBMITTALS

A. In accordance with Division 01 General Requirements.

B. Certificates

1. Provide design and submit shoring and bracing systems sealed by a registered professional Engineer in the state of the project location.

2. Submit certification indicating trench box application recommendations and applications for each trench box. Certifications shall be either sealed by a Professional Engineer registered in the state of the project location or shall be provided by the trench box manufacturer.

1.03 QUALITY ASSURANCE

A. Design of shoring and bracing systems shall be provided by a registered Professional Engineer in State of the Project location. Design of shoring and bracing systems shall comply with local codes and OSHA requirements.

1.04 SITE CONDITIONS

A. Before starting Work, check and verify governing dimensions and elevations. Survey condition of adjoining properties, structures, utilities, etc. with the Engineer. Take photographs, recording any prior settlement or cracking of structures, pavements, and other improvements. Prepare a list of such damages,

verified by dated photographs, and signed by the Contractor, Engineer and others conducting the investigation.

B. Survey adjacent structures and improvements, establishing exact elevations at fixed points to act as benchmarks. Clearly identify benchmarks and record existing elevations. Locate datum level used to establish benchmark elevations sufficiently distant so as not to be affected by excavation operations.

C. During excavation, resurvey benchmarks weekly, employing a licensed Land Surveyor or registered Professional Engineer in the state of the project location. Maintain accurate log of surveyed elevations for comparison with original elevations. Notify Engineer if changes in elevations occur or if cracks, sags or other damage is evident.

PART 2 – PRODUCTS

2.01 MATERIALS

A. General: Provide suitable shoring and bracing materials which will support loads imposed. Materials need not be new, but should be in serviceable condition.

B. Steel sheet piling and shapes (corners, etc.) shall be continuous interlocking type. Provide section modules and type of sections as required by design.

C. Bracing members shall be wood timbers or A36 steel members.

D. Bolts shall be in accordance with ASTM A307.

PART 3 – EXECUTION

3.01 GENERAL

A. Provide shoring and bracing systems to resist earth and hydrostatic pressures, including surcharges from surface loads and construction equipment.

B. Locate shoring and bracing to clear permanent construction and to permit forming and finishing of concrete.

C. Maintain shoring and bracing while excavation is open.

D. Remove systems in stages to prevent disturbance of soils and damage to structures and improvements. Fill voids as soon as sheeting is withdrawn.

3.02 STEEL SHEET PILING AND BRACING

A. Drive sheet piling prior to excavation where possible. Fill and compact voids outside sheeting to hold sides of excavation in place.

B. Brace as required to prevent distortion of piling and other bracing members. If necessary to move a brace, install new bracing prior to removal of original brace.

C. Cut off sheet piling to be left in place at least two feet below finish grade.

END OF SECTION

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SECTION 32 12 16

BITUMINOUS PAVEMENT

PART 1 – GENERAL

1.01 DESCRIPTION OF WORK

A. Provide hot bituminous pavement as specified and as shown on the Drawings, including but not limited to fine grading, temporary and permanent trench paving and new pavement as shown.

1.02 REFERENCES

A. "Standard Specifications for Road and Bridge Construction," latest revision, New Hampshire Department of Transportation (NHDOT).

1.03 SUBMITTALS

A. In accordance with Division 01 General Requirements.

B. Product Data

1. Provide a mix design for each grade of pavement to be used at least 20 days prior to the start of paving.

C. Reports

1. Provide reports that show conformance with NHDOT quality control requirements for pavement and all associated test data.

D. Certificates

1. Provide material certificates signed by the material producer and Contractor stating that each material complies with the requirements as indicated in the Contract Documents.

2. Provide certified weigh slips for each truckload of hot bituminous material.

1.04 SITE CONDITIONS

A. Weather and seasonal limitations shall be per NHDOT Standard Specifications

PART 2 – PRODUCTS

2.01 BASE AND SUB-BASE

A. Refer to Section 31 20 00 EARTHWORK for additional details and requirements regarding base and sub-base.

2.02 HOT BITUMINOUS PAVEMENTS

A. Bituminous pavements shall be in accordance with NHDOT Standard Specifications.

B. Base Course (Binder Course): HMA 19 mm

C. Surface Course, Driveways & Sidewalks (Wearing Course): HMA 12 mm

D. Shims: HMA 4.75 mm

PART 3 – EXECUTION

3.01 AGGREGATE BASE AND SUBBASE

A. General: Do not being paving operations until the base and subbase have been accepted.

3.02 HOT BITUMINOUS PAVEMENTS

A. General: per NHDOT Standard Specifications

B. Base Course: per NHDOT Standard Specifications

C. Surface Course: per NHDOT Standard Specifications

3.03 TEMPORARY PATCHING

A. The Owner may require that the Contractor not leave more than 1,000 linear feet of backfilled trench unpaved at any one time. Place aggregate sub base (gravel) as shown on the Drawings and as specified and provide temporary patching. The cost of this work shall be incidental to the project.

B. Provide a single course of Grading B, flush with existing pavement surface as shown on the Drawings.

3.04 PERMANENT PATCHING

A. Remove temporary pavement. Mechanically saw cut edges of existing pavement to a neat square edge to prevent deterioration of remaining pavement. Re-grade base material and provide compaction.

B. Provide base and surface pavement courses to the depths as shown on the Drawings.

3.05 STATE ROAD PAVEMENT

A. Not Applicable

3.06 PAVEMENT TESTING

A. Pavement testing shall be in accordance with NHDOT Standard Specifications.

END OF SECTION

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SECTION 32 90 00

PLANTING

PART 1 – GENERAL

1.01 SUMMARY

A. Provide landscape development Work as specified and as shown on the Drawings, including but not limited to preparation of sub-grade to receive topsoil, spreading a minimum of 4 inches of topsoil, seeding, watering, fertilizing, hydro seeding, and maintaining seeded areas until acceptance.

1.02 REFERENCES

A. "Standard Specifications for Road and Bridge Construction," latest revision, New Hampshire Department of Transportation (NHDOT).

1.03 SUBMITTALS

A. In accordance with Division 01 General Requirements.

B. Product Data

1. Submit manufacturers or vendors certified analysis for soil amendments and fertilizer materials. Submit other data substantiating that materials comply with requirements indicated in the Contract Documents.

2. Submit seed vendor's certified statement for each grass seed mixture required, stating botanical and common name, percentage by weight, and percentages of purity, germination, and weed seed for each grass seed species.

3. Perform testing of topsoil material from the onsite stockpile and all off site sources to be used, at independent laboratory and submit laboratory reports which state nutrient levels, pH, organic matter content, and recommendations for application rates of lime and fertilizer, for review by the Engineer.

1.04 QUALITY ASSURANCE

A. Analysis and Standards: Package standard products with manufacturers certified analysis. For other materials, provide analysis by recognized laboratory made in accordance with methods established by the Association of Official Agriculture Chemists, wherever applicable. Provide analysis testing.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver grass seed in original containers showing analysis of seed mixture, percentage of pure seed, year of production, net weight, date of packaging, and location of packaging. Damaged packages shall not be acceptable.

B. Deliver fertilizer in waterproof bags showing weight, chemical analysis, and name of manufacturer.

C. Do not remove container grown stock from containers until planting time.

1.06 SITE CONDITIONS

A. Proceed with and complete landscape Work as rapidly as portions of site become available, working within seasonal limitations for each kind of landscape Work required. When conditions detrimental to plant growth are encountered, notify the Engineer prior to planting.

B. Utilities: Locate all underground utilities. Perform Work in a manner which will avoid damage.

C. Plant or install materials during normal planting seasons for each type of landscape Work required.

D. Beginning Work shall mean acceptance of existing conditions.

PART 2 – PRODUCTS

2.01 TOPSOIL

A. Use topsoil stockpiled for re-use in landscape Work. If quantity of stockpiled topsoil is insufficient, provide additional topsoil to complete landscape Work.

B. Provide new topsoil which is fertile, friable, natural loam surface soil found at a depth of not less than 6 inches from the original ground surface, reasonably free of subsoil, clay lumps, brush, weeds and other litter, and free of roots, stumps, stones larger than ½ inch in any dimension, and debris.

C. Obtain topsoil from local sources or from areas having similar soil characteristics to that found at project site. Obtain topsoil only from naturally, well-drained sites where topsoil occurs in a depth of not less than 6 inch. Do not obtain from bogs or marshes.

2.02 SOIL AMENDMENTS

A. Lime: Natural limestone containing not less than 90% total carbonates, ground so that not less than 90% passes a 10-mesh sieve and not less than 50% passes a 100-mesh sieve.

B. Fertilizer: 10-10-10 grade commercial type with 50% of the elements derived from organic sources.

2.03 GRASS MATERIALS

A. Grass Seed: Provide fresh, clean, new-crop seed.

1. Germination: not less than 80%

2. Pure Live Seed: not less than 85%

3. Purity: not less than 85%

4. Weed content: not more than 1%

5. Do not use seed which has become wet, moldy, or damaged.

B. Seed Mixture

1. 45% Creeping Red Fescue

2. 35% Kentucky Bluegrass

3. 20% Perennial Rye grass

4. 5% White Clover

2.04 MISCELLANEOUS LANDSCAPE MATERIALS

A. Anti-Erosion Mulch: Provide clean, seed-free threshed straw of wheat, rye, oats or barley. The use of hay will not be permitted.

B. Erosion Control Mesh: Provide uniform, open weave jute matting or flexible vinyl mat.

C. Landscape Mulch: Provide shredded bark free from deleterious materials and suitable for top dressing of trees, shrubs and plants.

D. Trees: Provide nursery-grown trees, variety to be determined by property Owner with the approval of the Owner. Minimum size shall be five (5) feet tall above root ball or similar maturity for non-deciduous tree. Provide trees with minimum caliper sizes as indicated on the Drawings.

PART 3 – EXECUTION

3.01 PREPARATION - GENERAL

A. Protect existing underground improvements from damage.

B. Remove foreign materials, plants, roots, stones, and debris, from site. Do not bury foreign material.

C. Remove contaminated subsoil.

3.02 PREPARATION OF PLANTING SOIL

A. Mix soil amendments and fertilizers with topsoil. Delay mixing of fertilizer if planting will not follow placing of planting soil within a few days.

B. For pit and trench type backfill, mix planting soil prior to backfilling, and stockpile at site.

C. For grassed areas, mix planting soil either prior to planting or apply on surface of topsoil and mix thoroughly before planting.

D. Mix lime with dry soil prior to mixing of fertilizer.

3.03 PREPARATION FOR PLANTING LAWNS

A. Loosen sub-grade to a minimum of 3 inches. Remove stones over 1-1/2 inches in any dimension, sticks, roots, rubbish and other extraneous matter. Limit preparation to areas which will be planted promptly after preparation.

B. Spread top soil to minimum depth of 4 inches after light rolling and natural settlement. Add specified soil amendments and mix thoroughly into upper 4 inch of topsoil.

3.04 PREPARATION OF UNCHANGED GRADES

A. Where grass is to be planted in areas that have not been altered or disturbed by excavating, grading, or stripping operations, prepare soil for planting as follows:

1. Till to a depth of not less than 6 inches; apply soil amendments and initial fertilizers as specified; remove high areas and fill in depressions; till soil to a homogenous mixture of fine texture, free of lumps, clods, stones, roots and other extraneous matter.

2. Apply fertilizer and lime to loam at least 24 hours before sowing seed, at rates specified and thoroughly mix into upper 2 inches of topsoil. Delay application of fertilizer if lawn planting will not follow within a few days. Do not apply lime and fertilizer together unless applied hydraulically. Application rates shall be as follows:

   a. Lime - 25 pounds per 1,000 ft^2

   b. Fertilizer - 30 pounds per 1,000 ft^2

B. Fine Grade areas to smooth, even surface with loose, uniformly fine texture. Roll and rake and remove ridges and fill depressions, as required to meet finish grades. Limit fine grading to areas which can be planted immediately after grading. Assure positive drainage away from buildings.

C. Moisten prepared areas before planting if soil is dry. Water thoroughly and allow surface moisture to dry before planting lawns. Do not create a muddy soil condition.

D. Restore areas to specified condition if eroded or otherwise disturbed after fine grading and prior to planting.

E. Excavate pits, beds and trenches with vertical sides and with bottom of excavation slightly raised at center to provide proper drainage. Loosen hard subsoil in bottom of excavation.

3.05 SEEDING LAWNS

A. Sow seed using a spreader or seeding machine. Do not seed when wind velocity exceeds 5 miles per hour. Distribute seed evenly over entire area by sowing equal quantity in two directions at right angles to each other. Do not sow immediately following rain or when ground is too dry.

B. Seed application rate: 3 pounds per 1,000 square feet.

C. Rake seed lightly into top 1/8 inch of soil, roll lightly, and water with a fine spray.

3.06 HYDROSEEDING LAWNS

A. Mix specified seed, fertilizer and pulverized mulch in water, using equipment specifically designed for hydro seed application. Continue mixing until uniformly blended into homogenous slurry suitable for hydraulic application.

B. Apply slurry using an approved machine. Seed, fertilizer, lime, and suitable corn fiber mulch may be applied in one operation. Mix materials with water in machine and agitate to keep mixture uniformly suspended. Use spraying equipment which will distribute slurry uniformly at required rates.

C. Immediately following hydro seeding, mulch areas by means of mulch blower at rate of 1,200 pounds per acre on level grades, 2,000 lbs. on slopes if mulch is not part of slurry. Use mulch as previously described in this specification section.

3.07 PROTECTION OF SEEDED SLOPES

A. Protect seeded slopes against erosion with erosion netting or other methods acceptable to the Engineer.

B. Mulch: Spread specified lawn mulch after completion of seeding operations to form a continuous blanket not less than 1-1/2 inch loose measurement over seeded areas.

C. Anchor mulch by spraying with asphalt emulsion at the rate of 10 to 13 gallons per 1,000 ft^2. Take precautions to prevent damage or staining of construction or other plantings adjacent to mulched areas.

D. Cover seeded slopes where grade is 3:1 or greater with jute matting. Roll matting down over slopes without stretching or pulling.

E. Lay matting smoothly on soil surface, burying top end of each section in narrow 6-inch trench. Leave 12-inch overlap from top roll over bottom roll. Leave 4-inch overlap over adjacent section.

F. Staple outside edges and overlaps at 36-inch intervals.

G. Lightly dress slopes with topsoil to ensure close contact between matting and soil.

H. In ditches, unroll matting in direction of flow. Overlap ends of strips 6 inches with upstream section on top.

3.08 RECONDITIONING EXISTING LAWNS

A. Recondition existing lawn areas damaged by Work operations and existing lawn areas where minor re-grading is required.

B. Provide fertilizer, seed or sod and soil amendments as specified for new lawns and as required to provide a satisfactorily reconditioned lawn. Provide new topsoil as required to fill low spots and meet new finish grades.

C. Cultivate bare and compacted areas thoroughly to provide a satisfactory planting bed.

D. Remove diseased and unsatisfactory lawn areas; do not bury into soil. Remove topsoil containing foreign materials resulting from the Contractor's operations.

E. Water newly planted areas and keep moist until new grass has been thoroughly established

3.09 MAINTENANCE

A. Begin maintenance immediately after planting.

B. Maintain lawns for not less than 60 days after Substantial Completion, and longer as required to establish an acceptable lawn if seeded in fall and not given full 60 days of maintenance, or if not considered acceptable at that time, continue maintenance during the following spring until acceptable lawn is established.

C. Maintain lawns by watering, fertilizing, weeding, mowing, trimming, and other operations such as rolling, re-grading and replanting as required to establish a smooth, acceptable lawn, free of eroded or bare areas.

3.10 PLANTING TREES

A. Plant in accordance with nursery recommendations including soils, depth of burial, fertilizer, mulch, water, and stakes.

B. Maintain including watering as needed to ensure tree survives the first winter season following planting.

3.11 CLEANUP AND PROTECTION

A. Keep all pavements clean. Maintain protection during installation and maintenance periods. Restore pavement, grassed areas and planted areas damaged during execution of the Work of the Contract Documents.

3.12 INSPECTION AND ACCEPTANCE

A. Landscape Work may be inspected for acceptance in parts agreeable to the Engineer, provided the Work offered for inspection is complete, including maintenance. Replace rejected Work and continue specified maintenance until re-inspected by the Engineer and found to be acceptable. Remove rejected plants and materials promptly from the project site.

END OF SECTION

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SECTION 33 31 00

SANITARY UTILITY SEWERAGE PIPING

PART 1 – GENERAL

1.01 DESCRIPTION OF WORK

A. Provide new sanitary sewer, storm drain and pressure piping systems as specified and as indicated on the Drawings. The Work shall include but is not limited to sanitary sewer piping, wastewater force main pressure piping, sewer services, storm drains, culverts, under drains and drain piping. Provide all related appurtenances including but not limited to pipe fittings, thrust blocks, restraints, pipe supports, couplings and related items for complete systems.

B. The piping included in this specification section may or may not all be required for the work outlined in the Contract Documents. Provide all piping that is indicated on the Drawings, is specified, and/or is required to complete the work outlined in the Contract Documents.

1.02 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. Unless otherwise noted, the most recent version of the listed publications, including revisions, at time of bid opening shall apply.

B. AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

1. AASHTO M 252 (2009) Standard Specification for Corrugated Polyethylene Drainage Pipe

2. AASHTO M 294 (2009) Standard Specification for Corrugated Polyethylene Pipe, 300- to 1500-mm Diameter

C. ASTM INTERNATIONAL (ASTM)

1. ASTM D 3350 (2010) Polyethylene Plastics Pipe and Fittings Materials

2. ASTM D 3034 (2008) Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings

3. ASTM D 3212 (2007) Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals

4. ASTM F 477 (2008) Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe

5. ASTM F 405 (2005) Corrugated Polyethylene (PE) Tubing and Fittings

D. AMERICAN WATER WORKS ASSOCIATION (AWWA)

1. AWWA C104/A21.4 (2008; Errata 2010) Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water

2. AWWA C110/A21.10 (2008) Ductile-Iron and Gray-Iron Fittings for Water

3. AWWA C111/A21.11 (2007) Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings

4. AWWA C150/A21.50 (2002; Errata 2003; 2008) Thickness Design of Ductile-Iron Pipe

5. AWWA C151/A21.51 (2009) Ductile-Iron Pipe, Centrifugally Cast, for Water

6. AWWA C906 (2007) Polyethylene (PE) Pressure Pipe and Fittings, 4 In. (100 mm) through 63 In., (1,575 mm) for Water Distribution and Transmission

1.03 SUBMITTALS

A. In accordance with Division 01 General Requirements.

B. Product Data

1. Provide Manufacturer's descriptive data, technical literature, catalog cuts, and installation instructions. Product data shall also include dimensional data for each type of pipe, tube, and fitting.

2. Prior to shipment of pipe, submit a certified affidavit of compliance from the pipe Manufacturer stating that the pipe, fittings, gaskets, linings and exterior coatings for this project have been manufactured and tested in accordance with AWWA and ASTM standards as well as the requirements specified herein.

C. Reports

1. The Contractor shall submit test reports for each section of piping tested for pressure and leakage.

2. Construction Records: Record depth and location of the following:

a. Sewers

b. Service capped ends, cleanouts, bends in services, connection points to sewer main.

c. Repairs to existing pipes.

d. Force Main Pressure Piping

e. Keep all records neatly in a dedicated field notebook. Transfer to Drawings and submit to Engineer at Substantial Completion. Provide access to records for the Engineer at all times.

1.04 QUALITY ASSURANCE

A. Provide removal and disposal of all damaged pipe from the project site.

B. All piping utility work shall be in accordance with City of Portsmouth and NHDOT requirements.

1.05 SITE CONDITIONS

A. Refer to drawings.

PART 2 – PRODUCTS

2.01 PIPE AND FITTINGS - GENERAL

A. Unless otherwise indicated, all fittings and appurtenances shall be of the same type and grade of materials as the connecting pipe. All products provided under this section shall conform to current AWWA and ANSI specifications as appropriate to the type of pipe specified.

B. Provide commercially manufactured wyes or tees for service connections. Fittings shall have single piece gasket.

2.02 CULVERTS & STORM DRAINS

A. Provide culverts, culvert replacement and storm drain piping as specified and as indicated on the Drawings. Pipe and fittings shall be corrugated exterior polyethylene drainage pipe, smooth wall interior, highway grade in accordance with AASHTO M294 and ASTM D3350.

B. Pipe shall be joined using a bell & spigot joint meeting AASHTO M252, AASHTO M294, or ASTM F2306. The joint shall be soil-tight and gaskets, when applicable, shall meet requirements of ASTM F477. Gaskets shall be installed by the pipe manufacturer and shall be covered with a removable wrap to ensure the gasket is free from debris. A joint lubricant supplied by the manufacturer shall be used on the gasket and bell during assembly.

C. Fittings shall conform to AASHTO M252, AASHTO M294, or ASTM F2306. Bell and spigot connections shall utilize a spun-on or welded bell and valley or saddle

gasket meeting the soil-tight joint performance requirements of AASHTO M252, AASHTO M294 or ASTM F2306.

D. Virgin material for pipe and fitting production shall be high-density polyethylene conforming with the minimum requirements of cell classification 424420C for 4 inch through diameters, and 435400C for 12 inch through 60 inch diameters, as defined and described in the latest version of ASTM D3350, except that carbon black content should not exceed 4%. The 12- through 60-inch virgin pipe material shall comply with the notched constant ligament-stress (NCLS) test as specified in Sections 9.5 and 5.1 of AASHTO M294 and ASTM F2306 respectively.

E. High density polyethylene storm drain and culvert piping shall be a product of the following manufacturer:

1. Hancor, Inc. – Surelock

2. ADS, Inc. - N-12 WT IB

3. Engineer Approved Equal

2.03 GRAVITY SEWER PIPE & FITTINGS – TYPE (PVC/5)

A. PVC, SDR 35 in accordance with ASTM D3034 for sizes 4 inch to 15 inch and ASTM F679 for sizes 18 inch to 48 inch. Pipe and fittings shall be PVC in accordance with ASTM D1784 Cells Class 12454 or 12364. Gaskets shall be Nitrile (NBR/Buna-N) in accordance with ASTM F477. Joints shall be push-on integral bell and spigot in accordance with ASTM D3212. Pipe stiffness shall be in accordance with ASTM D2412 with $F/\Delta Y = 46$ psi or 115 psi. Provide factory pre-fabricated wyes and fittings which match the properties of the connecting pipe. All gravity sewer piping shall be a product of the following manufacturer:

1. J-M Manufacturing Company – Ring-Tite

2. North American Pipe Corporation

3. Engineer Approved Equal

2.04 DUCTILE IRON PIPE & FITTINGS – TYPE (DI/2)

A. Class 350 mechanical joint pipe and fittings for buried applications per AWWA C151/A21.51 standards. Refer to Section 40 05 13.01 PROCESS PIPE AND FITTINGS for additional requirements.

2.05 DUCTILE IRON PIPE & FITTINGS – TYPE (DI/3)

A. Class 350 push on joint pipe and fittings for buried applications as per AWWA C151/A21.51 standards. Refer to Section 40 05 13.01 PROCESS PIPE AND FITTTINGS for additional requirements.

2.06 PERFORATED UNDERDRAIN PIPE & FITTINGS

A. Provide non-pressure perforated PVC piping for underdrain applications as specified and as indicated on the Drawings. Piping shall be perforated PVC, per ASTM D3034 or ASTM D3033, SDR 35, with push-on joints per ASTM D3212 and gaskets per ASTM F-477.

2.07 HIGH DENSITY POLYETHYLENE PRESSURE PIPE – TYPE (PE/4)

A. High Density Polyethylene (HDPE) Pressure Pipe, DR-11, PE 3408 pipe with Iron Pipe Size (IPS) or Ductile Iron Pipe Size (DIPS) outside diameter as indicated on the Drawings. Refer to Section 40 05 13.01 PROCESS PIPE AND FITTTINGS for additional requirements.

2.08 PVC PRESSURE PIPE & FITTINGS – TYPE (PVC/6)

A. PVC Pressure Pipe - (Type PVC/6): Pipe, couplings and fittings shall be manufactured of materials conforming to ASTM D 1784, Class 12454B. Pipe shall conform to AWWA C900 or AWWA C905-10 standards and shall be plain end or gasket bell end, Pressure Class 235 psi (FM 150 psi), (DR-18), with ductile-iron-pipe-size (DIPS)-equivalent outside diameter. Fittings shall be PVC with push-on joint ends. All pipe bells shall incorporate gaskets which meet the requirements of ASTM F477. All gaskets shall be locked into the pipe bell. The assembled joint shall meet the requirements of ASTM D3139 standards. Pipe shall be designed for pressurized wastewater applications. All PVC pressure pipe shall be a product of the following manufacturer:

1. J-M Manufacturing Company

2. North American Pipe Corporation

3. Engineer Approved Equal

2.09 CLAY DAM DRAIN PIPE

A. Provide corrugated polyethylene drainage pipe, highway grade, AASHTO M 252, ASTM F 405-74 as shown on the Drawings or directed by the Engineer. Clay dam drain pipe may also be TYPE (PVC/5) SDR 35 pipe and fittings. Provide stainless steel rodent screen for daylight pipe end termination as indicated on the Drawings.

2.10 COUPLINGS

A. Provide couplings, adapters and fittings for pipe transitions as specified and as indicated on the Drawings. Refer to Section 40 05 13.02 PROCESS PIPE COUPLINGS AND CONNECTORS for additional details and requirements.

2.11 NON-WOVEN FILTER FABRIC

A. In accordance with Section 31 20 00 EARTHWORK.

2.12 DETECTABLE UNDERGROUND MARKING TAPE

A. Provide four (4) inch wide detectable underground metallic marking tape for all buried utilities including but not limited to force main pressure piping and gravity sewer piping systems. Provide detectable marking tape as follows:

1. Gravity Sewer Systems - Detectable tape shall be green and shall read "Caution - Buried Sewer Line Below".

2. Sanitary Pressure Piping Systems - Force Mains - Detectable tape shall be brown and shall read "Caution - Buried Force Main Below".

B. Underground marking tape shall be detectable marking tape, with a minimum 5.0 mil overall thickness. Tape shall be manufactured using a 0.8 mil clear virgin polypropylene film, reverse printed and laminated to a 0.35 mil solid aluminum foil core, and then laminated to a 3.75 mil clear virgin polyethylene film. Tape shall be printed using a diagonally striped design for maximum visibility, and meet the APWA Color-Code standard for identification of buried utilities.

2.13 TRENCH DAMS

A. Provide trench dams (trench baffles) as specified and as indicated on the Drawings for utility piping systems. Trench dams shall only be used with permission of the Engineer where specifically indicated on the Drawings. Baffles shall be self-supporting and provide a watertight seal around the pipe by use of an appropriately sized elastomeric PVC flexible coupling. Baffles shall form an impenetrable barrier in the pipe envelope to the flow of water. Baffles shall be constructed of ABS or PVC plastic. Baffles shall be designed and constructed in accordance with the following:

1. Specific Gravity: 1.05, per ASTM D 792

2. Izod Impact: 6.0 ft-lbs/inch at 73^0F, per ASTM D 256

3. Tensile Strength: 4,800 psi, per ASTM D 638

4. Tensile Modulus: 280,000 psi, per ASTM D 638

5. Flexural Strength: 7,000 psi, per ASTM D 790

6. Flexural Modulus: 300,000 psi, per ASTM D 790

7. Deflection Temperature: 190^0F, per ASTM D 648

8. Gardner Gloss: 10-15% at 60^0 Angle, per ASTM D 523

9. Hardness: 85 Rockwell R, per ASTM D 785

2.14 THRUST BLOCKS

A. Provide concrete thrust blocks at all pressure pipe fittings as specified, as indicated on the Drawings and as directed by the Engineer. Thrust blocks shall be 3,000 psi (minimum) compressive strength concrete. Cast-in-place concrete thrust blocks shall be ready mixed concrete from a concrete truck. Pre-cast concrete thrust blocks shall also be acceptable. Refer to the Drawings for additional details and requirements.

2.15 RIGID INSULATION

A. Provide rigid insulation as specified, as indicated on the Drawings or as directed by the Engineer. Insulation shall be 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 C 578. Insulation shall have a minimum compressive strength of 25 psi. Insulation shall conform to the following properties:

1. Thermal Resistance: 5.0 ft^2-h-^{0}F/Btu, per ASTM C 518 & ASTM C 177

2. Compressive Strength: 25 psi (minimum), per ASTM D 1621

3. Water Absorption: 0.3% by volume, per ASTM C 272

4. Water Vapor Permeance: 0.8 perms, per ASTM E 96

5. Maximum Use Temperature: 165 ^{0}F

6. Coefficient of Linear Expansion: $3.5x10^{-5}$ in/in-^{0}F, per ASTM C 203

7. Insulation Type: V, per ASTM C 578

B. Provide 4-inch minimum compacted sand layers directly above and below insulation, or as directed by the Engineer.

PART 3 – EXECUTION

3.01 INSTALLATION OF GRAVITY SEWER PIPE

A. Install gravity sewer pipe and fittings in accordance with manufacturer's recommendations and the trench details as indicated on the Drawings. Use a laser beam for line and grade unless otherwise permitted by the Engineer. Secure each length of pipe with bedding before placing next length. Plug open ends of pipe when Work is suspended. Bed pipe as shown on the Drawings. Provide 30-inch minimum cover over the top of PVC pipe before the trench is wheel-loaded.

B. Lay pipe to alignment and grade shown on the Drawings. If grade is not shown, determine elevations of start and finish points for each run of pipe. Lay pipe to a uniform grade between these points. Line and grade may be adjusted by the Engineer as required by field conditions. Unless otherwise specified, indicated on the drawings or directed by the Engineer, provide a clay dam for every 10 vertical feet of piping elevation change.

C. Lay pipe in the dry. Do not use installed pipe to remove water from work area.

D. Flush all piping and remove all debris. Flushing method used shall be approved by the Engineer. Gravity flushing shall not be acceptable. Provide all labor, water, pumps and related appurtenances for pipe flushing.

E. Connections to manholes and catch basins: Provide short length of pipe so that joints are located within 3 feet of inside surface of manholes and catch basins for piping other than PVC pipe.

F. Unless otherwise specified or indicated on the Drawings residential house service pipe and fittings shall be six (6) inch. Provide larger service connections as indicated on the Drawings. Depth and location of service shall be as specified or as indicated on the Drawings unless otherwise directed by the Engineer in the field. Provide pre-fabricated tee/wye or wye fittings on main line pipe. Extend services to right of way line or as indicated on the Drawings. Cap and stake ends of new services. Provide stake which extends from cap to one (1) foot above ground surface. Provide assistance and labor to Engineer in measurement of pipe installed and in obtaining swing ties to ends of leads.

G. Provide pre-cast sewer chimneys as specified and as indicated on the Drawings. Install chimneys in accordance with the manufacturer's instructions. Provide services of a Manufacturer's representative to provide a one day site visit to assist and instruct in the proper installation of sewer chimney products.

H. Provide backwater valves as specified and as indicated on the Drawings. Provide adaptors to transition to solvent weld pipe connection to push-on pipe with flexible adapter.

3.02 INSTALLATION OF FORCE MAIN PRESSURE PIPE

A. Install force main pressure piping in accordance with the manufacturer’s recommendations and the details as shown on the Drawings.

B. Refer to Section 40 05 13.01 PROCESS PIPE AND FITTINGS for additional installation requirements

3.03 UTILITIES TO BE ABANDONED

A. Provide closure of abandoned utilities as specified and as indicated on the Drawings. Provide caps, or watertight plugs on open ends of abandoned

underground utilities which are not indicated to be removed or demolished. Provide closures to withstand hydro-static or earth pressure which may result after ends of abandoned utilities have been closed.

3.04 INSULATION

A. Provide rigid insulation as shown on the Drawings or directed by the Engineer.

3.05 TESTING OF SANITARY SEWERS

A. Test all sanitary sewer pipes after backfilling. Install all house service leads on main line before testing. Perform tests in the presence of the Engineer. A maximum of 1,000 linear feet of pipe may be installed but not tested at any time. Provide low pressure air testing of all gravity sewer piping systems as follows:

1. Plug all ends of sections to be tested.

2. Supply air slowly to the pipe to be tested until the air pressure inside the pipe is 4.0 psi greater than the average back pressure of any groundwater submerging the pipe.

3. Disconnect air supply and allow a minimum of two minutes for stabilization of pressure.

4. Following stabilization period measure drop in pressure over the test period based on piping size.

Nominal Pipe Size (Inches)	Test Period (Minutes)
4	4
6	4
8	6
10	6
12	7
15	8
18	9
21	11
24	13

5. Acceptable Drop: Pressure drop shall not exceed more than 1.0 psi.

B. Deflection Test for PVC Gravity Sewer Pipe: Provide testing of all pipe with "GO-NO-GO" gauge (mandrel test) allowing a 5% maximum deflection.

C. Special Testing for Gravity Sewer Replacing Existing Sewer: For all new sewer replacing existing sewer and requiring an immediate tie-in of existing services, provide sewer TV inspection and joint testing services per NASSCO specifications. Provide two (2) DVD copies of inspections to the Engineer upon

completion of testing: Provide TV work during low flow periods (1:00 a.m.- 4:00 a.m.) unless otherwise directed by the Engineer.

D. Provide repair and retesting of all piping systems which do not pass tests using materials and methods approved by the Engineer.

3.06 TESTING OF FORCE MAIN PRESSURE PIPING

A. Testing of force main pressure piping systems shall be as indicated in Section 40 05 13.01 PROCESS PIPE AND FITTINGS.

END OF SECTION

SECTION 33 39 13

SANITARY UTILITY SEWERAGE MANHOLES

PART 1 – GENERAL

1.01 DESCRIPTION OF WORK

A. Provide all materials, tools, equipment, and labor necessary to manufacture install and test; precast concrete and precast concrete manhole structures complete with steps, frames, covers, and stainless steel anti-buoyancy hardware as specified herein and as shown on the Drawings. Provide precast concrete manholes and precast concrete items as shown on the Drawings and as specified herein including but not limited to precast manholes, precast catch basins, inverts, risers, frames, covers, grates, hatches and anti-flotation slabs.

1.02 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. Unless otherwise noted, the most recent version of the listed publications, including revisions, at time of bid opening shall apply.

B. AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

1. AASHTO M 198 - Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants

C. ASTM INTERNATIONAL (ASTM)

1. ASTM C 270 (2008a) Standard Specification for Mortar for Unit Masonry

2. ASTM C 139 (2005) Standard Specification for Concrete Masonry Units for Construction of Catch Basins and Manholes

3. ASTM A 36/A 36M (2008) Standard Specification for Carbon Structural Steel

4. ASTM A 48/A 48M (2003; R 2008) Standard Specification for Gray Iron Castings

5. ASTM B 26/B 26M (2009) Standard Specification for Aluminum-Alloy Sand Castings

6. ASTM C 32 (2009) Standard Specification for Sewer and Manhole Brick (Made from Clay or Shale)

7. ASTM C 478 (2009) Standard Specification for Precast Reinforced Concrete Manhole Sections

8. ASTM C 139 Concrete Masonry Units for Construction of Catch Basins and Manholes

9. ASTM C 913 (2008) Standard Specification for Precast Concrete Water and Wastewater Structures

1.03 SUBMITTALS

A. In accordance with Division 01 General Requirements.

B. Shop Drawings

1. Show components to be used, elevations of top of precast sections, base and pipe inverts, rim elevation, location of pipe penetrations, and steps for each manhole. Verify finish grade elevation at each proposed manhole location.

2. Record as-built structure information neatly in a permanently bound notebook and submit at Substantial Completion. Provide access to records for Engineer at all times. Submit copies to Engineer on a weekly basis. Record information on as-built structure locations.

C. Product Data

1. Provide Manufacturer's descriptive data, technical literature, catalog cuts, and installation instructions. Product data shall also include dimensional data for each structure. Provide product data for manholes, joint sealants, catch basins, inverts, risers, frames, covers, grates and frost barriers.

D. Reports

1. Submit leakage test reports for each structure.

2. Record and submit as-built information in accordance with Section 33 31 00 SANITARY UTILITY SEWERAGE PIPING. Provide the following:

a. Location and rim elevations of all precast concrete structures.

b. Locations and invert elevations of all pipe penetrations

E. Certificates

1. Provide design of all precast structures including anti-flotation slabs. Provide the precast structures requiring anti-flotation slabs as one complete unit. Submit a certificate of design signed by a Professional Engineer, registered in the State of the project location with five (5) years minimum experience in the design of similar structures. The design Engineer shall

certify that all precast structures including the anti-flotation slabs, whether provided separately or as a monolithic unit, have been designed to withstand all forces including soil, traffic and hydrostatic loads in accordance with all applicable laws, regulations, rules and codes.

1.04 QUALITY ASSURANCE

A. Provide complete manhole and precast concrete structures capable of supports AASHTO H20 loading. All precast concrete shall comply with ASTM C 913-07a.

B. Precast Concrete shall comply with ASTM C 913 "Precast Concrete Water and Wastewater Structures".

C. Precast Manhole Components shall comply with ASTM C 478.

PART 2 – PRODUCTS

2.01 MANHOLES & STRUCTURES – GENERAL

A. Base Sections: Precast monolithic construction with steps

B. Barrel Sections: Precast with steps

C. Top Sections: Precast eccentric cone top as shown on Drawings. Provide flat top structures as specified and as indicated on the Drawings. Substitution of flat top structures for eccentric cones shall only be allowed with written approval of the Engineer.

2.02 PRE-CAST CONCRETE

A. All concrete used for precast concrete structures shall conform to the following design criteria and conditions:

B. Concrete compressive strength shall be 5,000 psi (minimum) after 28 days.

C. Unless otherwise specified or indicated on the Drawings the minimum concrete structure thickness shall be 6 inches. Provide increased thicknesses to accommodate loadings from vehicles or mechanical equipment. Provide increased thicknesses to accommodate H20 load ratings.

D. Portland cement shall be Type II conforming to ASTM C 150 standards.

E. Fine aggregate shall consist of natural sand conforming to ASTM C 33 standards.

F. Coarse aggregate shall consist of well graded crushed stone conforming to ASTM C 33.

G. Air entrainment admixture shall conform to ASTM C 260. The air-entrained content shall be not less than 4 percent, nor greater than 7 percent.

H. A superplasticizer shall be used and shall conform to ASTM C 494 type F or G. Concrete shall be placed at a slump of between 5 and 8 inches.

I. Minimum cement content shall be 564 pounds per cubic yard.

J. Provide a trowel finish on all floors.

K. Structures shall be designed to resist soil loads, surcharges, and buoyant forces.

L. Concrete Fillet: Minimum 3,000 psi concrete.

2.03 REINFORCEMENT

A. All concrete reinforcement shall conform to the following design conditions and criteria:

1. Minimum reinforcing steel yield stress shall be 40,000 psi.

2. Minimum concrete cover over reinforcing bars shall be 1-1/2 inch.

3. Wire fabric shall conform to the requirements of ASTM A 185.

4. Reinforcing bars shall be new billet steel, deformed, conforming to the requirements of ASTM A 615, Grade 60.

2.04 BRICK & MORTAR

A. Sewer Brick: ASTM C 32, Grade SS, hard brick

B. Concrete Masonry Units: Conform to ASTM C 139

1. Portland cement shall conform to ASTM C 150. Sand shall conform to ASTM C 144. Hydrated lime shall conform to ASTM C 207.

2. Use Type II Portland cement, Type S Lime

3. Portions for Mortar are 1 part Portland cement, ¼ part hydrated lime, 3 to 3-¾ parts sand.

2.05 STEPS

A. Steps shall be constructed of aluminum or steel reinforced copolymer polypropylene conforming to ASTM C 478, cast-in-place or installed utilizing inserts approved by the Engineer. All steps shall be 12 inches on center with abrasive step surface and safety edge, drop front design, one (1) inch diameter and 16 inches wide. Metal items embedded in concrete shall be provided with a bituminous coating.

2.06 JOINTS

A. Pre-cast concrete sections shall be provided with bell and spigot or tongue-in-groove ends to ensure proper connection of the joints. Provide flat joints only where specified or indicated on the Drawings.

B. All joints shall be sealed with a minimum of two rows of butyl rubber sealant. A compatible primer shall be applied as recommended by the manufacturer. All seals shall be applied in accordance with the manufacturer's recommendations. Joint seals shall meet the hydrostatic performance requirements set forth in ASTM C 990, Section 10.1. Sealant properties shall meet or exceed the following criteria:

1. Hydrocarbon Blend Content: 50% (Minimum), per ASTM D4
2. Inert Mineral Filler: 30% (Minimum) by weight, per AASHTO T 111
3. Volatile Matter: 2% (Maximum) by weight, per ASTM D6
4. Specific Gravity: 1.15-1.50, per ASTM D71
5. Ductility: 5.0 (Minimum), per ASTM D 113
6. Penetration Cone: 50-100 mm, per ASTM D 217 at 77 0F, 150 gm. 5 Sec.
7. FED SS-S-210A: No deterioration, no cracking and no swelling after 30 days immersion in 5% solutions of HCl, H_2SO_4, NaOH, KOH, and H_2S

C. Precast structure joint sealants shall be a product of the following manufacturer:

1. Concrete Sealants, Inc. - Conseal CS-102 or CS-202 (Per Temperature)
2. Hamilton Kent – Kent Seal No. 2
3. Press-Seal Gasket Corporation – Pro-Stik
4. Engineer Approved Equal

2.07 PIPE CONNECTIONS

A. Provide seals for all piping penetrations in precast structures as indicated on the Drawings. In cases where the pipe sealing system has not been specifically indicated, provide pre-molded elastomeric (boot type) sealed joints between the pipe and precast sections. Where specified or indicated on the Drawings provide mechanical link type seals for piping penetrations.

B. Pre-molded elastomeric seals shall be manufactured of EPDM with 300 series stainless steel pipe clamps, bands and wedges. Each seal shall also be designed in accordance with the following criteria:

1. Head Pressure: 13 psi for 10 minutes at 00, per ASTM C 923

2. Head Pressure: 10 psi for 10 minutes at 00, per ASTM C 923

3. Deflection: 70, in any direction, per ASTM C 923

4. Load Test: 150 lbs/in pipe diameter, per ASTM C 923

C. All flexible seals shall be a product of the following manufacturer:

1. Trelleborg Pipe Seals, Inc. – Kor-N-Seal

2. A-Lok Products, Inc.

3. Press-Seal Gasket Corporation

4. Engineer Approved Equal

2.08 STAINLESS STEEL CONNECTOR

A. Stainless Steel Connector: Provide 304 stainless steel plate connectors between all manhole sections to prevent frost separation.

2.09 DAMPROOFING & WATER SEALING

A. Provide a two coat bituminous damp-proofing (water sealing) system for all precast structures. All exterior coatings shall conform to ASTM D 1227 and ASTM D 1187 standards. Concrete sealants shall be designed for use both above and below grade. Exterior concrete sealants shall be a product of the following manufacturer:

1. BASF Construction Chemicals, Inc. Hydrocide 600, 700 or 700B

2. Karnak Corporation – 100AF

3. Engineer Approved Equal

2.10 JOINT WRAP

A. Provide exterior joint wrap for all precast structure joints. The joint seal (wrap) shall be manufactured of a self-shrinking EPDM rubber material with a minimum thickness of 30 mils. The back side of the seal shall be coated with a cross-linked reinforced non-hardening butyl adhesive. The sealant shall be a minimum of 30 mils thick. The sealing system shall be designed to stretch entirely around each

structure along the joint and then be overlapped to create a fused bond. The width of the joint wrap shall be 6 inches (minimum) and each wrap shall be overlapped by at least two times the width of the wrap.

B. The butyl component of the tape shall consist of 50% (minimum) butyl rubber and it shall contain 2% or less volatile matter. Provide primer and/or adhesive as recommended by the manufacturer. Joint wrap shall conform to ASTM C 877 (Type III). All joint wrap shall be a product of the following manufacturer:

1. Press-Seal Gasket Corporation – EZ-Wrap

2. Sealing Systems, Inc. – Infi-Shield Gator Wrap

3. Con-Seal – CS-212

4. Engineer Approved Equal

2.11 RISERS (GRADE RINGS)

A. Grade Rings: Provide precast concrete grade rings (if required) to raise rim elevations of the frame and covers.

B. Grade rings of injection-molded HDPE shall also be acceptable.

2.12 FRAMES, GRATES & COVERS

A. Cast Iron: Conform to ASTM A 48/A 48M Class 30

B. Aluminum: Provide alloy number 713.0. Conform to ASTM B 26/B 26M.

C. Carbon Steel: Conform to ASTM A 36/A 36M.

D. Manhole Frames & Covers: Labeled with "SEWER" in 3" high raised letters on cover.

1. Standard Frames & Covers: 24-Inch lid: Model R-1670-A frame and type C cover with self-sealing application by Neenah Foundry or Engineer Approved Equal.

2. Waterproof Frames & Covers: Equal to Model R-1755-F2 frame and type C cover by Neenah Foundry or Engineer Approved Equal.

3. Manhole Frames & Hinged Covers: 24 inch opening, PAMREX frame and cover by Certainteed Corporation or Engineer Approved Equal.

E. Catch Basin Frames & Grates: Provide heavy duty, bicycle safe, cascading type frame & grate equal to Model R-3588 LL by Neenah Foundry or Engineer Approved Equal.

2.13 ANTI-FLOTATION DESIGN

A. Certificate of Design: The Contractor shall be responsible for design of all precast structures including anti-flotation slabs and may provide the precast structures requiring anti-flotation slabs as one complete unit. Submit a certificate of design signed by a Professional Engineer, registered in the State the project location and having five (5) years minimum experience in the design of similar structures, certifying that all precast structures including the anti-flotation slabs, whether provided separately or as a monolithic unit, have been designed to withstand all forces including soil, traffic and hydrostatic in accordance with all applicable laws, regulations, rules and codes.

B. Each structure shall be designed with a minimum factor of safety of 1.15 against buoyancy with an assumed flood elevation at the top of the structure. Frictional resistance in this calculation shall not be permitted. Where the structure is composed of successive vertical segments, the weight of the segments shall be such as to provide the same factor of safety for buoyancy, or stainless steel mechanical connections shall be used to connect the segments together. The design shall include positive anchorage to a reinforced concrete anti-buoyancy slab of the required size.

2.14 DESIGN LOADS

A. Unless otherwise specified or indicated on the Drawings, the design shall meet the requirements of AASHTO HB-17, including a HS-20 vehicle load. A lateral vehicle surcharge load of 125 psf shall be applied. Unless otherwise specified or indicated on the Drawings, water and wastewater structures shall be designed for the loads prescribed in ASTM C 890. Unless otherwise specified or indicated on the Drawings, utility structures shall be designed for the loads prescribed in ASTM C 857.

B. The equivalent lateral fluid pressure shall be 100 psf/lf below flood and/or the design groundwater elevation and 60 psf/lf above such elevation. The specified lateral vehicle surcharge load shall be added to this load.

2.15 MISCELLANEOUS

A. Frost Barrier: U.V.-resistant, high grade polyethylene, minimum thickness, 6 mils

B. Butyl Rubber Caulking: Conform to AASHTO M 198, Type B. Provide butyl rubber caulking at all manhole frames and covers as shown on the Drawings and as directed by the Engineer.

PART 3 – EXECUTION

3.01 INSTALLATION OF MANHOLES

A. Placement: Place precast bases on compacted bedding material so bottom of structure is plumb, and pipe inverts are at proper elevations. Place barrel and top sections in the appropriate height combinations. Plug all lifting holes inside and out with non-shrink grout. Fill below structure with 3,000 psi concrete, if required. Lay pipe to alignment and grade shown on the Drawings. If grade is not shown, determine elevations of start and finish points for each run of pipe. Lay pipe to a uniform grade between these points. Line and grade may be adjusted by the Engineer as required by field conditions. Install a mechanical water stop for every 10 vertical feet of sewer main elevation change.

B. Joints: Follow the manufacturer's instructions for sealing joints between precast sections. Provide two rings of 1-inch diameter butyl rubber sealant and joint wrap.

C. Frames and Covers

1. Set to final grade as shown on the Drawings. Unless otherwise specified or indicated on the Drawings frames and covers shall be set with a tolerance of 0 inches above pavement grade, and 1/4 inch below pavement grade (maximum). For cross-country areas, frames and covers shall be set above grade as indicated on the Drawings. Provide adequate temporary covers to prevent accidental entry until final placement of frame and cover is made.

2. Provide two rings of 1-inch diameter butyl rubber sealant between frame and chimney joints. Provide downward force to frame so as to compress the joint, provide a watertight seal, and prevent future settlement. Point compressed joint with butyl rubber caulk sealant.

3. Set manhole frames and covers to final grade only after pavement base course has been applied, or after final grading of gravel roads.

D. Frost Barriers: Wrap each structure to the maximum excavation depth or not less than 7 feet below grade, with a minimum of four layers of 6 mils each of the polyethylene.

1. Clean structure exterior of all dirt and remove any protrusions.

2. Apply a 6-inch wide vertical strip of bituminous waterproofing adhesive from the top of manhole to the greatest excavation depth, but not in excess of 10 feet.

3. Start poly wrap at adhesive strip and proceed around manhole continuously, overlapping adhesive strip a minimum of 24 inches on the final layer.

4. Tuck and pleat poly at top in a continuous manner, minimizing size of folds. Extend poly past top of manhole frame and temporarily tuck remainder inside frame, until final backfill and paving.

5. Paved areas: Cut poly flush with manhole rim after pavement is in place.

6. Unpaved areas: Pull loose ends of poly together, remove excess air and tie off end with galvanized wire. Bury with manhole below grade.

E. Inverts: See detail on Drawings.

F. Steps: Replace any steps that are out of plumb and proper horizontal placement.

3.02 LEAKAGE TESTING

A. General: Tests shall be observed and certified by the Engineer. Structures must be complete for final test acceptance except for shelf and invert brickwork. All pipe connections shall be made prior to testing. Plug all pipes and other openings in the structure walls prior to test. The Contractor shall test all precast concrete manholes as soon as they are installed and before they are backfilled to demonstrate that the work confirms to these specifications.

B. Vacuum Tests for Manholes

1. After the manhole has been constructed, the Contractor shall conduct a Manhole Acceptance Test using the vacuum test procedure in ASTM C1244, except as modified herein.

2. The manhole, regardless of diameter, shall pass if the time for the vacuum to drop from 10 inches of mercury to 9 inches of mercury is greater than:

   a. 2.0 minutes for 0’-10’ deep manholes

   b. 2.5 min for 10’-15’ deep manholes

   c. 3.0 min for 15’+ deep manholes

3. If the vacuum drops in excess of the prescribed rate, the Contractor shall locate the leak, make proper repairs, and retest the structure.

4. If the unit fails the test after repair, the unit shall be water exfiltration tested as directed by the Engineer in accordance with the following.

C. Exfiltration Test

1. Plug pipes into and out of structure and secure plugs.

2. Lower groundwater table (GWT) to below structure. Maintain GWT at this level throughout test. Provide means of determining GWT level at any time throughout test.

3. Fill structure with water to top of structure.

4. Allow a period of time for absorption, to be determined by the Engineer.

5. Refill to top of cone.

6. Determine volume of leakage in an 8 hour minimum test period and calculate rate.

7. Acceptable Leakage Rate: Not more than 1 gallon per vertical foot per 24 hours for manholes and wet wells. Not more than 1/10 of 1 percent of the tank volume in any 24-hour period for storage tanks.

8. The Engineer reserves the right to require an exfiltration test if a vacuum test has failed or cannot be performed.

3.03 REPAIRS

A. Determine the causes of all leaks and repair them. Perform earthwork required for repairs if manhole has already been backfilled.

B. Perform repairs using methods and materials approved by the Engineer.

C. Remove and replace or reconstruct the manhole if necessary.

D. Remove and replace the defective sections if required by the Engineer.

END OF SECTION

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SECTION 40 05 13.01

PROCESS PIPE AND FITTINGS

PART 1 – GENERAL

1.01 SUMMARY

A. Section includes all materials, equipment, and incidentals required for process pipe and fittings complete with all accessories as specified herein and as shown on the Drawings. Unless otherwise indicated, all fittings and appurtenances shall be of the same type, grade, material, and pressure rating as the connecting pipe and conform to current AWWA and ANSI Specifications as appropriate to the type of pipe specified.

1.02 PRICE AND PAYMENT PROCEDURES

A. Measurement and payment requirements per Division 01 General Requirements.

1.03 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. Unless otherwise noted, the most recent version of the listed publications, including revisions, at time of bid opening shall apply.

B. ASME INTERNATIONAL (ASME)

1. ASME A13.1 (1996, E1998) Scheme for the Identification of Piping Systems

2. ASME B1.1 (2003; R 2008) Unified Inch Screw Threads (UN and UNR Thread Form)

3. ASME B16.1 (1998) Cast Iron Pipe Flanges and Flanged Fittings Classes 25, 125, and 250

4. ASME B16.3 (1999) Malleable Iron Threaded Fittings Classes 150 and 300

5. ASME B16.18 (2001; R 2005) Cast Copper Alloy Solder Joint Pressure Fittings

6. ASME B16.26 (2006) Standard for Cast Copper Alloy Fittings for Flared Copper Tubes

7. ASME B16.15 (2006) Cast Bronze Threaded Fittings Classes 125 and 250

8. ASME B1.20.1 (1983; R 2006) Pipe Threads, General Purpose (Inch)

9. ASME B16.9 (2001) Factory-Made Wrought Buttwelding Fittings

10. ASME B16.26 (2006) Standard for Cast Copper Alloy Fittings for Flared Copper Tubes

11. ASME B16.21 (2005) Nonmetallic Flat Gaskets for Pipe Flanges

12. ASME B16.22 (2001) Wrought Copper and Copper Alloy Solder Joint Pressure Fittings

13. ASME B31.1 (2001) Power Piping

C. ASTM INTERNATIONAL (ASTM)

1. ASTM A 53 (2002) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless

2. ASTM A 153/A 153M (2005) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware

3. ASTM A 181 (2001) Standard Specification for Carbon Steel Forgings, for General-Purpose Piping

4. ASTM A 193/A 193M (2008b) Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service

5. ASTM A 197 (2001) Standard Specification for Cupola Malleable Iron

6. ASTM A 234 (2002) Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service

7. ASTM A 240 (2001) Heat-Resisting Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels

8. ASTM A 269 (2008) Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service

9. ASTM A 307 (2007b) Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength

10. ASTM A 312/A 312M (2008a) Standard Specification for Seamless, Welded, and Heavily Worked Austenitic Stainless Steel Pipes

11. ASTM A 380 (2006) Standard Practice for Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment, and Systems

12. ASTM A 47/A 47M (1999; R 2004) Standard Specification for Steel Sheet, Aluminum-Coated, by the Hot-Dip Process

13. ASTM A 479/A 479M (2008) Standard Specification for Stainless Steel Bars and Shapes for Use in Boilers and Other Pressure Vessels

14. ASTM A 733 (2003) Standard Specification for Welded and Seamless Carbon Steel and Austenitic Stainless Steel Pipe Nipples

15. ASTM A 774/A 774M (2006) Standard Specification for As-Welded Wrought Austenitic Stainless Steel Fittings for General Corrosive Service at Low and Moderate Temperatures

16. ASTM A 778 (2001) Standard Specification for Welded, Unannealed Austenitic Stainless Steel Tubular Products

17. ASTM B 117 (2007a) Standing Practice for Operating Salt Spray (Fog) Apparatus

18. ASTM B 61 (2008) Standard Specification for Steam or Valve Bronze Castings

19. ASTM B 62 (2002) Standard Specification for Composition Bronze or Ounce Metal Castings

20. ASTM B 88 (2003) Standard Specification for Seamless Copper Water Tube

21. ASTM C 150 (2007) Standard Specification for Portland Cement

22. ASTM D 1238 (2004c) Melt Flow Rates of Thermoplastics by Extrusion Plastometer

23. ASTM D 1248 (2005) Standard Specification for Polyethylene Plastics Extrusion Materials for Wire and Cable

24. ASTM D 1598 (2002; R 2008) Time-to-Failure of Plastic Pipe Under Constant Internal Pressure

25. ASTM D 1599 (2005) Resistance to Short-Time Hydraulic Failure Pressure of Plastic Pipe, Tubing, and Fittings

26. ASTM D 1784 (1999) Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds

27. ASTM D 1785 (1999) Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120

28. ASTM D 2239 (2003) Standard Specification for Polyethylene (PE) Plastic Pipe (SIDR-PR) Based on Controlled Inside Diameter

29. ASTM D 2467 (2006) Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80

30. ASTM D 2564 (2004e1) Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems

31. ASTM E 96/E 96M (2005) Standard Test Methods for Water Vapor Transmission of Materials

32. ASTM F 402 (1993, R1999) Standard Practice for Safe Handling of Solvent Cements, Primers, and Cleaners Used for Joining Thermoplastic Pipe and Fittings

33. ASTM A 530/A 530M (2004a) General Requirements for Specialized Carbon and Alloy Steel Pipe

34. ASTM A 632 (2004) Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing (Small-Diameter) for General Service

35. ASTM F 493 (2004) Solvent Cements for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe and Fittings

36. ASTM F 593 (2002; R 2008) Stainless Steel Bolts, Hex Cap Screws, and Studs

37. ASTM F 594 (2008) Standard Specification for Stainless Steel Nuts

D. AMERICAN WATER WORKS ASSOCIATION (AWWA)

1. AWWA C104/A21.4 (2003) Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water

2. ANSI/AWWA C110/A21.10 (1998) Ductile-Iron and Gray-Iron Fittings, 3 in through 48 in (75 mm through 1200 mm), for Water and Other Liquids

3. ANSI/AWWA C111/A21.11 (2000) Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings

4. AWWA C110/A21.10 (2008) Ductile-Iron and Gray-Iron Fittings for Water

5. ANSI/AWWA C115/A21.15 (1999) Water Treatment – Flanged Ductile-Iron Pipe With Ductile-Iron or Gray-Iron Threaded Flanges

6. AWWA C115/A21.15 (2005) Flanged Ductile-Iron Pipe With Ductile-Iron or Gray-Iron Threaded Flanges

7. AWWA C150/A21.50 (2002; Errata 2003) Thickness Design of Ductile-Iron Pipe

8. AWWA C151/A21.51 (2009) Ductile-Iron Pipe, Centrifugally Cast, for Water

9. AWWA C906 (2007) Polyethylene (PE) Pressure Pipe and Fittings, 4 In. (100 mm) through 63 In., (1,575 mm) for Water Distribution and Transmission

E. INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (ISO)

1. ISO 228-1 (2000) Pipe Threads Where Pressure-Tight Joints Are Not Made on The Threads - Part 1: Dimensions, Tolerances and Designation

F. MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

1. MSS SP-58 (2002) Standard for Pipe Hangers and Supports - Materials, Design and Manufacture

2. MSS SP-89 (2003) Pipe Hangers and Supports - Fabrication and Installation Practices

3. MSS SP-69 (2003; R 2004) Standard for Pipe Hangers and Supports - Selection and Application

1.04 ADMINISTRATIVE REQUIREMENTS

A. Per Division 01 General Requirements.

1.05 SUBMITTALS

A. Submit in accordance with Division 01 General Conditions

B. Product Data

1. Provide manufacturer's descriptive data, technical literature, catalog cuts, and installation instructions for each type of process pipe and fitting. Provide spare parts data for each different item of material and equipment specified, after approval of the detail Drawings and not later than one month prior to the date of beneficial occupancy.

2. Prior to shipment of pipe, submit a certified affidavit of compliance from the pipe manufacturer stating that the pipe, fittings, gaskets, linings and exterior coatings for this Project have been manufactured and tested in accordance with AWWA and ASTM standards as well as the requirements specified herein.

C. Shop Drawings

D. Samples and Mockups: as specified in Article 1.06.

E. Certificates

F. Design Data/Submittals

G. Sample Test Reports and Evaluations

H. Manufacturer Instructions

I. Source and Field Quality Control Submittals

J. Manufacturer Reports

K. Qualification Statements

1. Submit qualifications of personnel responsible for welding of HDPE pipe and evidence of manufacturer training on HDPE welding procedures.

L. Closeout and Maintenance Material Submittals: per Division 01 General Requirements.

1.06 QUALITY ASSURANCE

A. Inspect pipe after delivery on Site. All piping shall be subject to rejection at any time on account of failure to meet that which is outlined in the Contract Documents. Pipe which has been rejected after delivery shall be specifically marked for "non-use" and shall be removed from the Site at no additional cost. The acceptance of manufacturer's pipe samples prior to shipment shall not be equal to the Engineer's acceptance of all piping delivered to the Site.

B. All welding shall be conducted under qualified welding procedures. All welders and operators shall be certified in accordance with the latest applicable AWS and ANSI codes for shop and Project Site welding of piping Work. Provide written proof of certifications upon request from the Engineer.

C. All piping systems, components, and appurtenances in contact with potable water (including potable water during any stage of treatment or conditioning) shall be certified to meet the requirements of ANSI/NSF 61 for water service.

1.07 DELIVERY, STORAGE AND HANDLING

A. Protect pipe at all times from the weather, sunlight, excessive humidity, extreme temperatures, dirt, dust and/or other damage. Where possible, store pipe inside and protected from weather. Where necessary to store outside, follow manufacturers' instructions for protection, including but not limited to elevating above grade and enclosing with durable, waterproof wrapping. Protect flanges and fittings from moisture and dirt. Any material found to be damaged shall be replaced. Exercise extra care when handling cement lined pipe. Damage to the interior lining of piping shall render it unfit for use.

B. Unload all piping in accordance with the manufacturer's recommendations. Use padding on all hooks, slings, and pipe tongs used for unloading so as to prevent damage to the piping, its exterior coating and interior lining. Dropping of pipe during unloading shall not be acceptable. Do not skid piping against stationary piping during unloading or stacking.

C. Stack piping in accordance within the limits recommended by its manufacturer. The bottom row of the piping stack shall be elevated from the ground surface on timbers, rails, or concrete as recommended by the manufacturer.

D. The interior of all piping and fittings shall be kept clean and free from dirt or other foreign material at all times. Utilize suitable caps or wrapping to prevent entry of dirt or foreign material into the piping.

E. A material safety data sheet in conformance with 29 CFR 1910 Section 1200(g) shall accompany each chemical products delivered for use in pipe installations. At a minimum, this includes all solvents, solvent cements, glues and other materials that may contain hazardous compounds. Handling of chemicals for piping installation shall be in accordance with ASTM F 402 standards.

F. Plastic pipe shall be packed, packaged and marked in accordance with ASTM D 3892 standards.

1.08 SITE CONDITIONS

A. Per Division 01 General Requirements and as indicated on Drawings.

B. Dimensions shown on Drawings are approximate. Contractor shall field measure all relevant dimensions and notify Engineer of significant discrepancies prior to furnishing pipe and fittings.

1.09 MAINTENANCE

A. Extra Materials: Furnish as specified. Make interchangeable with and same material and workmanship as corresponding original parts.

B. Furnish one set of all special tools required to completely assemble, disassemble, or maintain the process piping and fittings. Special tools shall refer to oversized or specially dimensioned tools, special attachments or fixtures, or any similar items.

1.10 WARRANTY

A. Provide greater of:

1. Warranty per Division 01 General Requirements,

2. Manufacturer’s standard warranty; or

3. Additional warranty as specified below.

PART 2 – PRODUCTS

2.01 DUCTILE IRON PIPE & FITTINGS (FLANGED) - TYPE (DI/1)

A. All TYPE (DI/1) Ductile Iron Piping shall be Class 53 flanged pipe and fittings per AWWA C150/A21.50, AWWA C115/A21.15, and AWWA C110/A21.10 standards. Flanges shall conform to the drilling and facing of ASME B16.1/ANSI Class 125 unless otherwise noted or as required to connect to valves, tanks, equipment, and other appurtenances. The minimum class thickness for flanged pipe shall be Class 53 for sizes up through 54 inches. All flanged pipe joints shall be assembled using gaskets. All pipe shall be provided and installed in standard lengths whenever possible.

B. All TYPE (DI/1) ductile iron pipe of the same type, style, and duty shall be supplied by a single manufacturer. Class 53 ductile iron piping manufacturers.

1. U.S. Pipe & Foundry Company Inc.

2. American Cast Iron Pipe Company

3. Clow Water System Company

4. Or Equal

2.02 FLANGES & CONNECTORS – TYPE (DI/1)

A. All ductile iron flanges shall conform to ANSI/AWWA C115/A21.15 and be flat faced type unless otherwise Specified or indicated on the Drawings. All ductile iron fittings shall conform to ANSI/AWWA C110/A21.10 standards and be pressure rated for 250 psi. As a minimum, all fittings shall be rated equally to the connecting piping.

B. Unless otherwise specified or indicated on the Drawings, all ductile iron piping and fittings shall utilize ANSI standard flanged connections. The use of alternative joining methods, including but not limited to couplings, and flanged adaptors shall be acceptable where specifically indicated and as approved by the Engineer. Grooved connections with "rigid" connectors shall be an acceptable where specified or indicated on the Drawings or as approved by the Engineer.

2.03 GASKETS – TYPE (DI/1)

A. All gaskets to conform to ANSI/AWWA C111/A21.11 standards. The Gaskets shall be provided by pipe manufacturer unless otherwise noted or approved by the Engineer. For "Interior" and "Exterior" (Below Grade) wastewater service installations, gaskets shall be full face type Nitrile (NBR/Buna-N). For "Exterior" (Above Grade) wastewater service installations, gaskets shall be full face type

EPDM. All gaskets shall provide a positive sealing for all flanged joints. All gaskets shall be a minimum of 1/8 inches thick unless otherwise Specified or shown on the Drawings.

2.04 INTERIOR LININGS – TYPE (DI/1)

A. Unless otherwise Specified or shown on the Drawings, all "TYPE (DI/1)" ductile iron piping shall be provided with a cement-mortar lining. The cement-mortar lined piping shall conform to AWWA C104/A21.4 standards except that two (2) times the standard thickness shall be provided. The cement used shall be Type II and be in accordance with ASTM C 150.

B. Ductile iron piping used for high temperature applications such as air piping shall be unlined.

2.05 CERAMIC EPOXY LINING – TYPE (DI/1)

A. Provide a ceramic epoxy lining where specified or indicated on the Drawings. All Ceramic Epoxy Linings shall be in accordance with the following.

B. The "Ceramic Epoxy Lining" shall be an amine-cured novalac epoxy containing at least 20% by volume of ceramic quartz pigment. The dry film thickness shall be at least 40 mils (minimum thickness for any one test shall be 35 mils). The Lining shall meet the following requirements (provide certified test reports if requested by Engineer):

1. A permeability rating of 0.00 when tested according to Method A of ASTM E 96/E 96M, Procedure A, with a duration of 30 days.

2. The following tests shall be run on coupons from factory lined ductile iron pipe:

   a. ASTM B 117 Salt Spray (scribed panel) - Results to equal 0.0 undercutting after two years.

   b. ASTM G-95 Cathodic Disbondment 1.5 volts at 77 deg F. Results to equal no more than 0.5 mm undercutting after 30 days.

   c. Immersion Testing rated using ASTM D-&14-87.

      i.20% Sulfuric Acid - No effect after two years.

      ii. 140 deg F 25% Sodium Hydroxide - No effect after two years.

3. An abrasion resistance of no more than 3 mils loss after one million cycles using European Standard EN 598: 1994 Section 7.8 Abrasion Resistance.

2.06 EXTERIOR COATINGS – TYPE (DI/1)

A. Factory prime and field paint in accordance with Section 09 90 00 PAINTING AND COATING.

B. Top coat (finish coat) shall match the color coding for the material to be handled by the pipe. Unless approved in writing by the Engineer the finish coat shall be applied prior to assembly of the pipe in moist areas. Submerged piping shall not require a urethane finish. All stainless steel hardware and flange bearing surfaces shall be left uncoated.

2.07 FLANGE HARDWARE – TYPE (DI/1)

A. All nuts, bolts, washers and other flange or coupling fastening hardware shall be 304 stainless steel for interior and above grade installations. Provide 316 stainless steel flange hardware for submerged and below grade (buried) installations. Threads shall be coated with mineral oil or other anti-seize compound. Bolts shall be square headed machine bolts with hexagonal nuts in accordance with ANSI B18.2 standards. All threads shall conform to ANSI B1.1 standards. The bolts shall be of an adequate length such that they protrude through the nut following tightening. The bolt protrusion shall not exceed 1/2 inch.

2.08 PIPE MARKINGS – TYPE (DI/1)

A. All ductile iron pipe and fittings as specified in this section shall be permanently marked with the manufacturer, Date of Manufacture, Size, Type, Class/Wall Thickness, and Standard Produced to (ASTM, AWWA, ANSI, etc.).

2.09 NON-STANDARD FITTINGS – TYPE (DI/1)

A. Fittings with non-standard dimensions shall only be allowed with prior written approval of the Engineer. Unless approved in writing by the Engineer, all non-standard fittings shall meet the specification requirements for standard fittings and be of the same thickness and diameter. Laterals or reducing elbows not meeting the requirements of ANSI A21.10 standards shall meet the requirements of ANSI B16.1 - Class 125.

2.10 JOINT BRACING – TYPE (DI/1)

A. Provide joint bracing as shown on the Drawings and as required to prevent piping from being pulled apart when under pressure. If used, all bridles and tie rods shall be a minimum of 3/4 inches in diameter except when they replace flange bolts of a smaller size. If replacing flange bolts of a smaller size, the bridles shall be fitted with a nut on each side of the pair of flanges.

B. All pipe which requires joint bracing shall be provided with Engineer approved lugs/hooks cast integrally for use with pipe clamps, tie rods, or bridles. All pipe clamps, tie rods, and bridles shall be provided with the same coating as the piping

system for interior applications. Buried applications shall be provided with a bituminous coating system. If required the coating system shall be applied prior to assembly.

2.11 DUCTILE IRON PIPE AND FITTINGS, MECHANICAL JOINT FOR BURRIED SERVICE - TYPE (DI/2)

A. Class 350 mechanical joint pipe and fittings for buried applications per AWWA C151/A21.51 standards. Pipe shall be supplied in standard lengths whenever possible. The pipe thickness design shall be in accordance with AWWA C150/A21.50 standards, except provide a minimum of Class 350 for all piping 12 inches and smaller. Provide a minimum Class 350 for piping from 14 inches to 24 inches and provide a minimum of Class 250 for piping larger than 24 inches.

B. All "TYPE (DI/2)" ductile iron pipe of the same type, style, and duty shall be supplied by a single Manufacturer. All Class 350 ductile iron process piping shall be a product of the following Manufacturer:

1. U.S. Pipe & Foundry Company Inc.

2. American Cast Iron Pipe Company

3. Engineer Approved Equal

2.12 MECHANICAL JOINT FITTINGS – TYPE (DI/2)

A. Mechanical joint compact body fittings shall be ductile iron class 350 and shall be produced in strict accordance with AWWA C153/A21.53 and AWWA C111/A21.11 standards. All pipe and fittings shall be provided with a cement and mortar lining in accordance with AWWA C104/A21.4 standards for sizes 3 inches through 12 inches. Pipe and fittings 14 inches through 24 inches shall be a Manufacturer's standard and produced to AWWA C153/A21.53 standards. Mechanical joint fittings shall be UL listed and rated at 350 psi.

B. All joints shall be rated for pressure service. Joints shall be restrained rubber-gasket mechanical joints and fittings conforming to AWWA C111/A21.11 standards. All gaskets shall be as specified herein. All restrained joints shall be locked type and be produced by the pipe and fitting Manufacturer. The joints shall utilize restraint independent of the joint gasket.

C. All restrained joints of the same type, style, and duty shall be supplied by a single Manufacturer. All restrained joints for mechanical joint ductile iron piping shall be a product of the following Manufacturer:

1. U.S. Pipe & Foundry Company Inc. - TR Flex

2. American Cast Iron Pipe Company - Lok-Ring

3. Engineer Approved Equal

2.13 MECHANICAL JOINT GASKETS – TYPE (DI/2)

A. Mechanical joint gaskets shall meet or exceed the minimum requirements of AWWA C111/A21.11 specifications latest revision for SBR gaskets. Standard mechanical joint glands shall be Ductile Iron per ASTM A 536 standards, Grade 65-45-12.

2.14 MECHANICAL JOINT HARDWARE – TYPE (DI/2)

A. Mechanical joint nuts and tee-head bolts shall be Corten and shall meet or exceed the requirements of AWWA C111/A21.11, 11-7.5 and ANSI A-21.22 for high strength low alloy steel having the following composition: a maximum of 0.20% Carbon, 1.25% Manganese, 0.50% Sulfur, 0.25% Nickel, 0.20% Copper with a minimum combined of 1.25% of Nickel, Copper and Chromium. The mechanical joint nuts and tee-head bolts shall have minimum yield strength of 45,000 psi and an elongation in 2 inch increments of 20%.

2.15 DUCTILE IRON PIPE & FITTINGS – TYPE (DI/3)

A. Class 350 push on joint pipe and fittings for buried applications per AWWA C151/A21.51 standards. Pipe shall be supplied in standard lengths whenever possible. The pipe thickness design shall be in accordance with AWWA C150/A21.50 standards, except provide a minimum of Class 350 for all piping 12 inches and smaller. Provide a minimum Class 350 for piping from 14 inches to 24 inches and provide a minimum of Class 250 for piping larger than 24 inches.

B. All "TYPE (DI/3)" ductile iron pipe of the same type, style, and duty shall be supplied by a single Manufacturer. All push on joint ductile iron process piping shall be a product of the following Manufacturer:

1. U.S. Pipe & Foundry Company Inc.

2. American Cast Iron Pipe Company

3. Engineer Approved Equal

2.16 PUSH ON JOINT FITTINGS – TYPE (DI/3)

A. Push on joint fittings shall be ductile iron class 350 and shall be produced in strict accordance with AWWA C153/A21.53 and AWWA C111/A21.11 standards. All pipe and fittings shall be provided with a cement and mortar lining in accordance with AWWA C104/A21.4 standards for sizes 3 inches through 12 inches. Pipe and fittings 14 inches through 24 inches shall be a Manufacturer's standard and produced to AWWA C153/A21.53 standards. Fittings shall be UL listed and rated at 350 psi.

B. All joints shall be rated for pressure service. Provide concrete thrust blocks for joint restraint as specified and as indicated on the Drawings.

2.17 PUSH ON JOINT GASKETS – TYPE (DI/3)

A. Push on joint gaskets shall meet or exceed the minimum requirements of AWWA C111/A21.11 specifications latest revision for SBR {Styrene-Butadienne (synthetic) Rubber} gaskets.

2.18 PIPE LINING – TYPE (DI/3)

A. Unless otherwise Specified or shown on the Drawings, all "TYPE (DI/3)" ductile iron piping shall be provided with a cement-mortar lining. The cement-mortar lined piping shall conform to AWWA C104/A21.4 standards. Provide a 1/8 inch minimum double cement lining. The cement used shall be Type II and be in accordance with ASTM C 150.

2.19 EXTERIOR COATING – TYPE (DI/3)

A. Pipe outside coating shall be an asphaltic bituminous coating approximately 1 mil thick as specified in AWWA C151. The coating shall be applied to the outside of all pipe, unless otherwise specified or indicated on the Drawings.

2.20 HIGH DENSITY POLYETHYLENE PRESSURE PIPE – TYPE (PE/1 and PE/4)

B. High Density Polyethylene (HDPE), DR-11, PE 3408 pipe with Iron Pipe Size (IPS) or Ductile Iron Pipe Size (DIPS) unless otherwise indicated on Drawings. Outside diameter as indicated on the Drawings. Pipe and fittings shall conform to the requirements of AWWA C906. Provide transition couplings, mechanical joint adaptors and stiffeners as required, as indicated on the Drawings as specified and as recommended by pipe manufacturers. Provide solid end caps for all terminations as specified or as indicated on the Drawings.

A. Provide molded fittings.

B. Join using butt fusion or electrofusion in strict accordance with manufacturer instructions.

2.21 PVC PIPE & FITTINGS - TYPE (PVC/1)

A. All "Type PVC/1" pipe and fittings shall be flanged or socket welded Schedule 80 PVC pipe. The pipe shall conform to ASTM D 1785 standards, PS 21-70, PVC 1120. Pipe material shall be Type I, Grade I, compound cell classified 12454-B per ASTM D 1784 standards. The PVC compound shall be gray in color. The pipe marking shall indicate the pressure rating in psi for water at 73°F, per ASTM D 1785 standards, as well as the manufacturing date code. Schedule 80 fittings shall comply with ASTM D 2467 standards. Flange dimensions shall conform to ASME B16.1, Class 125 standards unless otherwise indicated or required for connection to

pumps, tanks, equipment, and appurtenances. Unions shall utilize Viton O-rings or a material compatible with the process fluid. The pipe shall have a minimum hydrostatic design stress of 2,000 psi at 73 degrees F.

B. Pipe, fittings, and solvent cement for use with potable water shall be certified by NSF standard No. 14 and the seal shall be included on the pipe.

C. All "TYPE (PVC/1)" of the same type, style, and duty shall be supplied by a single manufacturer. All manufacturers' named or otherwise shall comply with the Contract Documents. All "Type PVC/1" piping shall be a product of the following manufacturer:

1. Certain Teed Corporation

2. J-M Manufacturing Company

3. Harvel Plastics Inc.

4. Engineer Approved Equal

2.22 PVC CEMENT FOR SOCKET FITTINGS – TYPE (PVC/1)

A. All cement for socket welded connections shall be "Low VOC" emission, heavy bodied, medium setting, high strength solvent cement. When bonding sodium hypochlorite piping, sodium hydroxide piping or any other acid piping system the cement shall be specially formulated for the chemical application. The PVC cement shall conform to ASTM F 402.

B. ASTM D 2564 and ASTM F 493 standards. All Schedule 80 PVC piping solvent cement for "Acid and Chemical Piping Systems" shall be a product of the following manufacturer:

1. IPS Corporation - Series 724

2. Engineer Approved Equal

2.23 FLANGED JOINTS – TYPE (PVC/1)

A. Where indicated on the Drawings or as specified, all flanged joints shall be supplied with 1/8 inch thick full-faced gaskets. The gaskets shall be of materials as specified in this section based on the respective process fluid. Flanged bolt spacing shall conform to ANSI B16.5 standards. The flanges shall be rated for a minimum pressure of 150 psi. All flanges shall be single piece and be suitable for solvent cementing to the pipe. Two piece sleeve flanges shall not be acceptable. All gaskets shall be compatible with the process fluid.

B. All bolts, nuts, washers, and other fastening devices shall be designed for use in corrosive service environments. All fastening devices shall be 316 stainless steel

and conform to ASTM F 593 and ASTM F 594 standards. All nuts and bolts shall be installed with an anti-seize compound of molybdenum disulfite base.

2.24 CLEAR PVC TUBING - TYPE (PVC/2)

A. All "Type (PVC/2)" piping shall be braid reinforced, clear, PVC tubing. PVC tubing in chemical feed lines shall be installed as one continuous length of tubing from the source to the application point. No intermediate joints shall be allowed.

B. Tubing fittings shall be compression type and be comprised of forged brass alloy C37700 or other suitable material of construction which is compatible with the process fluid. All tube fittings shall conform to ASTM B 124/B 124M standards. All nuts, ferrules, bodies, elastomeric O-ring seals, and holding nuts shall be rated to a minimum 125 psi pressure. All straight threads shall conform to ASME B1.1 standards. Tube fittings on chemical feed lines shall be of a material compatible with the process fluid.

C. The tubing shall be constructed with open mesh polyester braiding permanently encapsulated in walls of clear, flexible PVC. All PVC tubing shall be made from non-toxic ingredients conforming to USP Class VI and FDA standards. The PVC tubing shall be of a crystal clear compound to provide full visual flow indication. The tubing interior shall be mirror smooth to permit uniform flow characteristics. All PVC tubing shall be corrosion and abrasion resistant. All clear PVC tubing shall be designed and constructed in accordance with the following:

1. Size: In Accordance with the Drawings
2. Maximum Pressure: 150 psi
3. Minimum Shore A
4. Hardness: 72
5. Tensile Strength: 2,500 psi
6. Elongation at Break: 320%
7. Brittle Temperature: -50 Degrees F
8. Maximum Operating Temperature: 175 Degrees F

D. All "TYPE (PVC/2)" tubing of the same type, style, and duty shall be supplied by a single manufacturer. All manufacturer's named or otherwise shall comply with the Contract Documents. All clear PVC tubing shall be a product of the following manufacturesr:

1. New Age Industries Inc. - Nylobrade

2. Alsco Industrial Products, Inc.

3. Or Equal

2.25 STAINLESS STEEL PIPE & FITTINGS, NPT - TYPE (SS/2)

A. All "TYPE (SS/2)" stainless steel piping shall be Schedule 40, 304L grade, with NPT threaded connections. All "Type (SS/2)" stainless steel pipe and fittings shall be used for sample piping, instrument piping and gauge connections two (2) inches and smaller in diameter as specified or as shown on the Drawings.

B. The piping shall meet ASTM A 312/A 312M, ASTM A 733, ASME B1.20.1, and ANSI B1.20.1 standards. All stainless steel piping shall be fabricated from stainless steel sheet conforming to ASTM A 778 standards. All pipe shall be finished to No. 1 or better.

C. Threaded fittings shall be austenitic stainless steel, Grade 304L, in accordance with ASTM A 182/A 182M ASME B16.11 standards. All fittings shall be threaded in accordance with ASME B1.20.1 standards. Polytetrafluoroethylene (PTFE) pipe-thread tape conforming to ASTM D 3308 standards shall be used for lubricant/sealant.

D. All "TYPE (SS/2)" piping of the same type, style, and duty shall be supplied by a single manufacturer. All manufacturer's named or otherwise shall comply completely with the Contract Documents. All stainless steel piping shall be a product of the following manufacturer:

1. Felker Brothers Corporation

2. Tioga Pipe Supply Company, Inc.

3. Or Equal

2.26 GASKETS

A. Gaskets shall be used on all flanged piping joints. All gaskets shall be a minimum of 1/8 inches thick unless otherwise specified or indicated on the Drawings. Unless otherwise noted, gaskets shall be low torque, full face to ANSI B16.5 dimensions for 125/150 pound flanges. Gaskets shall have two concentric, convex, molded rings between the center hole and bolt hole circle.

B. Gaskets for all water and wastewater applications (sludge, septage, etc.) in flanged piping systems shall be Nitrile (NBR/Buna-N) unless otherwise indicated. The NBR shall have a minimum durometer shore A hardness of 60 in accordance with ASTM D 2000 standards. The gasket finish shall be smooth. The gaskets shall be designed for use in plastic piping systems, as well as metal or plastic-lined metal piping systems.

C. Gaskets for strong acids and bases shall be Hypalon. Gaskets for oil and gasoline shall be Nitrile/Buna-N. Gaskets subject to abrasion, heat, or flame shall be Hypalon or Neoprene. Gaskets for low pressure air service piping shall be EPDM and be suitable for a temperature range of up to 225 degrees F.

D. If for a specific application a pipe or valve manufacturer recommends a different type of gasket than that specified, the Contractor shall submit to the Engineer the gasket information for review and approval.

E. Provide gaskets constructed of the following materials for process fluid/chemical piping systems as required and as shown on the Drawings:

1. Aluminum Sulfate: EPDM

2. Ferric Chloride: EPDM

3. Ferrous Chloride: EPDM

4. Sodium Bisulfite: Viton

5. Sodium Hydroxide: Viton

6. Sodium Hypochlorite: Viton

7. Sulfuric Acid: Viton

8. Wastewater (Interior/Below Grade): Nitrile (NBR/Buna-N)

9. Wastewater (Exterior/Above Grade): EPDM

10. Grit Slurry: Neoprene

F. All gaskets of the same type and material shall be provided by a single manufacturer. All manufacturers' named or otherwise shall comply completely with the Contract Documents. All gaskets shall be a product of the following manufacturers:

1. Asahi/America Inc.

2. Allstate Gasket Inc.

3. Metro Industries Inc.

4. Or Equal

2.27 UNIONS

A. When joining pipe segments, provide unions where called for on the Drawings and as specified. Provide additional unions to allow for disassembly of piping segments.

Provide unions at pumps, equipment, valves, etc. to allow for removal without disassembly of the piping systems.

2.28 PIPE AND FITTINGS COATINGS

A. An exterior coating shall be provided for all ferrous metallic pipe, fittings, and flanges. The prime coat shall be factory applied. The finish coat shall be field applied by the Painting Subcontractor in accordance with Section 09 90 00 PAINTING AND COATING except the finish coat shall be factory applied for all submerged piping applications. The finish coating color shall match existing color coding (for retrofit or upgrade Projects). For new Projects and systems, the color coding shall be as directed by the Engineer.

B. The color coding shall be in accordance with section 4.4.5 PLANT PAINT & EQUIPMENT IDENTIFICATION of the TR-16 Guides for Design of Waste Water Treatment Works (latest revision); a unique color shall be selected for each fluid carried. Fluid designations are provided on the Piping and Instrumentation Drawings.

C. All ferrous metallic pipe shall be "finish" painted (unless covered by insulation) by the Painting Subcontractor in accordance with Section 09 90 00 PAINTING AND COATING as well as the piping manufacturer's recommendations for coating types and requirements. The Painting Subcontractor shall coat pipes, fittings, hangers and supports using the same paint system. Attachment hardware shall not be painted. Stainless steel pipe and appurtenances shall not be painted. All ferrous metallic pipe in submerged applications shall not require a urethane finish. The finished coating shall be a product of the same manufacturer as the prime coat to ensure compatibility.

D. Confirm the final color coding with the Owner and Engineer prior any application.

2.29 ATTACHMENT HARDWARE

A. All attachment hardware, including but not limited to nuts, bolts, washers and all related fastening devices shall be 304L stainless steel. Threads shall be coated with mineral oil or another anti-seize compound prior to installation. Hardware for submerged applications shall be 316L stainless steel.

2.30 TAPPING SADDLES

A. Provide tapping saddles when pipe thickness and diameter is insufficient for tap size as required by manufacturer or as indicated on Drawings. Material: nylon coated ductile iron or 304 stainless steel. Hardware including nuts, bolts, strap: 304 stainless steel. Watertight gasket: material compatible with process fluid, NBR for wastewater. Pressure rating: 350 psi or same as rest of piping system, whichever is greater. Manufacturer: Romac or equal.

2.31 PIPE LABELS

A. All piping shall be labeled on two sides at "maximum" 15 foot intervals. A flow direction arrow shall follow the label legend and be of the same color. The labels shall meet or exceed ASME A13.1 and ANSI standards. The legend letters shall be Capitalized and be black or white, depending on the background color. The labels shall be self-adhesive vinyl type. The labels shall be suitable for a pipe temperature range of - 40 degrees F to 175 degrees F.

B. The pipes shall be labeled according to the fluid carried. The labels shall match the fluid designations as shown on the Piping and Instrumentation Drawings. Provide a detailed submittal which shall include each pipe label for each of the respective fluid designations for review by the Engineer. Pipe labels shall be installed on the exterior of all piping insulation/jacket.

C. The piping labels shall spell out the entire fluid designation, not the abbreviation. Confirm the naming convention with the Engineer prior to ordering the labels.

D. All pipe labels of the same type, style, and duty shall be supplied by a single manufacturer. All manufacturers' named or otherwise shall comply with the Contract Documents. All pipe labels shall be a product of the following manufacturer:

1. Marking Services Inc.

2. Brimar Industries Inc.

3. Or Equal

PART 3 – EXECUTION

3.01 STAINLESS STEEL PIPE

A. The Contractor shall specifically take care to avoid contacting stainless steel piping with ferrous surfaces or materials. Contact with ferrous surfaces or materials may lead to rusting of particles embedded in the walls of stainless steel piping. If rusting of stainless steel piping occurs after installation, the Contractor shall be Responsible for its removal at no additional cost to the Owner or Engineer. The Contractor shall pickle the affected surface area of the piping with a deoxidizer as recommended by the pipe manufacturer and as approved by the Engineer. The Contractor shall scrub all affected areas of the piping with stainless steel brushes and then thoroughly rinse the affected area.

B. All stainless steel piping shall be stored on supports constructed of non-ferrous metal materials. All tools, including but not limited to, wire brushes, wrenches, drills, saws, etc. for stainless steel piping installation shall be specifically designated for use on stainless steel piping to ensure no contamination from ferrous

metals occurs. All piping storage and fabrication supports shall be constructed from non-ferrous metal, stainless steel, or provided with a rubber lining.

3.02 INSTALLATION - GENERAL

A. Piping systems shall be fabricated and installed in accordance with ASME B31.1 standards. Install each run of piping with minimum joints and couplings, but with adequate and accessible unions for disassembly and maintenance/replacement of valves and equipment. Reduce sizes (where indicated on the Drawings) by use of reducing fittings. Align piping accurately at connections, within 1/16 inch misalignment tolerances.

B. Locate piping runs, except as otherwise indicated, vertically and horizontally (pitched to drain) and avoid diagonal runs wherever possible. Orient horizontal runs parallel with walls and column lines. Locate runs as shown or, if not otherwise indicated, run piping in the shortest route which does not obstruct usable space or block access for servicing the building and its equipment. Hold piping close to walls, overhead construction, columns and other structural and permanent-enclosure elements of buildings.

C. Horizontal piping shall pitch uniformly 1 inch in 40 feet and drain to a minimum number of low points. All low points shall be provided with a minimum one (1) inch tapped "TYPE (SS/2)" drain pipe, 316 stainless steel isolation ball valve (Type V26), and 316 stainless steel hose connection. Provide "TYPE (PVC/1)" drain piping and a (Type V20) PVC ball valve for drain connections off of PVC piping. Drain connections may or may not be shown on the Drawings. Confirm the final location of all drain connections with the Engineer and Owner prior to installation. Provide larger drain connections as required and as directed by the Engineer and Owner.

D. Provide unions in piping as shown on the Drawings and as specified herein. Provide unions in locations including but not limited to the following: equipment, pumps, tanks, valves, long piping runs, piping bypasses around equipment, or any other location as directed by the Engineer or Owner. Unions shall be located to as to allow for piping disassembly, alterations, and repairs.

E. Perform field routing and coordination of process piping routing as required to accommodate all necessary coordination with other Work of the Contract, including but not limited to HVAC, Electrical, Structural, Plumbing and Civil Work.

3.03 INSTALLATION – BURIED PIPING

A. Install buried piping in accordance with trench details provided on the Drawings, unless otherwise specified or indicated on the Drawings..

B. Lay pipe to line and grade shown on the Drawings. Do not allow positive-negative grade discontinuities. Line and grade may be adjusted by the Engineer as required by field conditions.

C. Lay pipe in the dry. Do not use installed pipe to remove water from work area.

D. For buried pressure pipe including water supply, force mains, and all pumped systems: provide concrete thrust blocks at all pipe fittings and changes in direction or alignment. Thrust blocks may or may not be shown at every bend, fitting or directional change. Thrust blocks which have not been shown shall not relieve the Contractor of the responsibility for providing and installing them.

E. Provide a firm, even bearing by digging bell holes at each joint and by tamping screened gravel at the sides of the pipe up to mid-diameter. Provide fill at least one (1) foot over the top of the pipe in accordance with the details shown on the Drawings. Blocking shall not be permitted.

F. Thoroughly clean all pipe prior to laying and keep clean throughout the duration of the Work. When laying is not in progress, including lunch breaks, the open ends of piping shall be closed by watertight plugs or other Engineer approved means. Deflection of joints shall not exceed that recommended by the pipe Manufacturer. All fittings shall be provided, for crossing utilities which may be encountered upon opening the trench. Solid sleeve couplings shall only be utilized where indicated on the Drawings or with written approval of the Engineer.

G. Flush all piping and remove all debris. Flushing method used shall be approved by the Engineer. Gravity flushing shall not be acceptable. Provide all labor, water, pumps and related appurtenances for pipe flushing.

H. Any and all defective pipe shall be removed even after it has been laid. The pipe shall be replaced with a sound, non-defective pipe in a satisfactory manner by the Contractor at no additional cost to the Owner or Engineer.

3.04 DUCTILE IRON PIPE INSTALLATION - TYPE (DI/1)

A. The Contractor shall install "Type (DI/1)" ductile iron piping and fittings true to alignment. The Contractor shall provide rigid supports and anchorage as required. The support spacing shall be in strict accordance with the recommendations of the piping manufacturer.

B. The installation and piping support system shall not allow deflection of piping greater than 50% of the maximum deflection as recommended by the piping manufacturer. Each section of piping and fittings shall be cleaned free of dirt, debris and other foreign material prior to installation. All cleaning shall be in accordance with the recommendations of the piping manufacturer.

C. All ductile iron piping and fittings shall be installed in accordance with requirements of AWWA C600 standards. The Contractor shall provide all fittings as required for field routing of piping in addition to those shown on the Drawings to provide for a complete and operational piping system. Provide additional flanges as directed by the Engineer where piping interferes with existing facilities.

3.05 PIPE CUTTING – TYPE (DI/1)

A. Pipe cutting shall be as approved by the Engineer. Any damage to the interior pipe linings shall be repaired to the satisfaction of the Engineer before installation. If approved by the Engineer, cutting shall be conducted using a saw with blades specifically designed for cutting iron pipe. All cuts shall be at right angles to the axis of the piping. The cuts shall leave smooth edges. Damages to interior pipe linings caused by cutting of pipe shall be repaired to the satisfaction of the Engineer and Owner.

B. The Contractor shall seal the ends of all cut pipe in accordance with the recommendations of the pipe manufacturer.

C. Field cutting and threading of ductile iron pipe shall not be acceptable under any circumstances, all pipe shall be pre-cut and threaded at the factory of origin.

3.06 JOINTS & CONNECTIONS – TYPE (DI/1)

A. The Contractor shall connect piping to equipment in accordance with the instructions of the equipment manufacturer. When manufacturer's indicate that equipment shall not support dead loads from piping, the Contractor shall submit, in writing, that the piping installation does not transfer loading from the piping to the equipment, and that all the manufacturer's requirements have been met. Install the piping so as not to impart any strain or loading on the connected equipment.

B. All bolts for flanged joints shall be tightened evenly. All bolts shall conform to the size of the flange and well as all ANSI standards. Flanged joints shall be made using gaskets, bolts, and bolt studs with a nut on each end. The Contractor shall utilize studs with nuts where the flange is tapped.

C. Tapping: Provide tapped pipe connections as shown on the Drawings and as directed by the Engineer. Drill and tap perpendicular to the longitudinal access of the pipe. Follow the manufacturer's instructions when tapping into fittings. All pipe taps shall be in accordance with ANSI A21.51 standards. Provide tapping saddles as required that will pass pressure test with the rest of the pipe system.

3.07 DUCTILE IRON PIPE INSTALLATION - (TYPE DI/2 & DI/3)

D. Install in accordance with the requirements of AWWA C600 and pipe manufacture instructions.

3.08 PIPE CUTTING – TYPE (DI/2) & (DI/3)

A. When required, cutting shall be done by a machine, leaving a smooth cut at right angles with the axis of the pipe. Cut ends of pipe shall be joined with a bell and shall be beveled to conform to the manufactured spigot end. Cement lining shall be undamaged. Field cut ends shall be sealed with an Engineer Approved epoxy, in accordance with the pipe Manufacturer's instructions. Cutting of restrained joint

pipe shall not be acceptable unless approved in writing by the Engineer. If approved, cutting shall be at specific locations and the Contractor shall provide all restrainer glands or field adaptable restrained joints.

3.09 PUSH-ON JOINTS – TYPE (DI/3)

A. All push on joints shall be installed in accordance with the recommendations of the pipe Manufacturer as well as all AWWA C600 standards. All pipe shall be laid with bell ends facing ahead. A rubber gasket shall be inserted in the groove end of the pipe, and the joint surfaces shall be cleaned and lubricated. The plain end of the pipe shall be aligned and inserted in the bell end of the pipe to which it is to be joined and pushed home with a jack or other means. After joining the pipe, a metal feeler shall be used to make certain that the rubber gasket is correctly located.

3.10 MECHANICAL JOINTS – TYPE (DI/2)

A. Mechanical joints shall be assembled in accordance with Appendix A of AWWA C111/A21.11 and the pipe Manufacturer's instructions. Thoroughly clean and lubricate the joint surfaces and rubber gaskets with soapy water before assembly. Bolts shall be tightened to the specified torques. Under no conditions shall extension wrenches or pipe over handle of ordinary ratchet wrenches be used to secure greater leverage. Bolts in mechanical or restrained joints shall be tightened evenly and alternately.

3.11 POLYETHYLENE PIPE INSTALLATION – TYPES (PE/1) AND (PE/4)

A. Install in accordance with the Manufacturer’s recommendations, Plastic Pipe Institute (PPI) Handbook of PE Pipe, and the details as shown on the Drawings.

B. Join using thermal butt fusion or electro-fusion methods. Personnel shall be trained by manufacturer's representative.

C. Install warning tape continuously over buried PE pipe (Type PE/4). At ends of rolls and repairs, splice tape with 3 foot overlap connected with tape. Provide the Owner with one full roll for future repairs. Extend to grade at each access point including manholes, cleanouts, and at pump stations.

3.12 PVC PIPE INSTALLATION - TYPE (PVC/1) AND TYPE (PVC/4)

A. The Contractor shall install "TYPE (PVC/1) and "TYPE (PVC/4)" pressure piping in strict accordance with the manufacturer's instructions as well as that specified herein. When cutting of piping is required, all burrs, chips, filings, and other associated defects shall be removed from both the pipe inside diameter and outside diameter before joining. Cutting of piping shall be with a hand saw or pipe cutter with blades. The use of pipe cutters with rollers shall not be acceptable. All cut pipe ends shall be beveled approximately 1/16 inch back from the edge of the pipe at an angle of 10 to 15 degrees. All cutting of PVC piping shall be in strict accordance with the recommendations of the piping manufacturer.

3.13 SOLVENT WELDING – TYPE (PVC/1) & (PVC/4)

A. All joints for plastic pipe shall be solvent welded except where flanged joints are required. All pipe and fittings to be socket welded shall be clean of all loose dirt and moisture from the inside and outside diameter of the pipe end and the inside diameter of the fitting. The Contractor shall not socket weld wet piping surfaces.

B. The solvent cement shall be a grade specifically recommended by the piping manufacturer for the size and schedule of the pipe as well as the process fluid carried. Solvent cements for acidic chemicals shall be in accordance with that previously specified. Prior to solvent welding, all fittings and couplings shall be exposed to the installation atmosphere for at least one (1) hour to the same temperature conditions as the pipe in order to assure proper thermal balance between the piping and associated fitting.

C. The Contractor shall apply "Low VOC" solvent cement to the pipe in accordance with the Manufactures recommendations. A minimum of two (2) coats shall be applied when recommended by the pipe, fitting, or solvent cement manufacturer. All piping system joints four (4) inches and larger shall use a primer and finished solvent cement coating prior to assembly. The Contractor shall apply the solvent cement to the socket while keeping both the surface and applicator wet and in motion for approximately 5 to 15 seconds. The Contractor shall take care so as not to add excess solvent cement. Joints shall not be cramped.

D. The atmospheric and weather conditions affect the solvent welding procedure. In cold weather sufficient time shall be allowed for proper penetration of the solvent cement. Joining of PVC pipe and fittings shall not be conducted in atmospheric conditions below 40 degrees F, above 90 degrees F, or when exposed to direct sunlight. The Contractor shall allow for a minimum of 48 hours of drying time before moving the socket welded joint or subjecting any internal or external pressure/force.

E. When solvent welding piping to valves or other appurtenances the Contractor shall take specific care so as not to allow solvent cement to enter the valve. Solvent cement shall not be allowed to run free from joints. All valves shall be solvent welded in strict accordance with the recommendations of the valve manufacturer.

F. All solvent welded joints shall remain undisturbed for a minimum of 48 hours so as to allow for the development of complete strength.

3.14 FLANGED JOINTS – TYPE (PVC/1) & (PVC/4)

A. When connecting "TYPE (PVC/1)" piping to metallic piping, the Contractor shall assemble the metallic piping first. Flanged connections shall be used to connect all PVC piping to metallic piping unless otherwise specified or shown on the Drawings. Tighten all bolts evenly to prevent warping/dishing of the PVC flange. A wrench may be used to provide a tight seal between the flanges and gaskets. All joints shall conform to the piping manufacturer's recommendations.

3.15 STAINLESS STEEL PIPE INSTALLATION - TYPE (SS/1) (SS/2) (SS/3) & (SS/4)

A. The Contractor shall install all "TYPE (SS/1) & TYPE (SS/2)" pipe and fittings in strict accordance with the recommendations of the pipe manufacturer. The installation shall be true to alignment. All piping shall be pitched to low points and shall be provided with condensate drains as required and as shown on the Drawings. All pipe supports and restraints shall be provided as recommended by the pipe manufacturer.

B. If pipe cutting is required for installation, a machine shall be used. All cuts shall be neat, true, and smooth at 90 degree angles to the pipe longitudinal axis/center line.

C. Prior to assembly in the field, the Contractor shall clean all flanges, gaskets or threads (if any) with a soap and warm water solution. All flanged bolts shall be tightened alternately and evenly to the manufacturer's required torque. The Contractor shall take care so as not to over-tighten any flange bolts. The Contractor shall not utilize extension or pipe ratchet wrenches; which may cause over-torque of flange bolts. All flange joints shall be assembled with; gaskets, bolts and nuts; bolt studs with a nut on each end; or studs and nuts when the pipe is tapped. The Contractor shall ensure all flange holes are provided with connectors.

D. The Contractor shall cut threads full and clean using sharp dies as required. The Contractor shall ream all threaded ends to remove burrs and restore the full inside pipe diameter. The Contractor shall apply pipe joint compound, or pipe joint tape (Teflon) as recommended by the pipe/fitting manufacturer, on male threads at each joint and tighten the joint to leave not more than three (3) threads exposed.

E. All pipe and fittings shall be cleaned of all dust, oil, grease, water, dirt or any other foreign matter prior to installation. The Contractor shall ensure no foreign matter, tools, or other construction materials are left in the piping. All stainless steel piping shall be washed clean with steam or warm water to remove any other remaining foreign matter or debris.

F. Stainless steel piping used in low pressure air or other associated "hot" applications shall be deigned to account for thermal expansion/contraction over a temperature range of 0 degrees F to 200 degrees F.

G. Welding in the field shall only be conducted with prior written approved by the Engineer. All welds shall be made by welders certified under ASME Section IX and be equal or exceed shop welds in all respects. Field welding shall only be conducted after a demonstration weld is successfully completed by each welder at no additional cost to the Owner or Engineer. All field welded joints shall be thoroughly cleaned and buffed using deburring and finishing wheels.

H. The Contractor shall provide certifications that all welders on Site are qualified, in accordance with ANSI B31.1, Paragraph 127.5 for shop and Project Site welding of pipe Work. The Contractor shall provide certified copies of current welding certificates for all welders on Site to the Engineer and Owner.

3.16 CARBON STEEL PIPE INSTALLATION - TYPE (CS/1)

A. Does not apply.

3.17 INSTALLATION OF SLEEVES AND SEALS

A. Install pipe sleeves of types as indicated on the Drawings where piping passes through walls, floors, ceilings, and roofs. Do not install sleeves through structural members of Work, except as detailed on the Drawings, or as approved by the Engineer. Install sleeves accurately centered on pipe runs. Size sleeves so that piping and insulation (if any) will have free movement in the sleeve, including allowance for thermal expansion; but not less than two (2) pipe sizes larger than the piping run. Install length of sleeve equal to thickness of construction penetrated, and finish flush to surface; except floor sleeves. Extend floor sleeves four (4) inches above the level floor finish, and four (4) inches above floor finishes sloped to drain. Provide temporary support of sleeves, and provide temporary closure to prevent concrete and other materials from entering sleeves.

B. Sleeve Seals shall be installed in accordance with the following:

1. Mechanical Sleeve Seals: Loosely assemble rubber links, around the pipe with bolts and pressure plates located under each bolt head and nut. Push into sleeve and center. Tighten bolts until links have expanded to form a watertight seal.

2. Wall Pipe: Install wall pipe where indicated on Drawings. Joints shall be as required and indicated for connection to adjacent piping.

3.18 CLEANING

A. The Contractor shall thoroughly clean the interior and exterior of all piping prior to testing. The Contractor shall be Responsible for removal of all dirt, dust, oil, grease and other foreign materials from the piping. Exercise care while cleaning piping to avoid damage to linings and coatings. The Contractor shall clean all piping in strict accordance with the recommendation of the piping manufacturer.

B. The Contractor shall flush out piping systems, except odor control piping, with clean water prior to proceeding with the required tests. The Contractor shall inspect each run of piping for completion of joints, supports, accessory items and appurtenances prior to testing.

3.19 PIPE TESTING - GENERAL

A. The Contractor shall test all piping in the presence of the Engineer and the plumbing or building inspector if required. All testing shall be in accordance with the requirements of the local and state plumbing codes and the appropriate Sections of these Specifications. All testing shall be conducted at no additional cost to the Owner or Engineer. The Contractor shall be Responsible for supplying all labor,

equipment, materials, taps, water, gauges, pumps, and appurtenances required to conduct all piping tests.

B. When requested by the Engineer or local plumbing inspector, building gravity drains shall be tested prior to backfilling or concealing. All other piping shall be tested after backfilling. Any deficiencies found during testing, including but not limited to leakage, damage to piping, loss of pressure, etc., shall be repaired and retested as required by the Engineer at no additional cost to the Engineer or Owner. The Contractor shall be Responsible for lawful disposal of all waste after the testing including but not limited to water or other test fluids.

C. Test all piping systems before insulation is installed wherever feasible. Remove all control devices before testing. Test each natural section of each piping system independently but do not use piping system valves to isolate sections where the test pressure exceeds the valve pressure rating. Test each section with water or other fluids as directed by the Engineer and Owner. Pressurize the pipe to the specified level for the required time period.

3.20 HYDROSTATIC PRESSURE TESTING

A. All liquid service pipe and fittings shall be pressure tested using water to the test pressures specified or as directed by the Engineer. All pipe and fittings shall be pressure tested with water at the maximum service temperature specified or as directed by the Engineer. Test pressures for designations and/or systems not listed shall be as approved by the Engineer prior to testing. All testing shall be in accordance with the procedures of ASME B31.1 standards.

B. The Contractor shall provide water or other test fluid as directed by the Engineer, of sufficient capacity to deliver the required test pressure specified. The Contractor shall provide all valves on the suction and discharge side of the pump as well as a strainer on the inlet side of the pump to prevent foreign matter from entering the system. The Contractor shall provide pressure gauge(s) capable of reading 50 percent higher the specified test pressure. The pressure gauges shall be located at the pump discharge and any other place as directed by the Engineer. The Contractor shall provide a pressure relief valve set at a pressure 20 to 25 percent above the specified test pressure. The Contractor shall also provide any heaters (if required) to heat the test water to the specified test temperature.

3.21 PREPARATION FOR TESTING

A. The Contractor shall coordinate the testing fluid to be used with the Engineer and Owner. When the fluid test temperature is not ambient, the Contractor shall consult the Engineer for the appropriate test temperature. All testing equipment shall be compatible with the piping and test fluid. The Contractor shall provide vents at all high points of the system if not already installed. The Contractor shall provide drains in locations as required where venting or draining devices do not exist.

B. The Contractor shall remove all discs, pistons, balls etc., from check valves if they prohibit testing of the piping system. The Contractor shall ensure all valves and appurtenances are fully open within the section of piping to be tested. The Contractor shall remove all control instruments and alarms prior to testing. Block off or remove all pressure relief valves prior to testing and temporarily close all external openings of the piping section to be tested. All closures shall be specifically designed for the test pressure. All joints in the piping section to be tested shall be left exposed for examination and inspection during the test period. The Contractor shall not install insulation prior to conducting tests.

C. The Contractor shall provide temporary supports for vapor or gas piping to support the weight of the test fluid; if the vapor or gas piping is directed to be hydrostatically tested. The Contractor shall provide temporary support/restraint or isolation for all expansion joints.

D. Hydrostatic Test

1. The Contractor shall slowly fill the piping system, expelling entrapped air from all high points. The fill rate shall be controlled so that the fluid velocity within the pipe system is less than 2 feet per second. Once the filling process has been completed the piping system shall be brought up to the specified test temperature, if required. The pressure shall be held at 20% less than the test pressure until the temperature has been stabilized. Once the temperature has stabilized the Contractor shall raise the pressure to the test level as specified or as directed by the Engineer.

2. The pipe system shall be slowly brought up to the test pressure. The Contractor shall take care so as not to create shock, surge or water hammer in the pipe system.

3. For "Pressure Piping", the Contractor shall test each piping system at 150% of the design operating pressure, but not less than 25 psi test pressure, whichever is greater. "Pressure Piping" shall be defined as piping systems in which the process fluid does not flow (move) via gravity. The minimum test pressure for all "Gravity Piping" shall be 10 psig. The Contractor shall provide the Engineer and Owner with a minimum of 24 hour notice prior to the testing. Tests which are not witnessed by Engineer shall not be acceptable. In the absence of specified test pressures the Contractor shall consult the Engineer for determining the test pressure for each system. The required test period shall be two (2) hours.

4. The test duration time limit shall not begin until the full pressure specified or indicated by the Engineer has been reached and the system has been stabilized to within (+/-) 5 percent of the test temperature. The system temperature shall be maintained to within (+/-) 5 percent of the specified or Engineer indicated value for the entire duration of the test. The test pressure

shall be maintained at (+/-) 5 psi of the specified or Engineer indicated test pressure for the entire duration of the test.

5. The pressure test shall be monitored by a recording type pressure gauge. When temperature and pressure control is required, the Contractor shall use a combination temperature/pressure recording gauge. The Contractor shall record the entire test process. The records shall include but are not limited to the Date of Testing, Piping Section Tested, Test Pressure, Testing Equipment, Testing Results, Test Fluid, Test Temperature (If Required), and Signatures of the Engineer, Contractor & Owner.

3.22 INSPECTION

A. Observe each test section for leakage during the test period. The hydrostatic test shall be deemed acceptable if no visible leaks are detected and the pipe system pressure can be maintained within (+/-) 1/2 percent but no more than 5 psi of the specified value.

B. Upon completion of the test, the pressure shall be slowly removed by opening a valve or other pressure relieving device at a location remote to the location of the pressure/temperature monitoring equipment. The pressure shall be reduced to approximately 20 percent of the specified or Engineer indicated test pressure. The Contractor shall stabilize the system pressure at that point while the entire system is inspected for leaks, cracks, or other piping system defects. If any defects are found, the Contractor shall alleviate all pressure in the piping system, drain the test fluid, correct all defects, and retest the piping system.

C. The Contractor shall repair all piping system sections which fail the hydrostatic pressure piping test, by disassembly and re-installation, using new materials to the extent required to overcome leakage and/or pressure drop. Do not use chemicals, stop-leak compounds, mastics, or other temporary repair methods. The Contractor shall be Responsible for repairing and retesting all defective piping sections at no additional cost to the Owner or Engineer. The Contractor shall drain all fluids from the piping systems after testing and repair Work (if required) has been completed.

END OF SECTION

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SECTION 40 05 13.02

PROCESS PIPE COUPLINGS AND CONNECTORS

PART 1 – GENERAL

1.01 SUMMARY

A. Provide, install, test, and make ready for operation all process pipe couplings and connectors of the type(s) and size(s) as required and as shown on the Drawings. All couplings and connectors shall conform to the requirements of the Contract Documents. The items include but may not be limited to sleeve type couplings, split type couplings, flanged adaptors, expansion joints, harnessing and restraints, quick connect couplings, unions, dielectric connectors, and restrained mechanical joint couplings. The aforementioned items may or may not all be required for the Work of the Contract. All items shall be provided for complete and operational systems, as shown on the Drawings, and as specified herein.

1.02 PRICE AND PAYMENT PROCEDURES

A. Measurement and payment requirements per Division 01 General Requirements.

1.03 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. AMERICAN WATER WORKS ASSOCIATION (AWWA)

a. AWWA C110/A21.10 Ductile-Iron and Gray-Iron Fittings for Water

b. AWWA C111/A21.11 Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings

c. AWWA C153/A21.53 Ductile-Iron Compact Fittings for Water Service

d. AWWA C207 Standard for Steel Pipe Flanges for Waterworks Service-Sizes 100 mm through 3600 mm 4 in. through 144 in.

e. AWWA C600 Installation of Ductile-Iron Water Mains and Their Appurtenances

f. AWWA C606 Grooved and Shouldered Joints

g. AWWA M11 Manual: Steel Pipe: A Guide for Design and Installation

2. ASTM INTERNATIONAL (ASTM)

a. ASTM A 108 Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished

b. ASTM A 126 Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings

c. ASTM A 183 Standard Specification for Carbon Steel Track Bolts and Nuts

d. ASTM A 197/A 197M Standard Specification for Cupola Malleable Iron

e. ASTM A 307 Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength

f. ASTM A 325M Standard Specification for Structural Bolts, Steel, Heat Treated, 830 Mpa Minimum Tensile Strength (Metric)

g. ASTM A 36/A 36M Standard Specification for Carbon Structural Steel

h. ASTM A 48/A 48M Standard Specification for Gray Iron Castings

i. ASTM A 512 Standard Specification for Cold-Drawn Buttweld Carbon Steel Mechanical Tubing

j. ASTM A 513 Standard Specification for Electric-Resistance-Welded Carbon and Alloy Steel Mechanical Tubing

k. ASTM A 536 Standard Specification for Ductile Iron Castings

l. ASTM A 564/A 564M Standard Specification for Hot-Rolled and Cold-Finished Age-Hardening Stainless Steel Bars and Shapes

m. ASTM A 575 Standard Specification for Steel Bars, Carbon, Merchant Quality, M-Grades

n. ASTM A 632 Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing (Small-Diameter) for General Service

o. ASTM B 584 Standard Specification for Copper Alloy Sand Castings for General Applications

p. ASTM B 62 Standard Specification for Composition Bronze or Ounce Metal Castings

q. ASTM B 633 Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel

r. ASTM B 88 Standard Specification for Seamless Copper Water Tube

s. ASTM D 2774 Underground Installation of Thermoplastic Pressure Piping

1.04 ADMINISTRATIVE REQUIREMENTS

A. Per Division 01 General Requirements.

1.05 SUBMITTALS

A. Submit in accordance with Division 01 General Conditions

B. Product Data

1. Submit Manufacturer's descriptive data, technical literature, catalog cuts, and installation instructions for each type of coupling and connector. Include diagrams, materials, dimensions, weights, operating pressures, compliance with applicable AWWA, ASTM, and other standards and all other relevant data for all components. Submit spare parts data for each different item of material and equipment specified.

2. Bellows-type expansion joints: submit materials of construction, including gauge of corrugated element, maximum test pressure force to compress joint, bellows spring rate, shear force and end moment due to calculated traverse only. Submit results of cycle life testing for the maximum diameter coupling to be installed.

C. Shop Drawings

D. Samples and Mockups: as specified in Article 1.06.

E. Certificates

F. Design Data/Submittals

G. Sample Test Reports and Evaluations

H. Manufacturer Instructions

I. Source and Field Quality Control Submittals

J. Manufacturer Reports

K. Qualification Statements

1. If required by the Engineer, the equipment Supplier shall submit a list of at least ten (10) similar installations, including contact names and phone numbers. All equipment shall be supported by a service organization that is, in the opinion of the Engineer, reasonably convenient to the Site to ensure parts and service can be acquired in a timely fashion.

L. Closeout and Maintenance Material Submittals: per Division 01 General Requirements.

1. Provide catalog cut sheets of joints, couplings, harnesses, expansion joints, gaskets, fasteners and all other process pipe couplings and connectors specified in this section.

1.06 QUALITY ASSURANCE

A. All welding shall be conducted under qualified welding procedures. All welders and operators shall be certified in accordance with the latest applicable AWS and ANSI codes for shop and Project Site welding of piping Work. The Contractor shall furnish written proof of certifications upon request from the Engineer.

B. All piping systems, components, and appurtenances in contact with potable water (including potable water during any stage of treatment or conditioning) shall be certified to meet the requirements of ANSI/NSF 61 for water service.

C. All process piping couplings and connectors shall be new and unused. The Contractor shall install all couplings and connectors to meet the requirements of all codes.

D. Field verify and coordinate dimensions and drilling of flanges with flanges for valves, pumps and other equipment to be installed in the piping systems. Bolt holes in flanges shall straddle the vertical centerline.

E. Materials and equipment shall be the standard products of a Manufacturer regularly engaged in the production of such products and shall essentially duplicate items that have been in satisfactory use in identical applications in other wastewater treatment facilities. The Manufacturer shall have a minimum of five (5) years of documented experience in the design and production of couplings and connectors of all types, and not less than five (5) years of experience in the production of equal or larger sized models of the exact equipment as specified herein.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Materials delivered and placed in storage shall be stored with protection from the weather, excessive humidity variation, excessive temperature variation, dirt, dust and/or other contaminants. Proper protection and care of materials before, during and after installation shall be the Contractor's responsibility. Any materials found to be damaged shall be replaced at the Contractor's expense. Materials shall be stored with protection from puncture, dirt, grease, moisture, mechanical abrasions, excessive heat, ultraviolet (UV) radiation, or other damage.

B. Surfaces such as female threads, internal mechanical joint ends or flange faces shall be protected from damage during shipment. The Contractor shall inspect the materials delivered to the Site for damage. Store rubber products under cover out of direct sunlight. Do not store materials directly on the ground. Keep the inside of couplings, connectors, and fittings free of dirt and debris.

1.08 SITE CONDITIONS

A. Per Division 01 General Requirements and as indicated on Drawings.

B. Dimensions shown on Drawings are approximate. Contractor shall field measure all relevant dimensions and notify Engineer of significant discrepancies prior to furnishing pipe and fittings.

1.09 MAINTENANCE

A. Extra Materials: Furnish as specified. Make interchangeable with and same material and workmanship as corresponding original parts.

B. Furnish one set of all special tools required to completely assemble, disassemble, or maintain the process piping and fittings. Special tools shall refer to oversized or specially dimensioned tools, special attachments or fixtures, or any similar items.

1.10 WARRANTY

A. Provide greater of:

1. Warranty per Division 01 General Requirements,

2. Manufacturer’s standard warranty

3. Additional warranty as specified below.

PART 2 – PRODUCTS

2.01 GENERAL

A. All couplings and connectors shall be of the sizes shown on the Drawings or as specified. Provide couplings which are sized to match the connecting piping outside diameters. Where piping outside diameters differ, provide transition type couplings. All couplings and connectors shall have the Manufacturer, size, flow directional arrows (if applicable), working pressure for which they were designed and all standard referenced Specifications cast in raised letters or permanently marked upon some appropriate part of the equipment. Unless otherwise specified or indicated on the Drawings, all couplings and connectors shall have a minimum pressure rating of 150 psi or be of the same working pressure as the pipes they connect, whichever is greater. All couplings and connectors shall be designed for the pressures of the application where they are to be installed. The reference of a Manufacturer's name and/or model number in this specification has been provided for the purpose of establishing the standard of quality or general configuration desired and shall not be considered as proprietary.

B. Unless otherwise specified or indicated on the Drawings all piping shall be connected using standard flanged, mechanical joint, push-on joint, threaded,

welded, or solvent cement welded connections. Couplings and connectors shall be used where specified or indicated on the Drawings. The use of couplings in place of standard piping connections shall not be acceptable unless approved by the Engineer in writing.

2.02 SOLID SLEEVE TYPE COUPLINGS - TYPE C01

A. Provide solid sleeve type couplings to join all plain end pipes and/or exterior below grade transitions in piping materials as shown on the Drawings, as specified and as outlined in AWWA C 201 standards. In cases where the outside diameters of the piping segments to be connected differ, provide "reduction/expansion" sleeve type couplings.

B. Sleeve type couplings shall also be provided for all exterior below grade piping runs prior to entering and exiting buildings or structures. The couplings shall be installed prior to the building or structure wall penetration to allow for differential settlement of the piping and structure. All sleeve type couplings shall conform to the provisions of AWWA C 219 standards. All sleeve type couplings shall be rated for use with the same operational pressure as the connecting pipes. All sleeve type couplings for low pressure air service shall be 304L stainless steel with 316L stainless steel followers.

C. All coupling lugs shall be in accordance with ASTM A 36/A 36M standards. All washers shall be in accordance with ASTM A 325M standards. All couplings shall be fitted with plastic plugs to protect the bolt holes.

D. Provide sleeve couplings on all piping buried directly under a structure at the structure's expansion joints. In applications where the piping is encased in concrete, provide a minimum of 3-inch-thick styrofoam placed perpendicular to the horizontal centerline of the coupling.

2.03 FASTENERS

A. All bolts shall be installed such that a minimum of 1/4 inch of the bolt projects beyond the surface of the nut. All hexagonal nuts shall be in accordance with ANSI B18.2 standards. Hexagonal nuts shall have threads in accordance with ANSI B1.1 standards. All bolts shall be in accordance with ASTM A 307 and ANSI B1.1 standards. All bolts shall be square or hexagonal head type. Bolts shall be threaded over the full length. All bolt ends shall be rounded or chamfered. Bolts shall be coarse thread fit type. Provide 316 stainless steel hardware for all sleeve type couplings.

2.04 GASKETS

A. Provide gaskets to match the particular service application. Unless otherwise specified or recommended by the coupling Manufacturer, all gaskets for low pressure air service shall be EPDM and all gaskets for waste water service shall be

Nitrile (Buna-N/NBR). The coupling gasket shall match the gasket material used for the piping system.

2.05 MIDDLE RING

A. The pipe stop within the inner surface of the middle ring of couplings shall be omitted as required to permit removal of valves, flow meters, equipment, and appurtenances. All other couplings shall be provided with pipe stops.

B. The middle ring of each sleeve type coupling shall have a thickness at least equal to that of the connecting piping on which the coupling is to be used. All sleeve type couplings shall be a minimum of 10 inches long for pipe 30 inches and larger. All sleeve type couplings shall be a minimum of 7 inches long for pipe under 30 inches in diameter.

C. Couplings which are designed to be self-restrained shall not be required to meet the minimum middle ring length requirements specified.

2.06 JOINT HARNESSES

A. When specified or when shown on the Drawings, anchor sleeve-coupled joints with harness bolts. Weld all harness lugs to steel pipe. All harnesses shall be in accordance with AWWA M11 standards. All harnesses shall be provided with a minimum of two (2) 5/8 inch diameter bolts.

B. All joint harness bolts shall be of sufficient length. Provide harness lugs and install them such that the coupling can be slipped in one direction to clear the joint. Provide harnesses of sufficient number and strength to withstand the test pressure of the piping being connected. Test pressures shall be as indicated by the Engineer or as specified in Section 40 05 13.01 PROCESS PIPE AND FITTINGS. Provide 304L stainless steel harnesses for stainless steel piping systems.

2.07 FINISHING

A. All ferrous metallic surfaces of couplings shall be provided with a standard fusion-bonded epoxy coating. All stainless steel, plastic, brass or bronze parts shall not be painted.

2.08 MANUFACTURER

A. All sleeve type couplings of the same type, style, and duty shall be supplied by a single Manufacturer. All Manufacturers named or otherwise shall comply completely with the Contract Documents. All sleeve type couplings shall be a product of the following Manufacturer:

1. Dresser Piping Specialties

2. Smith-Blair Inc.

3. Engineer Approved Equal

2.09 FLEXIBLE SLEEVE TYPE COUPLINGS - TYPE C02

A. Provide flexible sleeve type couplings to join all plain end pipes and/or transitions in piping materials as shown on the Drawings and as specified herein. In cases where the outside diameters of the piping segments to be connected differ, provide concentric reduction/expansion flexible sleeve type couplings.

B. Flexible sleeve type couplings shall also be provided for all exterior below grade piping runs prior to entering and exiting buildings or structures. The couplings shall be installed prior to the building or structure wall penetration to allow for differential settlement of the piping and structure. All sleeve type couplings shall be rated for use with the same operational pressure as the connecting pipes. The couplings shall also conform to applicable portions of ASTM A 564/A 564M, ASTM C 443, ASTM C 425 and ASTM D 1869 standards. Provide couplings with a 300 series stainless steel shear ring for all below grade installation applications.

C. The couplings shall be designed for a maximum operating temperature of 140 degrees F (non-consistent) and a minimum operating temperature: –30 degrees F. Each coupling shall include two (2) 316 stainless steel band clamps. Each clamp shall be an interlocked housing and band design which strengthens under tension to ensure a positive seal. The bands shall include additional slots to accommodate a greater dimensional range.

D. All flexible sleeve type couplings of the same type, style, and duty shall be supplied by a single Manufacturer. All Manufacturers named or otherwise shall comply completely with the Contract Documents. All flexible sleeve type couplings shall be a product of the following Manufacturer:

1. Fernco, Inc.

2. Engineer Approved Equal

2.10 COUPLING SLEEVE (GASKET)

A. The coupling sleeve shall be constructed of PVC to allow for flexibility and chemical resistance. The PVC sleeve shall also be resistant to ultraviolet rays, fungus growth and sewer gases. All flexible sleeve type couplings shall also be designed in accordance with ASTM D 5926, ASTM C 1173 and CSA B602 standards. All coupling sleeves shall be designed and constructed in accordance with the following criteria:

1. Hardness (Shore A): 65 (+/-) 5

2. Tensile Strength: 1,000 psi (minimum)

3. Elongation at Rupture: 250% (minimum)

4. Tear Strength: 150 lb/in (minimum)

5. Brittleness Temperature: -40°F

2.11 COUPLING SHEAR RINGS

A. For "buried" applications provide couplings with shear rings which are designed for resistance to heavy earth loads and shear forces to provide improved pipe alignment. The shear ring shall be a minimum of 0.12 inches thick 300 series stainless steel. The width of the shear ring shall be manufactured according to coupling width and the length shall be manufactured according to coupling diameter. Each shear ring shall have clamps spot welded in place at the factory.

2.12 SPLIT TYPE COUPLINGS

A. Provide rigid split type couplings for connection of grooved or shouldered end pipe. All split type couplings shall be cast in two (2) segments for sizes 3/4 inch through 14 inch, four (4) segments for sizes 15 inch through 24 inch pipe, and six (6) segments for pipe sizes over 24 inches, to facilitate ease of handling and installation.

B. The couplings shall be designed to engage grooved or shouldered pipe ends while encasing an elastomeric gasket to create a seal between the connected pipe segments. Split type couplings shall be utilized as directed by the Engineer for piping with thin wall thicknesses. The use of split type couplings shall prevent weakening of the piping due to compression.

2.13 GASKETS

A. The Manufacturer shall provide gaskets to match the particular service application. Unless otherwise specified or recommended by the coupling Manufacturer, all gaskets for low pressure air service shall be EPDM and all gaskets for waste water service shall be Nitrile (Buna-N/NBR). All EPDM gaskets shall be rated for a temperature range of -30 degrees F to +230 degrees F. All coupling gaskets shall be equal to the gasket used and recommended by the process piping Manufacturer of the pipe segments to be connected.

2.14 HOUSING

A. The coupling housing shall be constructed of ductile iron conforming to ASTM A 536 standards, grade 65-45-12. The housing shall be provided with two-part fusion bonded epoxy coating for corrosion resistance. Provide all finished coatings as required and as directed by the Engineer. The finished coatings shall be in accordance with the Manufacturer's recommendations as well as that specified in Section 09 90 00 PAINTING & COATING. Provide 316 stainless steel housings for use with stainless steel pipe.

2.15 FASTENERS

A. Only when specified or specifically indicated on the Drawings; provide all couplings with carbon steel bolts and nuts, conforming to ASTM A 183 standards. Unless otherwise specified or indicated on the Drawings, all couplings shall be provided with type 316 stainless steel, Grade B-8M, Class 2, bolts, nuts, and washers.

2.16 PIPING WALL THICKNESS

A. The standards of AWWA C606 as well as the respective coupling Manufacturers require a minimum thickness of pipe walls for use of various split type couplings. Provide piping with the minimum wall thicknesses required (unless a greater thickness is specified or required in the individual pipe Specifications) for use with split type couplings.

B. In the event that the minimum pipe wall thicknesses do not meet the coupling manufacturer or AWWA C606 standards for the minimum requirements for grooving, then a shouldered end treatment with couplings as specified or as shown on the Drawings shall be utilized.

2.17 DUCTILE IRON PIPING

A. All ductile iron pipe for use with split-type coupling joints shall be designed with radius grooved ends and conform to AWWA C606 standards. All ductile iron pipe shall have grooved ends to provide either a rigid joint or flexible joint as shown on the Drawings and as specified.

B. When not specifically specified or shown on the Drawings, provide "rigid" grooved coupling unless otherwise approved by the Engineer. Flexible joint grooving and couplings shall permit expansion, contraction, and angular deflection of the piping. All rigid joint grooving and couplings shall allow no angular or linear movement/deflection. The minimum pipe wall thickness for grooved pipe shall be as specified by the coupling Manufacturer.

2.18 STAINLESS STEEL PIPING

A. Grooved couplings for steel and stainless steel piping shall have roll grooving, machine-grooving, or ring collars fully welded to the pipe or fitting.

2.19 FLEXIBLE SPLIT RING GROOVED END COUPLINGS - TYPE C03

A. Unless otherwise specified or shown on the Drawings, all flexible split ring grooved end type couplings of the same type, style, and duty shall be supplied by a single Manufacturer. All Manufacturers named or otherwise shall comply with the Contract Documents. All flexible split ring grooved end type couplings shall be a product of the following Manufacturer:

1. Victaulic Company of America - Style 77

2. Gustin-Bacon Company

3. Engineer Approved Equal

2.20 FLEXIBLE SPLIT RING SHOULDERED END COUPLINGS - TYPE C04

A. Unless otherwise specified or shown on the Drawings, all flexible split ring shouldered end type couplings of the same type, style, and duty shall be supplied by a single Manufacturer. All Manufacturers named or otherwise shall comply with the Contract Documents. All flexible split ring shouldered end type couplings shall be a product of the following Manufacturer:

1. Victaulic Company of America - Style 44

2. Gustin-Bacon Company

3. Engineer Approved Equal

2.21 RIGID SPLIT RING GROOVED END COUPLINGS - TYPE C05

A. Unless otherwise specified or indicated on the Drawings, provide rigid split ring grooved end couplings on ductile iron pipe less than 36 inches. Pipe wall thickness shall meet all requirements of AWWA C606. If not specifically specified or indicated on the Drawings, the use of rigid split ring grooved end couplings shall only be used with written permission from the Engineer. If approved, all couplings used in place of flanges shall utilize "rigid" grooved pipe connections.

B. Unless otherwise specified or shown on the Drawings, all rigid split ring grooved end type couplings for ductile iron piping, of the same type, style, and duty shall be supplied by a single Manufacturer. All Manufacturers named or otherwise shall comply with the Contract Documents. All rigid split ring grooved end type couplings shall be a product of the following Manufacturer:

1. Victaulic Company of America - Style 31

2. Gustin-Bacon Company

3. Engineer Approved Equal

C. Unless otherwise specified or shown on the Drawings, all rigid split ring grooved end type couplings for manufactured steel and other associated standard groove piping, of the same type, style, and duty shall be supplied by a single Manufacturer. All Manufacturers named or otherwise shall comply with the Contract Documents. All rigid split ring grooved end type couplings shall be a product of the following Manufacturer:

1. Victaulic Company of America - Style 07

2. Gustin-Bacon Company

3. Engineer Approved Equal

2.22 RIGID SPLIT RING SHOULDERED END COUPLINGS - TYPE C06

A. Provide rigid split ring shouldered end couplings as specified and as shown on the Drawings. Utilize rigid split ring shouldered end couplings on all ductile iron pipe over 16 inches or ductile iron pipe without sufficient wall thickness as outlined in AWWA C606 standards. Also utilize rigid split ring shouldered end couplings on all manufactured steel pipe or thin walled stainless steel pipe. Unless otherwise specified or shown on the Drawings the coupling shall be of the same materials of construction as the piping being connected.

B. Unless otherwise specified or shown on the Drawings, all rigid split ring shouldered end type couplings for manufactured steel, ductile iron, stainless steel and other associated thin walled piping, of the same type, style, and duty shall be supplied by a single Manufacturer. All Manufacturers named or otherwise shall comply with the Contract Documents. All rigid split ring shouldered end type couplings shall be a product of the following Manufacturer:

1. Victaulic Company of America - Style 44

2. Gustin-Bacon Company

3. Engineer Approved Equal

2.23 EXPOSED SLEEVE TYPE FLANGED ADAPTORS - TYPE C07

A. Provide exposed sleeve type flanged adaptors for joining "Plain end cast iron, ductile iron, and steel piping at fittings, valves, equipment, flow meters, and other appurtenances as required, specified, as shown on the Drawings or as directed by the Engineer. All flanged adapters shall conform in size and bolt hole placement to ANSI standards for steel and/or cast iron flanges 125/150 pound standard unless otherwise required for connections. The flanged adaptors shall be rated for a minimum pressure of 150 psi.

B. The follower shall be in accordance with AISI C1012 or ASME SA36 standards. The Body and flange shall be of the same material as the connecting piping and designed in accordance with ASTM A 513, ASTM A 635, or ASME SA675 GR60 standards. All ductile iron bodies shall be in accordance with ASTM A 536 standards. All bolts, nuts and washers shall be 316 stainless steel in accordance with AWWA C111/A21.11 standards. Gaskets for waste water service shall be Nitrile (Buna-N/NBR). All flanged adaptors for use in potable water service shall be ANSI/NSF 61 listed. The gasket shall have a nominal temperature range of -20 degrees F to 180 degrees F. All ferrous metal surfaces of flanged adaptors shall be

provided with a corrosion resistant epoxy finish. Stainless steel components shall not be painted.

C. Unless otherwise specified or shown on the Drawings, all exposed sleeve type flanged adaptors, of the same type, style, and duty shall be supplied by a single Manufacturer. All Manufacturers named or otherwise shall comply with the Contract Documents. All exposed sleeve type flanged adaptors shall be a product of the following Manufacturer:

1. Dresser Inc. - Style 128

2. Smith-Blair Inc. - Style 912

3. Engineer Approved Equal

2.24 STAINLESS STEEL SLEEVE TYPE FLANGE ADAPTORS - TYPE C08

A. Provide exposed sleeve type flanged adaptors for joining plain end stainless steel piping at fittings, valves, equipment, flow meters, and other appurtenances as required, specified, and as shown on the Drawings. All flanged adapters shall conform in size and bolt hole placement to ANSI standards for steel and/or cast iron flanges 125/150 pound standard unless otherwise required for connections. The flanged adaptors shall be rated for a minimum pressure of 150 psi.

B. All flange adaptors for stainless steel piping shall be type 316L stainless steel and conform to AWWA C207 standards. Gaskets for low pressure air service piping shall be EPDM with a maximum temperature rating of at least 230 degrees F.

C. Unless otherwise specified or shown on the Drawings, all exposed stainless steel sleeve type flanged adaptors, of the same type, style, and duty shall be supplied by a single Manufacturer. All Manufacturers named or otherwise shall comply with the Contract Documents. All exposed stainless steel sleeve type flanged adaptors shall be a product of the following Manufacturer:

1. Dresser Inc.

2. Smith-Blair Inc.

3. Engineer Approved Equal

2.25 SHORT BODY FLANGED ADAPTORS - TYPE C09

A. Provide exposed "short body" flanged adaptors for joining plain end piping at fittings, valves, fittings, equipment, flow meters, and other appurtenances as required, specified, as shown on the Drawings or as directed by the Engineer. All flanged adapters shall conform in size and bolt hole placement to ANSI standards for steel and/or cast iron flanges 125/150 pound standard unless otherwise required

for connections. The flanged adaptors shall be rated for a minimum pressure of 150 psi.

B. The restraints shall be manufactured of ductile iron conforming to ASTM A 536 standards. The bolt circles and bolt holes shall conform to AWWA C110/A21.10 standards. The screws shall have a Rockwell hardness of C40-45 converted from Brinnell. The flanged adaptor shall be designed with a minimum safety factor of 2 to 1. The flange adaptor shall be UL listed. All flanged adaptors shall be designed for use on water or wastewater pipelines subject to hydrostatic pressure in accordance with AWWA C600 or ASTM D 2774 standards.

C. All flanged adaptor assemblies and related parts shall be processed through a phosphate wash, rinse, and drying operation prior to coating application. The coating shall consist of a minimum of two coats of liquid thermoset epoxy coating with heat cure to follow each coat. All casting bodies shall be surface pretreated with a phosphate wash, rinse, and sealer before drying. The coating shall be electrostatically applied and heat cured. The coating shall be a polyester based powder to provide corrosion, impact, and UV resistance.

D. All short body flanged adaptors of the same type, style, and duty shall be supplied by a single Manufacturer. All Manufacturers named or otherwise shall comply completely with the Contract Documents. All short body flanged adaptors shall be a product of the following Manufacturer:

1. EBAA Iron, Inc. - Series 1000

2. Engineer Approved Equal

2.26 SPLIT TYPE FLANGED ADAPTORS - TYPE C10

A. Provide exposed split type flanged adaptors for joining "Grooved or Shoulder End" piping at fittings, valves, equipment, flow meters, and other appurtenances as required, as specified, and as shown on the Drawings. All flanged adapters shall conform in size and bolt hole placement to ANSI standards for steel and/or cast iron flanges 125/150 pound standard unless otherwise required for connections. The flanged adaptors shall be rated for a minimum pressure of 150 psi. All flanged adaptors shall meet or exceed all applicable AWWA C 219 standards.

B. The flange housing/body shall be ductile iron conforming to ASTM A 536 standards, Grade 65-45-12 or carbon steel conforming to ASTM A 512 and ASTM A 52 standards. The follower flanges shall be ductile iron conforming to ASTM A 536 standards. All ferrous metal surfaces of flanged adaptors shall be provided with a corrosion resistant enamel or two part epoxy paint finish. The prime and finish coatings shall be in accordance with Section 09 90 00 PAINTING AND COATING.

C. Gaskets for waste water service shall be Nitrile (Buna-N/NBR), Grade S, with an NSF 61 listing. The gasket shall have a nominal temperature range of -20 degrees F to 180 degrees F. Gaskets for low pressure air service piping shall be EPDM with a maximum temperature rating of at least 230 degrees F.

D. Only when specified or indicated on the Drawings; provide all flanged adaptors with carbon steel bolts and nuts, conforming to ASTM A 183 standards. Unless otherwise specified or indicated on the Drawings, all flanged adaptors shall be provided with type 316 stainless steel, Grade B-8M, Class 2, bolts, nuts, and washers.

E. Unless otherwise specified or shown on the Drawings, all exposed split type flanged adaptors, of the same type, style, and duty shall be supplied by a single Manufacturer. All Manufacturers named or otherwise shall comply with the Contract Documents. All exposed split type flanged adaptors shall be a product of the following Manufacturer:

1. Victaulic Company of America - Style 341

2. Smith-Blair Inc. - Style 913 or 914

3. Engineer Approved Equal

2.27 EXPANSION JOINTS (LIQUID SERVICE) - TYPE C11

A. Provide single arch flexible connectors of the expansion/vibration type for connection to pumps and equipment as specified and as shown on the Drawings. Expansion joints for liquid waste water service shall be "filled arch" type to prevent sediment build up. Utilize filled arch expansion joints for all sludge, septage, raw waste water, chemicals and other piping of similar fluid service. Guides shall be provided for each expansion joint.

B. All expansion joints shall be designed for the axial movements required for the specified application along with the maximum axial force required to compress the joint. The joints shall prevent axial, lateral and rotational movement and vibration from being transmitted to the piping and equipment. All expansion joints shall be designed for the test pressure of the connecting piping where installed as outlined in Section 40 05 13.01 PROCESS PIPE AND FITTINGS or as directed by the Engineer.

C. Unless otherwise specified or shown on the Drawings, all expansion joints for liquid service, of the same type, style, and duty shall be supplied by a single Manufacturer. All Manufacturers named or otherwise shall comply with the Contract Documents. The manufacturer of the expansion joints shall be a member of the Rubber Expansion Joint Division of the Fluid Sealing Association. All liquid service expansion joints shall be a product of the following Manufacturer:

1. General Rubber Corporation - Style 1025

2. Mercer Rubber Company - Series 450

3. Red Valve Company Inc. - Type J-1

4. Engineer Approved Equal

2.28 MATERIALS OF CONSTRUCTION

A. The expansion joints shall be manufactured of butyl rubber surrounded by high grade woven cotton or suitable synthetic fiber and individual solid steel ring reinforcement. All soft rubber fillers shall be integrally cured into the arches to provide a smooth flow path to prevent settling of material, grit, sludge etc., into the arch. The rubber used shall be specifically designed for service with wastewater and/or sludge. The expansion joints shall include a three-ply abrasion resistant liner.

B. All expansion joints for chemical service shall be constructed of Viton.

2.29 JOINTS

A. Unless otherwise specified or shown on the Drawings, all joints shall match the connecting piping size. The expansion joints shall be designed for the working pressure and fluid service of the connecting piping. All joints shall have full faced fabric reinforced butyl flanges integral with the flexible connector body.

2.30 BACK-UP RINGS

A. Provide stainless steel back-up rings for each joint. Provide Split steel or ductile iron back-up rings only where specifically indicated on the Drawings to ensure a proper joint fit. Unless otherwise specified or shown on the Drawings, all rings shall be designed for mating with ANSI Standard 125/150 pound flanges. All joints shall be provided with a two part epoxy coating finish. Stainless steel back-up rings shall not be painted.

2.31 CONTROL HARNESSES

A. All expansion joints used for vibration isolation/expansion service shall be provided with control harness assemblies. All control harness assemblies shall consist of a minimum of two drilled plates, stretcher bolts, and rubber washers backed by metal washers. The stretcher bolts/control rods shall prevent over-elongation of the joint. Extra nuts shall be provided on the stretcher bolts/control rods on the inside of the plate to prevent over compression. All nuts, bolts, fasteners and plates shall be 316 stainless steel.

2.32 SEAL WATER SYSTEMS

A. Provide flexible connectors for the seal water connection to each pump stuffing box. The flexible connectors shall be designed to isolate vibration from being

transmitted from the pump(s) and the seal water piping assemblies. The flexible connectors shall be hose type constructed of Nitrile (Buna-N/NBR) with a fiber type reinforcement. All hose type flexible connectors shall be rated for a pressure of 150 psi. The hose type flexible connectors shall be a minimum of 12 inches long. Provide type 304L stainless steel or bronze NPT end fittings for connection to the pump stuffing box.

2.33 EXPANSION JOINTS (AIR SERVICE) - TYPE C12

A. Provide "bellows style" flexible connectors of the expansion/vibration type for all low pressure air service piping, equipment, and appurtenances as specified and as shown on the Drawings. The flexible connector shall be "non-filled arch" type. All expansion joints shall be designed for a maximum pressure of 20 psig at a temperature of 250 degrees F. The expansion joints shall be designed to prevent rotational movement and vibration from being transmitted to the piping, equipment, or associated appurtenances. All flexible connectors shall be constructed in accordance with the latest revision of Section C of The Standards of the Expansion Joint Manufacturers, Fifth Edition, 1980, including all current addenda.

B. Flange drilling shall match or be suitable for use with the connected equipment or companion flanges. Furnish guides with all bellows style expansion joints. "Hinged" or "Gimbal" expansion joints shall be provided at horizontal and vertical bends in strict accordance with the standards of the Expansion Joint Manufacturer's Association (EJMA). If reinforcement of the expansion joint is necessary for pressure, reinforcing rings shall be formed integrally with bolted-on control devices such as equalizing rings.

C. All bellows style expansion joints shall be hydraulically formed (with dies on the outside only). All seam welding shall be longitudinal only. All seams shall have equal strength, physical properties and thickness as the parent metal. The entire expansion joint, including but not limited to the bellow and internal sleeve shall be constructed entirely of Type 316 stainless steel (minimum). The end flanges shall be constructed of stainless steel. The entire inside length of the expansion joint shall be straight.

D. The expansion joint Manufacturer shall warrant their product to be suitable for the proposed service conditions as specified and as shown on the Drawings. The Manufacturer shall provide lifting lugs at each flange for ease in handling and removal of sheet metal coverage for any expansion joint for maintenance or installation.

E. Unless otherwise specified or shown on the Drawings, all expansion joints for low pressure air service, of the same type, style, and duty shall be supplied by a single Manufacturer. All Manufacturers named or otherwise shall comply with the Contract Documents. The manufacturer of the expansion joints shall be a member of the Expansion Joint Manufacturer's Association (EJMA). All air service expansion joints shall be a product of the following Manufacturer:

1. U.S. Bellows, Inc.

2. Unaflex Inc.

3. Engineer Approved Equal

2.34 HARNESSINGAND RESTRAINTS

A. Provide all harnessing as specified, as shown on the Drawings, and as required for couplings and adaptors. Unless otherwise specified or noted, the size and material for tie rods, clamps, plates and hex nuts shall be as shown on the Drawings. When not specifically specified or shown on the Drawings all harnessing and restraints shall be provided as required in AWWA M11 standards.

B. All restrained joints, such as welded, or locking mechanical joints shall be of the type specified with the individual type of pipe. If not specified, restrained (locking) mechanical joint pipe shall be of the Manufacturer's standard design utilizing a locking device (ring or ears) integrally cast with the pipe. The Contractor shall be Responsible for all anchorage and restraint for piping installations as shown in the Drawings.

C. Unless otherwise specified or shown on the Drawings, all harnessing and restraint systems, of the same type, style, and duty shall be supplied by a single Manufacturer. All Manufacturers named or otherwise shall comply with the Contract Documents. All harnessing and restraint systems shall be a product of the following Manufacturer:

1. Dresser Inc. - Style 440

2. Engineer Approved Equal

2.35 QUICK CONNECT COUPLINGS - TYPE C13

A. Provide quick connect couplings as specified and as shown on the Drawings. Quick connect couplings shall be provided at all exterior chemical delivery stations, septage delivery stations, and hauled wastewater and sludge pump out/delivery stations.

B. Couplings shall match the connecting pipe size shown on the Drawings. The quick connect couplings shall be cam and groove type with a male/female adapter as required. All quick connect couplings shall conform to A-A-59326 and (MIL-C-27487) standards. All couplings for wastewater and septage service which are connected to metallic piping shall have a body constructed of 316 stainless steel with 316 stainless steel handles and pull rings. All seals for wastewater and/or septage service shall be EPDM for maximum UV resistance in outdoor installations. The male adapter shall connect to the pipe via a 125/150 pound flange connection.

C. All couplings connected to PVC (non-metallic piping) as well as all couplings for chemical delivery or chemical service applications shall have a body constructed of polypropylene. The polypropylene shall be acid-resistant and glass-reinforced. Handles and pull rings for polypropylene couplings shall be brass. Gaskets shall be of a material which is compatible with the process fluid to match the gasket of the piping system, or of a material as specified or as directed by the Engineer. Gaskets for chemical delivery quick connect couplings shall be Viton.

D. The quick connect coupling shall be designed to receive a female/male coupler without requiring threading, bolting, or special tools. The connection shall remain tight and leak-proof under pressures up to 100 psi. Each quick connect coupling shall be furnished with a dust cap complete with an 18 inch long stainless steel security chain. Provide all adaptors and appurtenances as required to provide a complete and working system.

E. Unless otherwise specified or shown on the Drawings, all quick connect couplings, of the same type, style, and duty shall be supplied by a single Manufacturer. All Manufacturers named or otherwise shall comply with the Contract Documents. All quick connect coupling systems shall be a product of the following Manufacturer:

1. OPW Engineered Systems - Kamlock Series

2. Flow Lock Inc. - Snaplock Series

3. Banjo Corporation

4. Engineer Approved Equal

2.36 UNIONS

A. Provide unions as specified and as shown on the Drawings. In addition to that shown on the Drawings, provide unions at all locations including but not limited to the following: equipment, pumps, tanks, valves, long piping runs, piping bypasses around equipment, or any other location as directed by the Engineer or Owner. Unions shall be located to allow for ease of piping disassembly, alterations, or repairs.

B. All unions shall be brass or bronze for joining nonferrous metallic pipe. Provide malleable brass, bronze-seated iron, or steel unions for joining ferrous metallic pipe. Provide PVC unions for joining plastic and non-metallic pipe.

2.37 DIELECTRIC CONNECTORS

A. Provide dielectric piping connectors, fittings, and insulators as specified, as shown on the Drawings or as directed by the Engineer. Dielectric pipe connectors and unions shall be used to prevent galvanic action wherever valves or piping of dissimilar metals connect. In addition, Provide dielectric connectors whenever

copper, brass, or bronze piping is required to be connected to cast iron or steel piping.

B. Provide dielectric flange unions for all connections 2-1/2 inches and larger. All cast iron flanges shall meet ASTM A 126 standards. The copper solder end shall meet ASTM B 62 standards and the pipe thread shall meet ASME B2.1 standards. Dielectric flange unions shall be rated for at least 175 psi at 210 degrees F.

C. Dielectric unions used for piping connections two (2) inches and smaller shall be designed to accommodate the end connections of the two connecting pipe segments. Steel union nuts shall be in accordance with ASTM A 575 standards. Steel or ductile iron connection ends shall have accurately machined taper tapped pipe threads in accordance with ASME B2.1 standards. Copper connection ends shall be solder joint which meets the requirements of ASTM B 88 standards. All dielectric unions for piping connections two (2) inches and smaller shall be rated for at least 250 psi at 210 degrees F.

D. Dielectric fittings and unions shall be manufactured of one or more of the following materials. The materials shall be in accordance with the associated reference standards and criteria:

1. Gray iron - ASTM A 48/A 48M

2. Malleable iron parts - ASTM A 197/A 197M

3. Steel parts - ASTM A 108

4. Brass parts - ASTM B 16

5. Bronze parts - ASTM B 584

6. Zinc parts - ASTM B 633

7. Stainless steel - ASTM A 632

E. All gaskets for water or waste water service shall be Nitrile (Buna-N/NBR) or EPDM. Gaskets for low pressure air service or other high temperature applications shall be EPDM. The Contractor shall ensure that all gaskets are of a material which is compatible with the process fluid. The use of gasket materials shall be as approved by the Engineer and Manufacturer.

F. Unless otherwise specified or shown on the Drawings, all dielectric unions, of the same type, style, and duty shall be supplied by a single Manufacturer. All Manufacturers named or otherwise shall comply with the Contract Documents. All dielectric union systems shall be a product of the following Manufacturer:

1. Watts Inc. - Series 3000

2. Wilkins, a Zurn Company

3. G&L Fittings Inc.

4. Engineer Approved Equal

G. Provide all flange insulating kits for dielectric connections. One insulator shall be provided for each bolt of the flange connection. Insulated sleeve couplings and flange adaptors shall be similar to those units as previously specified.

H. Unless otherwise specified or shown on the Drawings, all flange insulating kits, of the same type, style, and duty shall be supplied by a single Manufacturer. All Manufacturers named or otherwise shall comply with the Contract Documents. All flange insulating systems shall be a product of the following Manufacturer:

1. Watts Inc.

2. Wilkins a Zurn Company

3. Engineer Approved Equal

2.38 RESTRAINED MECHANICAL JOINT COUPLINGS - TYPE C14

A. Provide restrained mechanical joint couplings where indicated on the Drawings or as specified. Restrained mechanical joint couplings shall only be utilized with written permission of the Engineer when not specified or indicated on the Drawings. Restrained mechanical joint couplings shall not be considered as and equivalent to concrete thrust blocks.

B. All restrained mechanical joint couplings shall be listed by Underwriters Laboratories, Inc., as meeting their standard (UL 6M46), latest revision. Restrained mechanical joint couplings shall also comply with Factory Mutual Research Corporation's approvals.

C. Unless otherwise specified or shown on the Drawings, all restrained mechanical joint couplings, of the same type, style, and duty shall be supplied by a single Manufacturer. All Manufacturers named or otherwise shall comply with the Contract Documents. All restrained mechanical joint couplings systems shall be a product of the following Manufacturer:

1. Romac Industries Inc.

2. Engineer Approved Equal

2.39 RETAINER AND FOLLOWER GLANDS

A. Mechanical joint retainer glands shall be incorporated in the design of the follower gland and shall include a restraining ring that, when actuated by a wedging action

of the gland, imparts a restraining force against the pipe that increases as the pressure increases. The restraining ring shall grip the full pipe circumference.

B. Coupling devices that restrain by a method of "Point-Loading" on the pipe shall not be acceptable.

2.40 MATERIALS OF CONSTRUCTION

A. Glands and restraining rings shall be manufactured of Ductile Iron meeting ASTM A 536 standards, Grade 65-45-12. Restraining rings shall also be heat treated to a minimum hardness of Rockwell 40. The restrained mechanical joint couplings shall meet the latest revisions of ANSI A21.10, AWWA C111/A21.11, and AWWA C153/A21.53 standards. The restraint ring shall be actuated solely by the tee-head bolts. Provide a two-part epoxy coating on all ferrous metallic surfaces of couplings.

B. The restrained mechanical joint couplings shall have a working pressure of at least 350 psi with a minimum safety factor of 2:1.

PART 3 – EXECUTION

3.01 INSTALLATION OF SLEEVE TYPE COUPLINGS

A. All sleeve type couplings shall be installed in strict accordance with the recommendations of the coupling Manufacturer. The Contractor shall thoroughly clean all pipe connecting ends prior to installation of sleeve couplings. The pipe ends shall be cleaned a minimum of 8 to 12 inches from the ends of the piping prior to installation. Provide clean soapy water for use as a gasket lubricant.

B. Install the follower ring then the gasket over each pipe end to a distance of approximately 6 inches from the end of the pipe. Place the middle ring over the center of the joint. Insert the pipe length into the middle ring the full and proper distance. The gaskets and followers shall then be pressed evenly into the middle ring flares.

C. Insert all bolts. All bolts shall be finger tightened prior to the use of tools. Progressively tighten diametrically opposite nuts uniformly around the adapter. Once the nuts can no longer be finger tightened use a torque wrench of the appropriate size and torque for the bolts. Utilize the wrench to progressively and uniformly tighten all bolts.

D. The torque applied shall be in accordance with the recommendations of the coupling Manufacturer. The correct torque as indicated by a torque wrench shall not exceed 75 foot-pounds for 5/8 inch bolts and 90 foot-pounds for 3/4 inch bolts.

E. Insert and tighten all tapered threaded lock pins. All bolts shall be finger tightened prior to use of tools. Progressively tighten diametrically opposite nuts uniformly around the adapter. Once the nuts can no longer be finger tightened use a torque

wrench of the appropriate size and torque for the bolts. Utilize the wrench to progressively and uniformly tighten all bolts.

F. Provide and install harnessing or flange clamp assemblies where shown on the Drawings, as specified or as directed by the Engineer. Harnessing or flange clamp assemblies shall be provided to prevent sleeve couplings from being pulled apart under pressure. It shall be the Contractor's responsibility for locating, providing and installing all restraints. Harnessing, flange clamp assemblies, or tie rods shall be provided on all pressurized lines.

3.02 INSTALLATION OF SPLIT TYPE COUPLINGS

A. Install all split type couplings in strict accordance with the recommendations of the coupling Manufacturer. Where applicable the

B. Contractor shall refer to specified procedures for the installation of sleeve type couplings. The shoulders of the connecting pipes as well as all other associated portions of the assembly shall be thoroughly cleaned prior to assembly. The Contractor shall slip the gasket over the pipe end. The ends of the pipes and outside of the gaskets shall be moderately coated with petroleum jelly, cup grease, soft soap, or graphite paste to provide lubrication for installation. Once the other pipe has been brought to the correct position, the gasket shall be centered properly over the pipe ends with the lips against the pipes. The Contractor shall then install the housing sections of the coupling.

C. The Contractor shall ensure that the joints are fully extended after the rings are in place. Do not tighten the bolts prior to assuring that the joints are fully extended. Insert all bolts and tighten nuts progressively and uniformly until the housing sections are in tight contact. Do not overtighten such that excessive bolt tension or strain is applied on the connecting piping. Tighten all fasteners to the torque rating as recommended by the coupling Manufacturer.

3.03 INSTALLATION OF EXPANSION JOINTS

A. Align all piping systems prior to installation of expansion fittings. The alignment shall be provided by fitting a rigid pipe spool in place of the expansion joint. Prior to testing of the piping system, the pipe spool shall be replaced with the specified expansion or flexible fitting.

B. In addition to the locations noted on the Drawings, expansion fittings and anchors shall be located and spaced as specified by the Expansion Joint Manufacturer's Association (EJMA). The Contractor shall not install any expansion joints or flexible connectors during times of temperature extremes or in a fully compressed or fully expanded condition. Install all expansion joints in strict accordance with the Manufacturer's recommendations.

3.04 TESTING

A. All couplings and connectors specified in this section shall be hydrostatically pressure tested with the associated piping as specified in Section 40 05 13.01 PROCESS PIPE AND FITTINGS or as directed by the Engineer.

END OF SECTION

SECTION 40 05 13.03

PROCESS PIPE SUPPORTS

PART 1 – GENERAL

1.01 SUMMARY

A. The Contractor shall provide all labor, materials, equipment, incidentals, hardware and appurtenances to install a complete system of pipe hangers, pipe supports, concrete inserts, anchor bolts and related appurtenances for supporting non-buried piping as shown on the Drawings and as specified herein. All pipe hanger and support systems shall be designed and constructed to resist the seismic forces as specified herein or as indicated on the Drawings.

B. Pipe supports and details are not always specifically shown on the Drawings. The absence of pipe supports and details on the Drawings shall not relieve the Contractor of the responsibility for providing them. Pipe supports indicated on the Drawings are shown only to convey the intent of the design for a particular location and are not intended to represent a complete system.

1.02 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. Unless otherwise noted, the most recent version of the listed publications, including revisions, at time of bid opening shall apply.

B. MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

1. MSS SP-58 (2002) Standard for Pipe Hangers and Supports - Materials, Design and Manufacture

2. MSS SP-69 (2003; R 2004) Standard for Pipe Hangers and Supports – Selection and Application

3. MSS SP-90 (2000) Guidelines on Terminology for Pipe Hangers and Supports

1.03 SUBMITTALS

A. The submittals shall also include but are not limited to the following:

1. Shop Drawings

    a. Submittals shall include complete layout drawings for each piping system. The piping layouts shall indicate the type of hanger and/or support, location, guides, and any other supporting appurtenances including structural attachment hardware.

    b. Where standard hangers and/or supports are not suitable, submit detailed Drawings showing materials and methods of construction for each type of custom hanger and/or support.

2. Product Data

    a. Submit catalog cuts, specifications and dimensioned drawings for each type of pipe hanger, support, and appurtenance. Indicate materials of construction, important dimensions, mounting locations, and range of pipe sizes for which that hanger is suitable.

1.04 QUALITY ASSURANCE

A. Provide pipe hangers and supports of which materials, design, and manufacture comply with MSS SP-58 standards. Select and apply pipe hangers and supports, complying with MSS SP-69 standards. Terminology in this specification is defined in MSS SP-90 standards.

B. The Contractor shall provide the Engineer with detailed Drawings and product data for any construction-related deviations in piping layouts, materials or routing. The review of construction-related deviation submittals shall only be for conformance to the Specifications and Drawings. All piping hangers, supports and appurtenances shall conform to the latest applicable requirements of the State Building Code of the Project location and ANSI B31.1, except as supplemented or modified by the requirements of this specification.

C. All piping hangers, supports and appurtenances shall be of approved standard design where possible. All piping hangers, supports and appurtenances shall be adequate to maintain the supported load in proper position under all operating conditions. The minimum working factor of safety for all supporting equipment, with the exception of springs, shall be one fifth the ultimate tensile strength of the material, assuming a minimum 10 feet of water filled pipe being supported.

D. The Contractor shall coordinate process piping hangers, supports, and appurtenances to eliminate interference with similar support systems to be installed for Plumbing, HVAC, Electrical and other disciplines of Work. The piping support systems shall account for structural expansion joints and co-located piping expansion joints. The piping hanger and support system shall provide and maintain unhindered access to all equipment for both operation and removal. No material handling equipment supports shall be used for piping supports under any circumstances. The Contractor shall not attach piping hangers, supports and

appurtenances from structural struts, or braces unless approved in writing by the Engineer.

E. All process piping and appurtenances connected to equipment shall be supported in such a manner as to prevent any strain or force from being imposed on the equipment. When the equipment Manufacturers have indicated that piping loads shall not be transmitted to their equipment, the Contractor shall submit a written certification stating that such requirements have been complied with.

1.05 QUALIFICATIONS OF MANUFACTURER

A. The fabricator of pipe hangers, supports and related appurtenances shall have not less than five (5) years of current experience in the design and fabrication of the pipe hangers and supports as specified in this section.

1.06 SEISMIC CONDITIONS

A. Provide seismic restraints for all piping systems including but not limited to free standing, suspended or wall mounted piping. Use the restraints defined in the manual when the seismic criteria, and size of piping, are within the limits of the latest edition of the SMACNA Seismic Restraints Manual at the time of bid opening. Select restraints from the tables that represent the highest seismic hazard class or level possible within the State in which the Project resides. Provide members of material of equal strength to those in the standards where materials other than carbon steel are specified. All process piping supports shall be designed in accordance with the seismic criteria indicated in the Contract Documents.

PART 2 – PRODUCTS

2.01 GENERAL

A. The products specified herein are intended to support the various types of process piping systems shown on the Drawings. The Contractor shall be Responsible for developing the final details associated with the specific installation conditions. The details include but are not limited to piping system temperatures and pressures associated with each application.

B. The Contractor may propose minor adjustments to the piping arrangements in order to simplify the supports and/or to resolve conflicts in the layout of process piping systems. An example of an adjustment shall be a minor change to a pipe centerline elevation so that a single trapeze support may be used for a process piping system.

C. Space supports such that the sag of the pipe (if any) is within the limits of the piping Manufacturer. The support design and layout shall be such that it permits drainage of the pipe line. The support design and layout shall minimize bending stresses on the supported piping from concentrated loads between supports.

D. Unless otherwise specified or shown on the Drawings, process piping hangers and supports shall be a Manufacturer's standard product. All products specified or otherwise shall conform to the requirements of MSS SP-58 and MSS SP-69 standards. Any reference to specific catalog or figure numbers from a specific Manufacturer shall be for the purpose of establishing the type, design, and quality of a piping support product. Any references contained in this specification section shall "NOT" be considered as proprietary.

E. All piping supports and hangers of the same type, style, and duty shall be supplied by a single Manufacturer. All Manufacturer's named or otherwise shall comply with the Contract Documents. All process piping supports and hangers shall be a product of the following Manufacturer:

1. Anvil International Inc. (Formerly Grinnell)
2. Carpenter & Patterson Inc.
3. Cooper B-Line Inc.
4. PHD Manufacturing Inc.
5. Engineer Approved Equal

2.02 PIPING FORCES

A. The Contractor shall provide supports for all pipe and tubing to prevent significant stresses in the material, valves, fittings and other connected pipe appurtenances. All supports and anchors shall be designed to secure the pipe in the intended position and alignment. All supports and anchors shall be designed to secure all pipe and tubing against excessive dislocation due to thermal expansion and contraction.

B. The pipe supports and anchor design shall specifically account for internal flow forces, all probable external forces from equipment connection, human contact, and all seismic forces. The Contractor shall provide and install all structural steel members as required to brace any piping system from excessive dislocation. All pipe fittings and appurtenances connected to equipment shall be supported in a manner to prevent any strain from being imposed on the equipment or piping systems. All pipe supports shall be installed such that they do not induce point loadings on the piping. All supports shall distribute pipe loads evenly along the pipe circumference.

C. All valves shall be provided with a dedicated independent supporting system. Supporting of valves by the connected piping shall not be acceptable. All electric and hydraulic valve actuators shall be independently supported.

2.03 COUPLING SUPPORT

A. All flexible couplings shown on the Drawings and as specified for connection to tanks, pumps, equipment, and appurtenances shall be provided with supports. The supports shall be located at the end opposite the tank, pump, equipment, and appurtenance. All such couplings shall be rigidly supported, to prevent transfer of

force to the equipment. Fixed or restraining supports shall not be installed between a flexible coupling and the connected piece of equipment/appurtenance.

2.04 DISSIMILAR METALS

A. All stainless steel piping shall be isolated from all ferrous metals including galvanized steel. Provide a neoprene sheet and/or stainless steel protection shields to prevent direct contact when installed.

B. All copper piping shall be protected from galvanic corrosion from contact with ferrous metals. The Contractor shall provide corrosion protection by wrapping the copper pipe with 1/16 inch thick neoprene, sheet metal and a galvanized protection shield with isolators. Copper plated or PVC-coated hangers and supports may also be used to provide dielectric isolation.

2.05 NON-METALLIC PIPING

A. All uninsulated non-metallic piping including but not limited to "TYPE (PVC/1)", "TYPE (PVC/3)", "TYPE (PVC/4)" and "TYPE (PE/1)", shall be protected from local stress concentrations at each support point. Protection from local stresses shall be provided by PVC coated steel or 304 stainless steel protection shields.

B. All pipes which are bottom supported for 180 degrees shall be provided with arc shields. All pipes which are supported for 360 degrees shall be provided with protection shields for the entire exterior pipe circumference. All protection shields shall have an 18 gauge minimum thickness. All protection shields shall be a minimum of l2 inches in length. The Contractor shall securely fasten each protection shield to the pipe with 304 stainless steel straps not less than 1/2 inches in width.

2.06 INSULATED PIPE

A. All insulated piping shall be provided with a rigid insulating saddle at each pipe support location. Provide protection shields at each support location.

2.07 SUPPORT SPACING FOR METAL PIPE

A. All solid metallic process piping, including but not limited to, cast iron, ductile iron, steel and stainless steel shall be provided with supports spaced in strict accordance with the pipe Manufacturer's recommendations. Provide a minimum of one (1) support per pipe section at joints, changes in direction, and valves. At a minimum provide supports for steel, stainless steel, cast iron, and ductile iron pipe in accordance with the following:

Pipe Size (Inches)	Maximum Span (Feet)
1½ inches & smaller	5 feet
2 inches to 4 inches	10 feet
5 inches to 8 inches	15 feet
10 inches & larger	20 feet

2.08 VERTICAL PIPING

A. Supports for all vertical pipes shall be provided when piping is in close proximity to the floor. All vertical piping shall be provided with Engineer approved supports spaced at intervals of not more than ten (10) feet by approved pipe collars, clamps, brackets, or wall rests.

B. All floor and wall supports for vertical piping runs shall provide rigid and solid support. All vertical pipes passing through pipe sleeves shall be secured using a pipe collar. Whenever possible, floor supports shall be used rather than wall supports. Concrete supports, base elbows, and base tees shall be used where possible and as shown on the Drawings.

2.09 SUPPORT LOCATIONS

A. The Contractor shall provide supports at all changes in directions of piping runs as well as at locations as shown on the Drawings or as specified herein. The Contractor shall NOT support piping from other piping or appurtenances including but not limited to metal stairs, ladders, walkways, or process equipment unless specifically directed or authorized in writing by the Engineer.

B. Pipe supports shall be provided to minimize lateral forces through valves as well as both sides of split type couplings and sleeve type couplings. All supports shall be designed and installed in a manner to minimize all forces on pump housings. Pump housings shall not be utilized to support connecting piping. Piping shall not be used to support process equipment and appurtenances.

2.10 PLASTIC PIPING SUPPORTS

A. Provide continuous support for plastic piping consisting of v-troughs or ladder type cable trays. Refer to the Drawings for typical v-trough multiple pipe support details and requirements.

B. All ladder type cable trays shall be shall be constructed of PVC coated aluminum, aluminum or stainless steel. The ladder rung spacing shall be a maximum of l2 inches. The tray width shall be a minimum of six (6) inches for single piping runs and l2 inches for double piping runs. Provide all appurtenances including but not limited to all hanger rods, rod couplings, concrete inserts, hanger clips, etc., required for a complete support system.

C. Individual plastic pipes shall be secured by strap clamps or fasteners at intervals not be greater than ten (10) feet.

D. All ladder cable trays of the same type, style, and duty shall be supplied by a single Manufacturer. All Manufacturer's named or otherwise shall comply with the Contract Documents. All ladder type cable trays for "TYPE - (PVC/1) piping supports shall be a product of the following Manufacturer:

1. MP Husky - Ladder Cable Tray

2. Cooper B-Line Inc. - Ladder Cable Tray

3. Engineer Approved Equal

E. Where continuous support is not feasible and as directed by engineer, support plastic piping at the following minimum spacing:

Pipe Size (Inches)	Maximum Span (Feet)
1½ inches & smaller	4.5 feet
2 inches to 4 inches	6 feet
5 inches to 8 inches	9 feet
10 inches & larger	10 feet

2.11 MATERIALS OF CONSTRUCTION

A. Unless otherwise specified or shown on the Drawings, all rods, clamps, hangers, inserts, anchor bolts, brackets, components, and appurtenances for interior pipe supports shall be constructed of 304 stainless steel. All interior pipe clamps on plastic pipe shall be provided with a plastic coating or neoprene isolator. All supports for copper pipe shall be copper plated or shall have a minimum 1/16 in plastic coating.

B. All rods, clamps, hangers, inserts, anchor bolts, brackets, components, and appurtenances for exterior pipe, submerged pipe, polymer piping, interior piping within chemical containment areas, pipe within unheated structures, pipe within tanks, interior pipe within manholes, interior pipe within channels, and exterior pipe within channels shall be constructed of stainless steel. The grade of stainless steel shall be in accordance with the following criteria.

C. All process piping support systems shall be constructed of the following materials based on location unless otherwise indicated on the Drawings:

1. All Submerged Piping and Outdoor Piping: 316 Stainless Steel

2. All Interior Building Piping: 304 Stainless Steel

D. All fasteners and related hardware for supports including but not limited to nuts, bolts, and washers shall be 316 stainless steel regardless of location. Fasteners for submerged support locations shall be 316 stainless steel.

2.12 HORIZONTAL PIPING HANGERS AND SUPPORTS

A. Unless otherwise specified or indicated on the Drawings, provide factory fabricated horizontal piping hangers and supports conforming to MSS SP-58 standards. Horizontal piping supports and hangers shall be one of the following Manufacturers Standardization Society of the Valve and Fittings Industry (MSS) types listed below.

B. The specific type of support shall be selected by the Contractor to suit the horizontal piping system layout in accordance with MSS SP-69 standards as well as the piping Manufacturer's published support requirements. Whenever possible, the Contractor shall use only one (1) type of support system by one (1) Manufacturer for each piping service. The Contractor shall select the size of hangers and supports to exactly fit the nominal pipe outside diameter for bare piping, and to exactly fit around piping insulation with a saddle or shield for all insulated piping.

C. Type 5 - Pipe Hangers, Type 12 - Pipe Clamps, and Type 26 - Pipe Clips shall not be used. Type 3 - Three Bolt Pipe Clamps shall not be used on insulated piping systems. Type 24 - U-Bolts shall only be used in conjunction with other pipe support types.

2.13 SINGLE PIPE CLEVIS HANGERS

A. Whenever possible, single process piping runs shall be supported by single pipe adjustable clevis type hangers, (MSS Type 1), suspended by hanger rods from structural steel members, concrete ceilings, or the bottom of trapeze hangers. The clevis type hanger shall be specifically designed for the process piping type being supported as follows:

1. Adjustable Clevis Hangers

    a. Anvil International Inc. - Figure No. 260

    b. Carpenter & Patterson Inc. - Figure No. 100

    c. PHD Manufacturing Inc. - Figure No. 425

    d. Engineer Approved Equal

2. Adjustable Clevis Hangers (Insulated Pipe)

    a. Anvil International Inc. - Figure No. 300

    b. Carpenter & Patterson Inc. - Figure No. 100EL

    c. PHD Manufacturing Inc. - Figure No. 430

    d. Engineer Approved Equal

3. Adjustable Clevis Hangers (Cast Iron or Ductile Iron Pipe):

   a. Anvil International Inc. - Figure No. 590

   b. Carpenter & Patterson Inc. - Figure No. 100DI

   c. PHD Manufacturing Inc. - Figure No. 420

   d. Engineer Approved Equal

2.14 PIPE CLAMPS

A. Single process piping runs supported by Pipe Clamps, (MSS Type 4), shall be in accordance with the following:

1. Anvil International Inc. - Figure No. 212

2. Carpenter & Patterson Inc. - Figure No. 175

3. PHD Manufacturing Inc. - Figure No. 520/521

4. Engineer Approved Equal

2.15 ADJUSTABLE BAND HANGERS

A. Single process piping runs supported by Adjustable Band Hangers, (MSS Type 7), shall be in accordance with the following:

1. Carpenter & Patterson Inc. - Figure No. 1A

2. PHD Manufacturing Inc. - Figure No. 180, 181, & 183

3. Engineer Approved Equal

2.16 PIPE SADDLE SUPPORTS

A. Single process piping runs supported by Pipe Saddle Supports, (MSS Type 36), shall be in accordance with the following:

1. Anvil International Inc. - Figure No. 258

2. PHD Manufacturing Inc. - Figure No. 880

3. Engineer Approved Equal

B. Provide pipe base supports and cast floor flanges for all pipe saddle supports. Refer to the details on the Drawings for additional requirements.

2.17 PIPE STANCHION SADDLES

A. Single process piping runs supported by Pipe Stanchion Saddles, (MSS Type 37), shall be in accordance with the following:

1. Anvil International Inc. - Figure No. 259

2. Carpenter & Patterson Inc. - Figure No. 125

3. PHD Manufacturing Inc. - Figure No. 882

4. Engineer Approved Equal

B. Provide pipe base supports and floor flanges for all pipe stanchion saddles. Refer to the details on the Drawings for additional requirements.

2.18 ADJUSTABLE ROLLER HANGERS

A. Single process piping runs supported by Adjustable Roller Hangers, (MSS Type 43), shall be in accordance with the following:

1. Anvil International Inc. - Figure No. 181

2. Carpenter & Patterson Inc. - Figure No. 140

3. PHD Manufacturing Inc. - Figure No. 470 & 475

4. Engineer Approved Equal

2.19 PIPE ROLL STANDS

A. Single process piping runs supported by Pipe Roll Stands, (MSS Type 44), shall be in accordance with the following:

1. Anvil International Inc. - Figure No. 271

2. Carpenter & Patterson Inc. - Figure No. 54

3. PHD Manufacturing Inc. - Figure No. 486

4. Engineer Approved Equal

2.20 PIPE ROLLS & PLATES

A. Single process piping runs supported by Pipe Rolls and Plates, (MSS Type 45), shall be in accordance with the following:

1. Anvil International Inc. - Figure No. 277

2. Carpenter & Patterson Inc. - Figure No. 63

3. Engineer Approved Equal

2.21 PIPE GUIDES & SLIDE PLATES

A. Provide structural slide assemblies and guides (MSS Type 35) using reinforced polytetrafluoroethylene (PTFE) or graphite slides to allow for longitudinal pipe movement. Slide materials shall be suitable for the system operating temperatures, atmospheric conditions, and bearing loads encountered. Lateral restraints shall be provided as needed. Where slides do not require provisions for lateral restraint the following methods may be used:

1. For piping systems four (4) inches and larger when the temperature of the medium is 60°F or higher, a Pipe Covering Protective Saddle (MSS Type 39) which is welded to the pipe may freely rest on the support.

2. For piping systems less than four (4) inches a Pipe Protection Shield (MSS Type 40) attached to the pipe or insulation, may freely rest on a support.

3. For piping systems four (4) inches and larger carrying medium less than 60°F a Pipe Protection Shield (MSS Type 40), attached to the pipe or insulation, may freely rest on the support.

B. In cases where there are high system temperatures and welding to piping is not desirable, pipe slide assemblies and guides shall include a pipe cradle, welded to the guide structure and strapped securely to the pipe. The pipe shall be separated from the slide material by at least four (4) inches or by an amount adequate for the insulation, whichever is greater.

C. Except as otherwise indicated, provide factory fabricated pipe guides and slide plate systems. Provide pipe guides and slide plates (MSS Type 35) in accordance with the following:

1. Anvil International Inc. - Figure No. 439

2. PHD Manufacturing Inc. - Figure No. 690

3. Carpenter & Patterson Inc. - Figure No. 1010

4. Engineer Approved Equal

2.22 EXTENDED VERTICAL PIPING CLAMPS

A. Except as otherwise indicated, provide factory fabricated extended vertical piping clamps. Use only one type by one Manufacturer for each piping service. Select size of hangers and supports to exactly fit pipe size for bare piping. Provide larger diameter clamps to accommodate insulated piping and shields. Provide vertical piping two bolt extended riser clamps in accordance with the following:

1. Anvil International Inc. - Figure No. 100

2. Carpenter & Patterson Inc. - Figure No. 267

3. PHD Manufacturing Inc. - Figure No. 545

4. Engineer Approved Equal

2.23 OFFSET PIPE CLAMPS

A. Except as otherwise indicated, provide factory fabricated offset vertical piping clamps. Use only one type by one Manufacturer for each piping service. Select the size of clamps and supports to exactly fit the pipe size for bare piping. Copper clad or PVC coated clamps shall be used on all copper piping. Provide vertical piping two bolt offset riser clamps in accordance with the following:

1. Anvil International Inc. - Figure No. 103

2. Carpenter & Patterson Inc. - Figure No. 179

3. PHD Manufacturing Inc. - Figure No. 535

2.24 PIPE RISER CLAMPS

A. Pipe riser clamps (MSS Type 8) shall be used to support vertical piping runs extending through floor slabs. Copper clad or PVC coated clamps shall be used on copper pipes. Insulation shall be provided for the entire diameter of insulated pipes prior to installing riser clamps. Insulation shall not be damaged by clamp installation. Provide pipe riser clamps in accordance with the following:

1. Anvil International Inc. - Figure No. 261

2. Carpenter & Patterson Inc. - Figure No. 126

3. PHD Manufacturing Inc. - Figure No. 550, 551, or 553

2.25 WALL PIPE SUPPORTS

A. Where pipe runs are in close proximity to supports including but not limited to walls, beams, and columns; and are also located an excessive distance from ceilings or the underside of beams, welded stainless steel wall pipe supports shall be used for hanging pipe. In cases where single pipes rest on top of bracket pipe supports, all attachments shall meet requirements as specified under multiple pipe hangers. Provide Structural Wall Pipe Supports in accordance with the following:

B. For Light Duty Applications (MSS Type 31). Light duty applications shall be defined as small diameter piping less than two (2) inches nominal pipe size.

1. PHD Manufacturing Inc. - Figure No. 850

2. Carpenter & Patterson Inc. - Figure No. 69

3. Engineer Approved Equal

C. For Medium Duty Applications (MSS Type 32). Medium duty applications shall be defined as three (3) inch through six (6) inch PVC or Stainless Steel piping.

1. PHD Manufacturing Inc. - Figure No. 855

2. Carpenter & Patterson Inc. - Figure No. 84

3. Engineer Approved Equal

D. For Heavy Duty Applications (MSS Type 33). Heavy duty supports shall be used for all "Type DI/1" piping and all piping larger than six (6) inch nominal pipe size.

1. PHD Manufacturing Inc. - Figure No. 860

2. Carpenter & Patterson Inc. - Figure No. 139

3. Engineer Approved Equal

E. Where applicable and approved by the Engineer the use of "C" channels with stainless steel brackets and pipe clamps shall be provided. All members shall be securely fastened to walls, columns, or other Engineer approved structural members. Attachment shall utilize double expansion shields or other methods as approved by the Engineer. Additional wall bearing plates shall be provided where required.

2.26 MULTIPLE PIPE HANGERS

A. Suspended multiple pipes, running parallel in the same horizontal plane, which are adjacent to each other shall be suspended by trapeze type hangers or wall brackets. Trapeze hangers shall consist of stainless steel or aluminum structural channels supported from stainless steel threaded rods. Whenever possible attach multiple pipe supports to concrete walls, columns, structural steel, and other Engineer approved support members.

B. Provide all other necessary accessories including but not limited to rods, concrete inserts, "C" clamps, beam clamps, welded beam attachments, and expansion shields, as required and as specified for a complete piping support system.

C. Unless otherwise specified or indicated on the Drawings pipe anchors used for attaching pipe to trapeze or multiple pipe wall brackets shall be anchor or pipe chairs as required.

D. The anchors shall be constructed of stainless steel. All chair "U" bolts shall be tightened to allow freedom of movement for normal expansion and contraction of piping runs except where pipe shall be anchored to control direction of movement or act as a thrust anchor.

2.27 HANGER ROD ATTACHMENTS & BEAM CLAMPS

A. All hanger rod attachments shall be stainless steel, machine threaded, and passivated after fabrication. The strength of the rod shall be based on its root diameter. Hanger rods shall be attached to concrete structures using concrete inserts. Threaded rods shall not be formed or bent in the field.

B. All inserts shall be malleable iron, or steel with a galvanized finish. Beam clamps, "C" clamps, or welded beam attachments shall be used for attaching hanger rods to structural steel members. Where required and as

C. approved by the Engineer, expansion anchors shall be used for attaching to concrete structures. Provide a bituminous coating for all iron or steel in direct contact with concrete.

D. All Top Beam C-Clamps (MSS Type 19) and C-Clamps (MSS Type 23) shall be torqued in accordance with MSS SP-69 standards. Both locknuts and retaining devices shall be furnished by the piping support

E. Manufacturer. Field fabricated clamp bodies and retaining devices shall not be acceptable. Side Beam or Channel Clamps (MSS Type 20) shall be provided with an added iron heel plate or adaptor. U-bolts (MSS Type 24) shall only be used in conjunction with trapeze hanger systems or on fabricated frames. Whenever possible utilize Center Beam Clamps (MSS Type 21).

2.28 ANCHORS

A. The Contractor shall anchor piping at locations indicated on the Drawings or required per the Specifications. The anchor design and materials shall be in accordance with ANSI/ASME B.31 standards. Additional anchoring shall be provided as approved by the Engineer. All anchors shall be 316 stainless steel regardless of installation location.

B. The length of expansion bolts shall be sufficient to place the wedge portion of the bolt a minimum of one (1) inch behind the steel reinforcement. Concrete anchors for ceiling mounted pipe supports and appurtenances shall be adhesive or expansion type.

C. Anchors for wall supports, floor supports and all related appurtenances shall be in accordance with the following. Size all supports as required for proper support as well as to provide compatibility with the associated pipe support.

1. Hilti - Kwok-Bolt

2. Simpson Strong-Tie - Wedge All

3. Powers Power-Stud

4. Engineer Approved Equal

2.29 INSULATION SHIELDS & SADDLES

A. Provide Pipe Covering Protective Saddles (MSS Type 39) on insulated pipe four (4) inches and larger when the temperature of the medium is 60°F or higher. All Pipe Covering Protective Saddles shall be welded to the pipe. The saddle materials of construction shall match the connecting pipe.

B. Provide Pipe Protection Shields (MSS Type 40) for use on insulated piping systems less than four (4) inches. Shields may be used on piping systems larger than four (4) inches when the temperature of the medium is 60°F or less. All shields shall be 304 stainless steel.

C. Single process piping protective sleeves (MSS Type 40), shall be stainless steel, 14 gage sheet metal. All protective shields shall be in accordance with the following:

1. Anvil International Inc. - Figure No. 167

2. Carpenter & Patterson Inc. - Figure No. 265

3. PHD Manufacturing Inc. - Figure No. 170

4. Engineer Approved Equal

2.30 HORIZONTAL SMALL DIAMETER PIPE SUPPORT

A. Horizontal piping runs less than three (3) inches in diameter shall be held in position by supports fabricated from 304 stainless steel or aluminum "C" channels, welded post bases and pipe clamps.

B. Where required to assure adequate support, fabricate supports using two vertical members and post bases connected together by a horizontal member of sufficient load capacity to support the piping run. Wherever possible supports shall be anchored to nearby walls or other structural members to provide horizontal rigidity. More than one pipe may be supported from a common fabricated support as approved by the Engineer.

2.31 CUSTOM FABRICATED PIPE SUPPORTS

A. Whenever possible the Contractor shall utilize standard piping supports and appurtenances. If standard supports are not suitable for an application, the Contractor shall furnish custom fabricated structural steel shapes, concrete, and anchor hardware for support of process piping systems. All custom fabricated supports shall be of approved materials of construction identical to items previously specified herein. All anchor hardware shall be similar to items previously specified herein and shall meet the minimum requirements for support as approved by the Engineer. All custom fabricated piping supports shall be subject to the approval of the Engineer.

B. All pipe support systems shall meet all requirements of this Section and all related Sections as well as the Drawings. Complete design details of the pipe support system and system components shall be submitted for review and approval as specified. No hanger or support shall be installed without the written approval of the Engineer. The pipe support system shall not impose loads on the supporting structures in excess of the loads for which the supporting structure was designed.

2.32 THIN-WALLED PIPE SUPPORTS

A. Supports for thin walled pipe shall be provided per the requirements of this specification, and shall include all required saddle bracing to avoid damaging the pipe at the point of contact with the associated support.

2.33 CONCRETE INSERTS

A. Provide inserts (MSS Type 18) to allow a connection point for hanger rods in concrete. Inserts shall be secured to concrete forms before concrete is placed. Continuous inserts which allow more adjustment may be used if they otherwise meet the requirements for (MSS Type 18) inserts. Provide a bituminous coating for all metallic inserts in direct contact with concrete. All concrete inserts shall be in accordance with the following:

1. Anvil International Inc. - Figure No. 282

2. Carpenter & Patterson Inc. - Figure No. 650

3. PHD Manufacturing Inc. - Figure No. 951

4. Engineer Approved Equal

PART 3 – EXECUTION

3.01 GENERAL

A. Hangers, supports, and guides shown on the Drawings are for estimating purposes only and represent recommendations based on assumed pipe routing. The Contractor shall be Responsible for actual routing and installation of all hangers, supports and guides for complete piping systems.

B. The Contractor shall proceed with the installation of piping and supports only after any building structural Work has been completed and all new concrete has reached its specified design strength. The installation of pipe support systems shall in no way interfere with the operation of monorails, access hatches, building system, overhead doors, etc. The installed systems shall not interfere with maintenance and operational access to any equipment installed under this Section, or any other related Section.

C. All pipe supports shall be designed with liberal strength and stiffness to support the respective pipes under the maximum combination of peak loading conditions to

include pipe weight, liquid weight, liquid movement and pressure forces, thermal expansion and contraction, vibrations and all probable externally applied forces including seismic forces. Prior to installation, all pipe support systems shall be approved by the Engineer.

3.02 INSTALLATION OF BUILDING ATTACHMENTS

A. Install building attachments at required locations within concrete. Space attachments where support is required for additional concentrated loads, including flanges, valves, guides, strainers, expansion joints, and at changes in direction of piping.

B. Apply anti-seize compound to all nuts, bolts, and other associated fasteners. Supports installed without the approved anti-seize compound shall be dismantled and correctly installed, at no additional cost to the Owner or Engineer.

3.03 INSTALLATION OF HANGERS AND SUPPORTS

A. Install hangers, supports, clamps, and attachments to support piping properly from building structures in accordance with MSS SP-69. Arrange for grouping of parallel runs of horizontal piping to be supported together on trapeze type hangers where possible. Install supports with maximum spacing complying with MSS SP-69. Where piping of various sizes is to be supported together by trapeze hangers, space hangers for smallest pipe size or install intermediate supports for smaller diameter pipe. Do not use wire or perforated metal to support piping, and do not support piping from other piping. No piping shall be supported from existing precast concrete tees, metal stairs, ladders and/or walkways unless specifically directed or authorized by the Engineer.

B. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories. Except as otherwise indicated for exposed continuous pipe runs, install hangers and supports of same type and style as installed for adjacent similar piping.

C. Install hangers and supports such that piping live and dead loading, and stresses from movement, will not be transmitted to connected equipment. Equipment shall not be used to support piping.

D. Except as otherwise permitted, make provisions for vertical adjustment of all hangers after installation. Locate one hanger immediately adjacent to each change of direction and offset, additional hangers where installation of inline equipment produces concentrated loads. Provide additional guides or supports at offsets in piping as necessary to prevent deflection of the pipe axis due to expansion or pressure forces except where right angle bends are utilized to compensate for expansion.

E. Provide hangers and/or supports immediately adjacent to either side of all in-line instruments, including but not limited to valves and flow meters.

3.04 COUPLING SUPPORT

A. Pipe supports shall be provided to minimize lateral forces through valves, both sides of split type couplings and sleeve type couplings (within four pipe diameters) and to minimize all pipe forces on pump housings and other equipment. Pump housings and other equipment shall not be utilized to support connecting pipes.

3.05 CONCRETE INSERTS

A. Concrete inserts for pipe hangers and supports shall be installed on forms before concrete is placed. Before setting these items, all Drawings and figures shall be checked which have a direct bearing on the pipe location. Responsibility for the proper location of pipe supports shall be the responsibility of the installing Contractor. Continuous metal inserts shall be embedded flush with the concrete surface. Provide a bituminous coating for all metallic concrete inserts in contact with concrete.

3.06 FINISHING

A. All sharp edges and comers within 7 feet of the floor or walking surfaces shall be ground down and/or protected with plastic protective covers. All ferrous metal surfaces shall be finished in accordance with Section 09 90 00 PAINTING AND COATING. Stainless steel, galvanized steel, plastic, brass, bronze, copper and FRP components shall not be painted unless otherwise indicated in the Contract Documents.

3.07 TESTING

A. All pipe support systems shall be tested for compliance with this Section. After installation, each pipe support system shall be tested in conjunction with the respective piping pressure tests as specified in Section 40 05 13.01 PROCESS PIPE AND FITTINGS. If any part of the pipe support system proves to be defective or inadequate, it shall be repaired or augmented under this Section to the satisfaction of the Engineer at no additional cost to the Owner or Engineer.

END OF SECTION

SECTION 40 05 13.04

PROCESS PIPE SLEEVES & SEALS

PART 1 – GENERAL

1.01 SUMMARY

A. Provide all labor, materials, equipment, incidentals and appurtenances required to install pipe penetration assemblies as indicated on the Drawings and as specified herein. The following specification section outlines the materials and designs for the various pipe penetration configurations as shown on the Drawings. Refer to the Drawings for additional details and requirements for each configuration.

1.02 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. AMERICAN WATER WORKS ASSOCIATION (AWWA)

   a. AWWA C110/A21.10 Ductile-Iron and Gray-Iron Fittings for Water

   b. AWWA C111/A21.11 Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings

   c. AWWA C115/A21.15 Flanged Ductile-Iron Pipe With Ductile-Iron or Gray-Iron Threaded Flanges

   d. AWWA C151/A21.51 Ductile-Iron Pipe, Centrifugally Cast, for Water

   e. AWWA C153/A21.53 Ductile-Iron Compact Fittings for Water Service

2. ASTM INTERNATIONAL (ASTM)

   a. ASTM D 2000 Standard Classification System for Rubber Products in Automotive Applications

   b. ASTM D 297 Rubber Products - Chemical Analysis

   c. ASTM D 395 Standard Test Methods for Rubber Property - Compression Set

   d. ASTM D 412 Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers - Tension

   e. ASTM F 593 Stainless Steel Bolts, Hex Cap Screws, and Studs

   f. ASTM F 594 Standard Specification for Stainless Steel Nuts

1.03 SUBMITTALS

A. Submit in accordance with Division 01 General Requirements.

1. SD-03 Product Data

a. Submittals

b. Pipe Sleeves and Seals

c. Submittal Requirements

B. Product data shall include Manufacturer's descriptive data, technical literature, performance charts, performance curves, catalog cuts, and installation instructions. Include all spare parts data for each different item of material and equipment specified. Provide literature, installation instructions, and where applicable, fire ratings and certified test results of the various components on all sleeves and seals to be furnished.

1.04 QUALIFICATIONS OF MANUFACUTRER

A. Materials and equipment shall be the standard products of a Manufacturer regularly engaged in the production of such products and shall essentially duplicate items that have been in satisfactory use in identical applications in other wastewater treatment facilities. The Manufacturer shall have a minimum of five (5) years of documented experience in the design and production of pipe sleeves and seals of "all types", and not less than five (5) years of experience in the production of equal or larger sized models or designs of the exact products as specified herein.

B. The Manufacturer shall provide an installation list of at least twenty (20) similar installations, including contact names and phone numbers. Products shall be supported by a service organization that is, in the opinion of the Engineer, reasonably convenient to the Site to ensure parts and service can be acquired in a timely fashion.

1.05 FIELD MEASUREMENTS

A. The Contractor shall become familiar with all details of the Work, verify all dimensions in the field, and shall advise the Engineer of any discrepancy before performing the Work. The Contractor shall coordinate with equipment Suppliers to determine and collect required field dimensions to ensure equipment, piping and pipe supports are properly manufactured and located in field.

1.06 SPECIAL TOOLS

A. Furnish one set of all special tools required to completely assemble, disassemble, or maintain the equipment and appurtenances. Special tools shall refer to oversized or specially dimensioned tools, special attachments or fixtures, or any similar items.

PART 2 – PRODUCTS

2.01 PIPE SLEEVES

A. Provide pipe wall sleeves and seal penetrations as indicated on the Drawings. Unless otherwise specified or indicated on the Drawings, all pipe sleeves 24 inches and smaller be constructed of High Density Polyethylene (HDPE). The use of ferrous metallic sleeves shall not be acceptable. All pipe sleeves larger than 24 inches shall be constructed of 304L stainless steel. Pipe sleeves of all sizes and materials shall include a two (2) inch (minimum) circumferential water stop welded or integrally molded to the exterior of the sleeve at its midpoint. The sleeve length shall be specifically coordinated with the respective thickness of the penetrated structural wall, floor or ceiling. Ends of sleeves shall be flush with the wall or ceiling and extend a minimum of four (4) inches above finished floors. Refer to the piping penetration details on the Drawings for additional information and requirements. Pipe sleeves which penetrate masonry block walls shall not require an integral water stop.

B. Pipe sleeves which are to be sealed with mechanical seals shall be sized in accordance with the recommendations of the seal manufacturer.

C. Sleeves to be sealed by caulking or sleeves for insulated piping shall be sized, constructed and installed as specified or as indicated on the Drawings. All pipe sleeves which penetrate fire rated walls, floors or ceilings shall be 304L stainless steel regardless of size.

D. All pipe sleeves shall be supplied by a single Manufacturer. All Manufacturer's, named or otherwise shall comply completely with the Contract Documents. All wall pipe sleeves shall be a product of the following Manufacturer:

1. Pipeline Seal & Insulator, Inc.

2. Advance Products & Systems, Inc. - "Infinity Series"

3. Engineer Approved Equal

2.02 WALL CASTINGS (WALL PIPE)

A. Provide wall castings (wall pipe) as specified or indicated on the Drawings. All wall castings shall be constructed of ductile iron conforming to AWWA C151/A21.51 standards, Class 53, with a diameter to match the connecting piping system. Ductile iron, wall castings shall be grade 60-42-10. All wall castings shall have minimum physical properties in accordance with the following:

1. Minimum Tensile Strength: 60,000 psi

2. Minimum Yield Strength: 42,000 psi

3. Minimum Elongation: 10%

B. Flanges and/or mechanical joint bells shall be drilled and tapped for studs where flush with the wall. Castings shall be provided with a two (2) inch minimum circumferential flange/waterstop integrally cast with or welded to the pipe. All welded flanges/waterstops shall include a continuous 360 degree fillet weld on both sides of the collar over the entire circumference of the wall pipe. The pipe collar shall be designed for use as both a thrust collar and a water stop mechanism.

C. Unless otherwise noted, all cast flanges shall be in accordance with AWWA C110/A21.10, AWWA C153/A21.53 and AWWA C115/A21.15 standards. All mechanical joints shall be in accordance with AWWA C111/A21.11 standards. Fabricated mechanical joint bells shall be in accordance with applicable portions of AWWA C153/A21.53 standards. Flanges shall be designed for a 125 lb drilling pattern.

D. For castings set flush with walls, locate the flange/waterstop at the center of the overall length of the casting. For castings which extend through the wall locate the flange/waterstop within the middle third of the wall. All ductile iron wall castings shall be provided with a two-part epoxy prime and finished coating system in accordance with Section 09 90 00 PAINTINGS AND COATINGS. In addition, provide a bituminous coating on all surfaces of wall castings which are in contact with concrete.

E. Stainless steel wall pipes shall be provided for all stainless steel piping systems to match the connecting piping. All stainless steel wall pipes shall be Schedule 10S, Type 304L stainless steel with a two (2) inch minimum circumferential flange/waterstop integrally cast with or welded to the pipe. All stainless steel wall pipes shall be in accordance with the requirements of "Types SS/1" piping as noted in Section 40 05 13.01 PROCESS PIPE AND FITTINGS.

F. All ductile iron wall castings shall be supplied by a single Manufacturer. All Manufacturer's, named or otherwise shall comply completely with the Contract Documents. All wall castings (wall pipes) shall be a product of the following Manufacturer:

1. American Cast Iron Pipe Company

2. Clow Water Systems Company

3. Engineer Approved Equal

2.03 MECHANICAL PIPE SEALS

A. Unless otherwise specified or indicated on the Drawings; all core drilled or sleeved wall, floor and ceiling penetrations shall be provided with a modular, mechanical type, sealing system. The sealing system shall consist of inter-locking synthetic rubber links shaped to continuously fill the annular space between the pipe and the cored opening or pipe sleeve. The elastomeric element shall be sized and selected in accordance with the Manufacturer's recommendations and sizing guidelines. Coloration shall be throughout elastomer as indicated below for the respective seal materials to allow for

positive field identification. Each link shall have a permanent identification of the size and Manufacturer's name molded into it. Each seal shall be rated by the manufacturer for positive sealing at a minimum pressure of 40 feet of water or 20 psig. All mechanical pipe seals shall have the following properties. Provide mechanical pipe seals for each respective application as indicated in the following paragraphs:

1. General Service Applications: EPDM seals per ASTM D 2000standards. Color: black. Pressure plates: reinforced nylon polymer or composite material. Seals: rated for a temperature range of -40 to 250°F. Minimum EPDM durometer hardness (Shore A) shall be 50 (+/-) 5. Areas where this type of seal shall be used include but are not limited to the following:

    a. Dry Process Areas

    b. Below Grade Vaults

2. Thin Wall Pipe Applications: EPDM seals per ASTM D 2000 standards. Color shall be blue. Pressure plates shall be constructed of reinforced nylon polymer or composite material. Seals shall be rated for a temperature range of -40 to 250°F. The minimum EPDM durometer hardness (Shore A) shall be 40 (+/-) 5. Examples of thin walled pipe include but are not limited to the following:

    a. Copper Tubing

3. Wastewater or Corrosive Chemical Service Applications: Where sewage gas or solvents may present (see partial list below), utilize EPDM seal elements per ASTM D 2000 standards. Color shall be black. Pressure plates shall be constructed of reinforced nylon polymer or composite material. Temperature rating shall be -40°F to 250°F. The minimum EPDM durometer hardness (Shore A) shall be 50 (+/-) 5. Areas where this type of seal shall be used include but are not limited to the following:

    a. Pumping Stations

    b. Collection System

    c. Exterior Areas Exposed to Direct Sunlight

4. Fire Rated or High Temperature Penetration Applications: Silicone or rubber seal elements. All seals shall meet or exceed the fire rating requirements of the wall, floor or ceiling which is penetrated. Provide a double seal for all fire rated penetrations. Color shall be gray or red. All seals shall be rated for a temperature range of at least -67 to 400°F. Pressure plates shall be constructed of corrosion resistant zinc plated steel. All Fire Rated seals shall be Factory Mutual (FM) approved for the rating of the constructed element being penetrated. Refer to the Drawings for the fire ratings of each respective area.

5. Oil Resistant Applications: utilize Nitrile (NBR/Buna-N) seal elements. Typical oil resistant applications include but are not limited to areas with exposure to solvents, oil, and hydraulic fluid. Color shall be green. Pressure plates shall be constructed of reinforced nylon polymer or composite material.

Temperature rating shall be -40°F to 210°F. The minimum EPDM durometer hardness (Shore A) shall be 50 (+/-5).

B. Provide mechanical seals with wall sleeves for new construction where specified or as indicated on the Drawings. Provide seals for cored openings for existing construction where pipe penetrations pass through a sound concrete wall. When a pipe penetration into a tank or other vessel is below the high water level, provide two (2) mechanical seals, one flush with the inside wall and one flush with the outside wall. Mechanical seal hardware shall be oriented towards the wall side which allows for future access. Refer to the Drawings for additional details and requirements.

C. All mechanical pipe seals shall be supplied by a single Manufacturer. All Manufacturer's, named or otherwise shall comply completely with the Contract Documents. All pipe seals shall be a product of the following Manufacturer:

1. Pipeline Seal & Insulator, Inc. - "Link-Seal"

2. Advance Products & Systems, Inc. - "Innerlynx"

3. Engineer Approved Equal

2.04 MECHANICAL PIPE SEAL PROPERTIES

A. All EPDM mechanical pipe seals shall be designed and constructed in accordance with the following minimum physical and chemical properties:

1. Tensile Strength: 1,450 psi per ASTM D 412

2. Elongation At Break: 400% per ASTM D 412

3. Compression Set: 15% 22 hrs. at 150°F per ASTM D 395

4. Specific Gravity: 1.10 per ASTM D 297

B. All Silicone mechanical pipe seals shall be designed and constructed in accordance with the following minimum physical and chemical properties:

1. Tensile Strength: 860 psi per ASTM D 412

2. Elongation At Break: 250% per ASTM D 412

3. Compression Set: 38% 22 hrs. at 150°F per ASTM D 395

4. Specific Gravity: 1.30 per ASTM D 297

C. All Nitrile (NBR/Buna-N) mechanical pipe seals shall be designed and constructed in accordance with the following minimum physical and chemical properties:

1. Tensile Strength: 1,200 psi per ASTM D 412

2. Elongation At Break: 300% per ASTM D 412

3. Compression Set: 45% 22 hrs. at 150°F per ASTM D 395

4. Specific Gravity: 1.15 per ASTM D 297

2.05 SEALING OF FLAMMABLE PIPE

A. All pipe sleeves which penetrate fire rated walls, floors or ceilings shall be 304L stainless steel regardless of size. In cases where small diameter flammable plastic pipes penetrate fire rated construction, provide an intumescent pipe wrap with a rating which meets or exceeds the fire resistance requirements of the area. Examples of flammable plastic pipes include but are not limited to PVC, UPVC, ABS, polypropylene, and polyethylene. All intumescent pipe wrap shall be water resistant as well as halogen and plasticizer free. Provide a minimum fire expansion rate of 40:1.

B. In cases where larger diameter flammable plastic pipes penetrate fire rated construction, provide an intumescent pipe collar with a rating which meets or exceeds the fire resistance requirements of the area. The collar shall be surface mounted for existing construction. Provide centrally cast flush fitted collars for new construction. Pipe collars shall be galvanized or epoxy coated steel and contain high-performance intumescent material. On exposure to heat from a fire the pipe collars shall rapidly expand inwards to squeeze the collapsing flammable pipe until the aperture is completely sealed. For horizontal installations the collar may be surface mounted or recessed depending upon the construction installation requirements. Install a collar on one or both sides of walls, floors, or ceilings according to the direction of risk. Provide fire rated insulation, caulk, putty, mortar, pillows and hardware to provide a complete installation.

C. All fire rated sealing systems shall be supplied by a single Manufacturer. All Manufacturer's, named or otherwise shall comply completely with the Contract Documents. All fire rated pipe collars, wraps and related appurtenances shall be a product of the following Manufacturer:

1. 3M Fire Protection Products

2. Hilti Corporation

3. Biofireshield Company

4. Engineer Approved Equal

2.06 HARDWARE

A. All process pipe sleeve and seal hardware, including mechanical seal hardware shall be 316 stainless steel in accordance with ASTM F 593 and ASTM F 594 standards. The minimum hardware tensile strength shall be 60,000 psi. Provide dielectric insulation and/or isolation between ferrous metal surfaces and stainless steel hardware.

PART 3 – EXECUTION

3.01 GENERAL INSTALLATION

A. Install pipe sleeves, seals and wall castings of the types and configurations as indicated on the Drawings. Provide sleeves, seals and wall castings where piping passes through walls, floors, ceilings, and roofs. Do not install sleeves through structural members of Work, except as detailed on the Drawings, or as approved by the Engineer. Install all sleeves and castings accurately centered on pipe runs. Size wall sleeves so that piping and insulation (if any) will have free movement in the sleeve, including allowance for thermal expansion; but not less than two (2) pipe sizes larger than the piping run.

B. Provide and install sleeves and wall castings with a length equal to thickness of the construction being penetrated. Unless otherwise specified or indicated on the Drawings all wall sleeves and castings shall be finished flush to the wall construction being penetrated. Floor sleeves shall be extended a minimum of four (4) inches above the finished floor in Process Areas. Provide temporary supports of sleeves, and provide temporary closure to prevent concrete and other materials from entering sleeves during construction.

3.02 MECHANICAL PIPE SEAL INSTALLATION

A. Center the pipe in the cored or sleeved opening. Provide temporary support for the pipe on both ends. Loosen the rear pressure plate with nut just enough so mechanical links move freely. Connect both ends of belt around the pipe. Check to be sure all bolt heads are facing the installer. Extra slack or sag is normal. Do not remove links if extra slack exists. On smaller diameter pipe, links may require stretching. Slide belt assembly into annular space. For larger size belts, start inserting the mechanical seal assembly at the 6 O'clock position and Work both sides up toward the 12 O'clock position in the annular space.

B. Using a hand socket or offset wrench only, start at 12 O' Clock. Do not tighten any bolt more than 4 turns at a time. Continue in a clockwise manner until links have been uniformly compressed. Approximately 2 or 3 rotations is typical. Make 2 or 3 more passes at 4 turns per bolt maximum, tightening all bolts clockwise until all sealing elements "bulge" around all pressure plates. If the mechanical seals include type 316 stainless steel bolts, hand tighten ONLY without use of power tools to prevent galling.

END OF SECTION

SECTION 40 05 23.01

PROCESS VALVES AND STRAINERS

PART 1 – GENERAL

1.01 DESCRIPTION OF WORK

A. The Contractor shall provide and test process valves, strainers, and appurtenances as shown on the Drawings and as specified herein. The valves, strainers, and appurtenances shall be of sizes and connection types as shown on the Drawings as well as that specified herein. The following sections reference the process valve type and specification reference numbers shown in the valve tag symbols on the Drawings. Valves without valve tag symbols are specified elsewhere. **The valves and strainers included in this specification section may or may not all be required for the Work of the Contract.** The Contractor shall be Responsible for providing all valves that are indicated on the Drawings and/or are required to complete the Work outlined in the Contract Documents.

1.02 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. AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

    a. ANSI B16.1 Cast Iron Pipe Flanges and Flanged Fittings Classes 25, 125, and 250 Ref Title

2. ASTM INTERNATIONAL (ASTM)

    a. ASTM A 126 Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings

    b. ASTM A 216/A 216M Standard Specification for Steel Castings, Carbon, Suitable for Fusion Welding, for High-Temperature Service

    c. ASTM A 240/A 240M Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications

    d. ASTM A 276 Standard Specification for Stainless Steel Bars and Shapes

    e. ASTM A 351/A 351M Standard Specification for Castings, Austenitic, Austenitic-Ferritic (Duplex), for Pressure-Containing Parts

f. ASTM A 436 Standard Specification for Austenitic Gray Iron Castings

g. ASTM A 48/A 48M Standard Specification for Gray Iron Castings

h. ASTM A 536 Standard Specification for Ductile Iron Castings

i. ASTM B 124/B 124M Standard Specification for Copper and Copper Alloy Forging Rod, Bar, and Shapes

j. ASTM B 150/B 150M Standard Specification for Aluminum Bronze Rod, Bar, and Shapes

k. ASTM B 505/B 505M Standard Specification for Copper-Base Alloy Continuous Castings

l. ASTM D 2000 Standard Classification System for Rubber Products in Automotive Applications

m. ASTM D 3222 Unmodified Poly(Vinylidene Fluoride) (PVDF) Molding Extrusion and Coating Materials

n. ASTM D 4024 Machine Made "Fiberglass" (Glass-Fiber-Reinforced Thermosetting Resin) Flanges

o. ASTM D 429 Standard Test Methods for Rubber Property-Adhesion to Rigid Substrates

p. ASTM B 61 Standard Specification for Steam or Valve Bronze Castings

q. ASTM B 62 Standard Specification for Composition Bronze or Ounce Metal Castings

r. ASTM D 1784 Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds

3. ASME INTERNATIONAL (ASME)

a. ASME B16.5 Pipe Flanges and Flanged Fittings NPS 1/2 Through NPS 24 Addenda A - 10/26/1998

B. AMERICAN WATER WORKS ASSOCIATION (AWWA)

a. AWWA C550 Protective Epoxy Interior Coatings for Valves and Hydrants

b. AWWA D102 Coating Steel Water-Storage Tanks

c. AWWA C504 Standard for Rubber-Seated Butterfly Valves

d. AWWA C508 Swing-Check Valves for Waterworks Service, 2 In. (50 mm) Through 24 In. (600 mm) NPS

e. AWWA C509 Resilient-Seated Gate Valves for Water Supply Service

C. ASTM INTERNATIONAL (ASTM)

a. ASTM B 584 Standard Specification for Copper Alloy Sand Castings for General Applications

1.03 SUBMITTALS

A. Submit in accordance with Division 01 General Requirements.

B. Shop Drawings

1. Submittals

2. Process Valves

3. Submittal Requirements

a. Shop Drawings shall include descriptive literature, bulletins and/or catalog cuts of the valves and strainers as well as a complete bill of materials. Include the weights of all components. The Drawings shall specifically outline all required clearances for maintenance and manual operation. Shop Drawings shall show layout and dimensions of equipment, major components, key alignment locations and locations of bolt holes. Drawings shall also indicate where access points for maintenance and operations are located on the equipment. Drawings shall show all critical field dimensions identified by the Manufacturer and obtained by the Contractor.

C. Product Data

1. Submittals

2. Process Valves

3. Submittal Requirements

a. The Manufacturer shall submit data including details of construction, extent of shop assembly of the valves/strainers and a detailed description of installation procedures. The Manufacturer shall submit standard Drawings or catalog cuts. The type, thickness, application procedure, and test for coatings, and non-metallic and metallic linings shall also be included.

D. Reports

1. Submittals

2. Process Valves

3. Submittal Requirements

a. The Manufacturer shall submit performance test reports in booklet form showing all field tests performed to adjust each component and all field tests performed to prove compliance with the specified performance criteria, upon completion and testing of the installed system.

E. Operation and Maintenance Data Submittals

1. Process Valves

2. Submittal Requirements

a. Submit operation and maintenance data for each valve and strainer in accordance with Division 01 and as follows:

1) Complete information on operation, installation, lubrication, adjustment, safety precautions, routine and special maintenance disassembly, repair, reassembly, and trouble diagnostics of each valve or strainer. The manuals shall contain attached copies of the factory and field test reports as well as a description of the unit and its component parts.

2) Operation and Maintenance Data shall include all required cuts, Drawings, equipment lists, descriptions, etc., which are required to instruct operation and maintenance personnel unfamiliar with such equipment.

1.04 QUALIFICATIONS OF MANUFACTURER

A. Materials and equipment shall be the standard products of a Manufacturer regularly engaged in the production of such products and shall essentially duplicate items that have been in satisfactory use in identical applications in other wastewater treatment facilities. The Manufacturer shall have a minimum of five (5) years of documented experience in the design and production of process valves or strainers of "all types", and not less than five (5) years of experience in the production of equal or larger sized units of the exact equipment models/designs as specified herein.

B. The Manufacturer shall provide a list of at least ten (10) similar installations, including contact names and phone numbers. Equipment shall be supported by a service organization that is, in the opinion of the Engineer, reasonably convenient to the Site to ensure parts and service can be acquired in a timely fashion.

1.05 QUALITY ASSURANCE

A. All valves and strainers of the same type shall be from one (1) Manufacturer. If required or shown on the Drawings; floor stands, associated adapters, extension

stems, extension stem brackets, and all associated appurtenances shall be provided by the Manufacturer of the valve being served whenever possible.

B. The pressure ratings and materials specified represent minimum acceptable standards for valves and strainers. All valves and strainers shall be suitable for the services specified and intended. All valves and strainers shall have a pressure rating no less than that required for the system in which they are installed.

1.06 DELIVERY, STORAGE & HANDLING

A. Surfaces such as female threads, internal mechanical joint ends or flange faces shall be protected from damage during shipment. The Contractor shall inspect all products and materials delivered to the Site for damage. All valves and strainers shall be stored with a minimum of handling. Store all materials on Site in enclosures or under protective coverings. Store rubber gaskets under cover out of direct sunlight. Do not store materials directly on the ground. Keep the inside of valves, strainers, and fittings free of dirt and debris.

B. Materials delivered and placed in storage shall be stored with protection from the weather, excessive humidity variation, excessive temperature variation, dirt, dust and/or other contaminants. Proper protection and care of materials before, during and after installation shall be the Contractor's responsibility. Any materials found to be damaged shall be replaced at the Contractor's expense. Materials shall be stored with protection from puncture, dirt, grease, moisture, mechanical abrasions, excessive heat, and ultraviolet (UV) radiation. All valves and strainers shall be handled and stored in accordance with the Manufacturer's recommendations. Plastic valves shall be packed, packaged and marked in accordance with ASTM D 3892 standards.

1.07 WARRANTY

A. The Manufacturer shall provide a full and comprehensive warranty for all valves and strainers as well as all related equipment/appurtenances specified in this section. All valves, strainers, and appurtenances shall be warrantied to be free from defects in workmanship, design, and materials for a period of not less than one (1) year. If any parts of the equipment supplied under this section should fail during the Manufacturer's Warranty Period, replacement of parts or the valve/strainer itself shall be provided. The valves/strainers shall be restored to active working service at no expense to the Owner. The Manufacturer shall incur all costs including but not limited to parts, labor, service, technicians, shipping, and handling required for restoration of equipment to active service as required under the Manufacturer's warranty.

B. The Manufacturer's warranty shall commence at the date of substantial completion or partial utilization.

1.08 FIELD MEASUREMENTS

A. The Contractor shall become familiar with all details of the Work, verify all dimensions in the field, and shall advise the Engineer of any discrepancy before performing the Work. The Contractor shall coordinate with the equipment Supplier to determine and collect required field dimensions to ensure equipment, valves, strainers, hand wheels, chain wheels, extension stems, and all related appurtenances are properly manufactured and located in field.

1.09 SPECIAL TOOLS

A. Furnish one set of all special tools required to completely assemble, disassemble, or maintain the valves and/or strainers. Special tools shall refer to oversized or specially dimensioned tools, special attachments or fixtures, or any similar items.

PART 2 – PART 2 – PRODUCTS

2.01 GENERAL

A. The following sections reference the process valve type and specification reference number shown in the valve tag symbols on the Drawings. Valves without valve tag symbols are specified elsewhere. The Contractor shall be Responsible for providing all valves that are indicated on the Drawings or referred to in the Specifications. The use of a Manufacturer's and/or identification catalog number shall be for the purpose of establishing a standard of quality and/or the valve configuration/assembly desired for the application specified or shown on the Drawings. The reference to specific product catalog, model, or figure numbers shall not be considered as "Proprietary".

B. Valve sizes shall be equal to line sizes as shown on the Drawings, unless otherwise noted. The Contractor shall provide all necessary reducers and/or expansion fittings for connection of valves to pipelines that are not of equal size. All flanged valves shall conform to ANSI B16.1 standards unless otherwise noted.

C. Valves and strainers shall include all required operator(s), actuator(s), handwheel(s), chain wheel(s), extension stem(s), floor stand(s), floor box(es) worm and gear operator(s), operating nut(s), chain(s), wrenches, and all other appurtenances required for a properly installed and operational valve assembly as shown on the Drawings and as specified herein. The installation shall form a complete workable system as shown on the Drawings.

D. Cast marking(s) shall be provided on all valves and strainers. The marking(s) shall include size, working pressure, a cast arrow to indicate direction of flow, name of Manufacturer, and year of Manufacture. The marking shall be located on an appropriate part of the valve in a clearly visible location. All valves and strainers shall be suitable for the intended service shown on the Drawings and specified herein. Renewable parts shall not be of a lower quality than those specified and provided with the initially specified and installed valve or strainer assembly.

E. **All valves shall open by turning/rotating the valve actuator Counterclockwise ("Left"), unless otherwise specified or shown on the Drawings.** The Contractor shall provide all special adaptors as required to ensure compatibility between valves, appurtenances, and adjacent piping.

2.02 RESILENT SEATED KNIFE GATE VALVE - TYPE V10

A. Provide heavy-duty, resilient seated, stainless steel knife gate valves as shown on the Drawings. Manufactured in accordance with MSS SP-081 and applicable ANSI and AWWA standards. Gate guides and jams cast into the body shall handle full reverse pressure without damage. Rounded gate edge and corresponding rounded packing and packing chamber for maximum seal life. Full, round-port design for high flow capacity and minimum pressure drop.

1. Size: 2 inch through 48 inch - Match to Piping Size as Shown on Drawings

2. End Connections: Lugged - Drilled & Tapped per ASME B16.5 ANSI Class 150

3. Body: Type 304 Stainless Steel per ASTM A 351/A 351M, cast as a single piece.

4. Gate, Stem, and Yoke: Type 304 Stainless Steel per ASTM A 276 ASTM A 351/A 351M

5. Gland: Ductile Iron ASTM A 536 Grade 65-45-12, Epoxy Coated

6. Packing: PTFE Impregnated Syntex Fiber-Maximum Temperature 450°F, replacable without draining pipeline.

7. Actuator: Handwheel - Cast Iron ASTM A 126 Class B, Epoxy Coated

8. Resilient Seat (Wastewater Service): Nitrile (NBR/Buna-N)

9. Hardware (including body bolts, yoke bolts, set screws, pins, nuts, and washers): Type 316 Stainless Steel per ASTM F 593.

B. Knife gate valves up to 24 inches shall be rated at 150 psi water working pressure. Knife gate valves larger than 24 inches shall be rated at 100 psi water working pressure. Seat tightness at rated pressure shall be in accordance with values shown in AWWA C500 and AWWA C509 standards for gate valves.

C. All resilient seated knife gate valves shall provide drip tight closure. The resilient seat material shall be bonded into a stainless steel seat ring. When the valve is closed, the gate shall be pushed against the seat and held in place by the gate jams. When the valve is open, the gate shall move away from the seat allowing operating clearance which shall prevent seat damage and make operation easy.

D. All knife gate valves of the same type, style, and duty shall be supplied by a single Manufacturer. All Manufacturers, named or otherwise, shall comply completely with the Contract Documents. All resilient seated knife gate valves shall be a product of the following Manufacturer:

1. Dezurik - Model KGC-HD

2. Engineer Approved Equal

2.03 BURIED GATE VALVE (RESILIENT SEATED) - TYPE V14

A. All "Buried Resilient Seated Gate Valves" shall be of resilient wedge gate valve design, meeting or exceeding all requirements of the latest revision of AWWA C509 standards. The valve shall be in accordance with that previously specified for GATE VALVES (RESILIENT SEATED) - TYPE V12 as well as that specified herein. The valves shall be specifically designed for buried service. The wedge shall consist of a ductile iron casting encased in a bonded-in-place nitrile elastomer covering which shall form the resilient sealing surfaces. All "buried" valves shall be non-rising stem design with sealing accomplished by double o-rings. The valve wedge encapsulation material shall be Nitrile (NBR/Buna-N). All gate valves shall be designed and constructed in accordance with the following criteria:

1. Size: 2 inch through 48 inch - Match to Piping Size as Shown on Drawings

2. End Connection: Restrained Mechanical Joint - With AWWA Bituminous Coating System

3. End Connection: Valves 2 Inches & Smaller - Threaded NPT

4. Operator: 2 Inch Square Operating Nut - Securely Fastened to Shaft

B. Provide T-Handle valve extension stem wrenches for operating valves of various depths. Length of extension stem shall be designed for the depth of the valve. All buried valves shall be provided with a valve box as shown on the Drawings and as specified herein. The valve boxes shall be cast iron, tar coated, sliding type. The valve box shall be adjustable together with a cast iron cover. The bell end of the valve box shall be sufficiently large to fit over the stuffing box of the gate valve.

C. All gate valves of the same type, style, and duty shall be supplied by a single Manufacturer. All buried resilient seated gate valves shall be a product of the following Manufacturer. Provide the following gate valve in accordance with the Oxford Water District standards:

1. American Flow Control – Model AFC 2500

2.04 STAINLESS STEEL BALL VALVE 3" AND UNDER - TYPE V26

A. Non-lubricated with a blow-out proof stem design, full floating ball. Seats and seals shall be easily accessible and replaceable. Designed and constructed in accordance with the following criteria:

1. Size: 1/4 Inch to 3 Inch - Match to Piping Size as Shown on Drawings

2. End Connections: Threaded NPT, Provide ANSI 150# Flanged Connections as indicated on the Drawings and as required for connection to piping and appurtenances.

3. Body & Trim: 316 Stainless Steel per ASTM B 276

4. Ball & Stem/Shaft: 316 Stainless Steel per ASTM B 276

5. Seats & Seals: PTFE

6. Maximum Operating Pressure: 150 psi

7. Valve Type: Full Port

8. Valve Body Type: Two Piece

9. Valve Operator: Lever - 304 Stainless Steel Lever Hand Grip: Vinyl

B. An easily visible, permanent indicator located conspicuously on the top of the valve shall be provided to determine the position of the ball within the valve in the "Open" or "Closed" position.

C. All stainless steel ball valves of the same type, style, and duty shall be supplied by a single Manufacturer. All Manufacturers, named or otherwise, shall comply completely with the Contract Documents. All stainless steel ball valves shall be a product of the following Manufacturer:

1. Apollo by Conbraco Industries Inc.

2. Neles Jamesbury Company

3. Watts Regulator Company

4. Hammond Valve Company

5. Engineer Approved Equal

2.05 ECCENTRIC PLUG VALVE - TYPE V40

A. All plug valves shall be manufactured in accordance with AWWA C517 standards. All valves shall have a body with integral flanges, faced and drilled per ASME

B16.5 Class 125. All plug valves shall be non-lubricated, eccentric, quarter turn, with resilient faced plugs. Valves shall be furnished with a 1/8 inch welded seat overlay of not less than 90% pure nickel. Seat area shall be raised and the raised surface shall be completely covered with a weld to insure that the plug face only contacts nickel. Screwed-in seats shall not be acceptable. The valve shall be provided with adjustable limit stops for both opening and closing. A clearly marked position indicator shall also be provided.

B. The plug shall have a cylindrical seating surface eccentrically offset from the center of the plug shaft. The interference between the plug face and body seat, with the plug in the closed position, shall be externally adjustable in the field with the valve in the line under pressure. The valve plug shall be resilient faced with Nitrile (Buna-N/NBR) and be suitable for use with wastewater. Valves shall have sleeve type metal bearings and shall be sintered, oil impregnated, and permanently lubricated. Valve shaft seals shall be multiple V-ring type and shall be externally adjustable and re-packable without removing the bonnet or actuator from the valve under pressure. All metallic plug valves for water/wastewater service shall be designed and constructed in accordance with the following criteria:

1. Size: 3 Inch to 72 Inch - Match to Piping Size as Shown on Drawings

2. End Connections: Flanged, ANSI Class 125/150

3. Body Type: Minimum 80% Nominal Port Area

4. Body & Cover: Cast Iron per ASTM A 126, Class B or Ductile Iron per ASTM A 536, (Epoxy Coated)

5. Seat: Welded Nickel

6. Plug: Cast Iron per ASTM A 126 Class B or Ductile Iron per ASTM A 536

7. Plug Facing: Nitrile (Buna-N/NBR)

8. Valve Operator (Valves 6 Inches & Smaller): Lever, for 2 Inch Square Operating Nut

9. Valve Operator (Valves Larger than 6 Inches): Gear Operated Handwheel

10. Bolts, Nuts, Washers: 316 Stainless Steel

C. Valves utilizing O-ring seals or non-adjustable packing shall not be acceptable. Valves shall provide drip-tight bidirectional shutoff at the rated pressures. The plug shall have a cylindrical seating surface eccentrically offset from the center of the plug shaft. The interface between the plug face and body seat, with the plug in the closed position, shall be externally adjustable in the field with the valve in the line under pressure. For "Sludge Service", plug valves shall permit pigging of the piping with line-size pigs.

D. The valve plug shall be removable without the need to take the valve out of the line. The valve plug shall be one piece for valves up to 14 inches and a maximum of two (2) pieces for larger valves.

E. Valves in horizontal liquid lines shall have plugs that travel from open above the flow to closed on the upstream end of the valve. Valves in vertical liquid lines shall have plugs that close up. Valves shall be tagged or marked by the Manufacturer to indicate the proper mounting position. All gearing shall be enclosed in semi-steel housing and be suitable for running in a lubricant with seals provided on shafts to prevent entry of dirt and water into the actuator. The actuator shaft and the quadrant shall be supported on permanently lubricated bronze bearings. Actuators shall clearly indicate valve position and an adjustable stop shall be provided to set closing torque and to provide seat adjustment to compensate for change in pressure differential or flow direction change. The actuator shall be capable of holding the valve in a single position without slip or vibration.

F. Plug valves up to 12 inches shall be rated at 200 psi water working pressure. Plug valves larger than 12 inches shall be rated at 150 psi water working pressure. Seat tightness at rated pressure shall be in accordance with AWWA C504 standards. The valves shall be certified by the Manufacturer as allowing zero (0) leakage for a period of at least 1/2 hour with the specified pressure applied in either direction. If requested, a valve seat leakage test shall be conducted & witnessed by the Engineer to prove compliance of the valve with this section.

G. All three way plug valves shall be designed in accordance with the previously specified criteria and performance requirements for "two way" plug valves. All three way plug valves shall be designed for installation in either horizontal or vertical piping. Each valve shall be designed for flow in any direction. Each valve shall be designed for positive shut-off of the "feed port" as well as the two "discharge ports". Provide tight shut-off of bi-directional flow in either direction.

H. All plug valves of the same type, style, and duty shall be supplied by a single Manufacturer. All manufacturers, named or otherwise, shall comply completely with the Contract Documents. All metallic plug valves shall be a product of the following Manufacturer:

1. DeZurik Water Controls

2. Henry Pratt Company

3. Clow Valve Company

4. Engineer Approved Equal

2.06 METALLIC FLAP STYLE SWING CHECK VALVE - TYPE V63

A. Provide rubber flap type swing check valves suitable for use with wastewater containing grit. Valve sizes shall be equal to line sizes as shown on the Drawings,

unless otherwise noted. The valve Manufacturer shall state in writing that valve is suitable for intended service. The valve shall be designed constructed and tested in accordance with AWWA C508 standards.

B. The body and cover design shall be of a long pattern (not wafer) with integrally cast-on end flanges. The valve body shall be full flow equal to nominal pipe diameter at all points through the valve. The seating surface shall be approximately 45 degrees from the long axis of the valve to minimize disc travel. The top access port shall be full size, allowing the removal of the disc without removing the valve from the line. The access cover shall be shaped to provide flushing action over the disc for operation in lines containing high solids content and/or grit.

C. All valves shall be hydrostatically tested and seat tested to demonstrate zero leakage by the valve Manufacturer. The flex portion of the disc shall be warranted for a minimum of twenty-five years. The valve disc shall be cycled 1,000,000 times in accordance with ANSI/AWWA C508 standards and show no signs of wear, cracking or distortion of the disc or seat and shall remain drip tight at both high and low pressures. Test results shall be independently certified. A copy of independent standard certification shall be provided to the Engineer upon request. The valves shall be designed and constructed in accordance with the following criteria:

1. Size: 2 Inches to 24 Inches - Match to Piping Size as Shown on Drawings

2. End Connections: Flanged, per ANSI B16.1 125/150

3. Body & Cover: Cast Iron, per ASTM A 126 Class B or Ductile Iron, per ASTM A 536 Gr 65-45-12

4. Flap/Disc: Nitrile (NBR/Buna-N), per ASTM D 2000

5. Hardware (Bolts, Nuts, Washers): 316 Stainless Steel Pressure Rating: 175 psi

D. Provide external screw-type, back-flow device to create back-flow through the check valve, to allow for pump priming, or to allow for back-flushing of a clogged pump. Nitrile (NBR/Buna-N) seals shall be used to seal the stainless steel stem in a bronze bushing. The backflow device shall be rising-stem type to indicate position. A stainless steel T-handle shall be provided for ease of operation.

E. Provide external mechanical position indicator with limit switch.

F. Valve exterior shall be painted Universal Metal Primer for high resistance to corrosion. The seat and internal body shall be fully coated with a two-part thermosetting epoxy suitable for use in both potable water and wastewater applications. The interior and exterior coatings shall meet all applicable ANSI/NSF 61 standards.

G. The disc shall be one piece construction with an integral O-ring type sealing surface and an internal steel and/or nylon reinforcing. Non-slamming closing shall be incorporated by providing for a short (approximately 35 degrees) travel length of the disc. The flow area shall be equal to the nominal pipe inside diameter throughout the valve.

H. All metallic flap style check valves of the same type, style, and duty shall be supplied by a single Manufacturer. All metallic flap style check valves shall be a product of the following Manufacturer:

1. APCO Valve & Primer Company - Series 100

2. Henry Pratt Company - RD Series

3. Val-Matic Valve & Manufacturing Company - Series #500

4. Engineer Approved Equal

2.07 SPARE PARTS

A. Concurrent with delivery and installation of the specified valves, spare parts for each different item of material and equipment specified that is recommended by the Manufacturer to be replaced any time up to three (3) years of service shall be furnished. For each type and size of valve, the following extra materials shall be provided: lubricator, lubricant (with appropriate temperature rating), lubricator/isolating valve; galvanized operating wrench, 4 feet long, for T-handled operators; galvanized operating key for cross handled valves.

B. Extra materials shall include two (2) of the following spare parts for each type and size of valve: gaskets; O-ring seals; diaphragms (molded); all elastomer parts; stem packing; seat rings and seat ring pulling tool.

2.08 VALVE ACTUATORS & OPERATORS

A. Unless otherwise specified or shown on the Drawings, all valves shall be manually actuated. All valves shall have an operating handwheel or a handle/lever mounted on the operator. Valves with operating nuts shall be non-rising stem design with an AWWA 2 inch square operating nut. The Contractor shall provide at least six (6) two (2) foot long steel operating bars for all operating nuts. All valves shall be provided with handwheel actuators on all manually actuated valves larger than six (6) inches in size unless otherwise specified or shown on the Drawings.

B. The valve Manufacturer shall supply and factory mount all actuators; including any type of manual or powered actuators. The valves and actuators shall be shipped as a single unit. All valve actuators shall be sized to operate the associated valve for the full range of pressures and velocities. Position indicators shall be provided for interior NRS valves.

C. The force in a manual operator shall not exceed 40 pounds of rim-pull under any operating condition, including initial breakaway. The operator shall be equipped with gear reduction when force exceeds 40 pounds of rim-pull. All manual operators shall be self-locking type or shall be equipped with a self-locking device. The actuators shall be capable of moving the valves from a fully open to a fully closed position and a fully closed position to a fully open position. The actuator shall be capable of holding the valve at any position in between the fully open and fully closed positions. A position indicator shall be supplied on quarter-turn valves. Each operating device shall have the word "OPEN" permanently cast as well as an arrow indicating the direction of operation.

2.09 CHAINWHEEL OPERATORS

A. Unless otherwise specified or shown on the Drawings, chainwheel actuators shall be provided for all valves when the valve center line is located six (6) feet or greater above the operating floor or as noted on drawings. All chainwheel actuators shall be provided complete with chain guides. The operator chain shall loop within a minimum of four (4) feet from the operating floor level. Where chains hang in normally traveled areas, 316 stainless steel "L" type tie-back anchors shall be provided to allow for chain attachment. All chain shall be weldless single loop lock type.

B. All chainwheel actuators and chain guides shall be specifically sized for the diameter of the valve handwheel. All chainwheel actuators shall be designed to allow for field adjustment and detachment. All chainwheel actuators shall be designed and constructed in accordance with the following criteria:

1. Size: Match to Valve Handwheel Diameter

2. Chainwheel: Cast Iron or Ductile Iron - Epoxy Coated

3. Chain Guide: Malleable Iron

4. Attachment Hardware: 316 Stainless Steel

5. Chain: 316 Stainless Steel

6. Chain: Spark-Resistant Brass (Explosion Proof Environments Only)

C. The chainwheel rim shall contain a groove into which the chain guide attaches. The groove shall be an integral part of the casting. All ferrous metallic surfaces of the chainwheel actuators shall be provided with a two part epoxy paint coating. The coating color system shall be matched to the valve piping system color coding. All chainwheel actuators which are located in Class 1, Division 1 & 2 "Explosion Proof" electrical hazard areas shall be equipped with spark-resistant brass chain.

D. All chainwheel actuators of the same type, style, and duty shall be supplied by a single Manufacturer. Where applicable, chainwheel actuators shall be provided by

the Manufacturer of the valve being served. All manufacturers, named or otherwise, shall comply with that specified for the valves. The stem guides and extension stems shall be a product of the following Manufacturer:

1. M&H Valve Company

2. Kennedy Valve Company

3. Babbitt Steam Specialty Company

4. Engineer Approved Equal

2.10 GEAR OPERATORS

A. Unless otherwise specified or shown on the Drawings, all valves larger than eight (8) inches shall be provided with gear operators. All manually operated valves with a rim pull greater than 40 ft-lbs shall also be provided with gear operators. Worm and gear operators shall be a one-piece design with worm-gears of bronze or machine cut steel material. Worm shall be hardened alloy steel with the thread ground and polished. Traveling nut type operators shall have threaded steel reach rods with an internally threaded bronze or ductile iron nut.

B. The output shaft shall be perpendicular to the valve shaft and be provided with a removable handwheel. Unless otherwise noted or specified all gear actuators shall conform to AWWA C504 standards. All butterfly valve actuators shall provide proof of certification. All gear actuators shall be removable from the valve without removing the valve from the line or dismantling the valve.

C. All gear operators shall indicate the valve position and have adjustable stops. The maximum handwheel size shall be 24 inches in diameter. All position indicators shall be of the embossed, stamped, engraved, etched, or raised types.

D. Unless otherwise specified or shown on the Drawings, all gear operated valves three (3) inches & larger shall be provided with position indication at the point of operation. Valves smaller than three (3) inches shall have position indication on the respective handwheel's or lever actuators.

2.11 UNDERGROUND OPERATORS

A. Buried service operators on valves larger than 2.5 inches shall have a 2 inch operating nut. Buried operators on valves 2 inches and smaller shall have a cross handle for operation by a forked key. The moving parts of valves and operators shall be enclosed in a housing to prevent contact with the soil. Buried service operators for quarter-turn valves shall be designed to withstand an input torque of 450 foot-pounds at the fully open or fully closed positions, and shall be grease packed and gasketed to withstand a submersion in water to 10.2 psig. Buried valves shall have extension stems, bonnets, and valve boxes.

2.12 EXTENSION STEMS & STEM GUIDES

A. Where the depth of the valve is such that its centerline is more than six (6) inches below grade or operator level, an operator extension stem shall be furnished with a two (2) inch operating nut to bring the operating nut to a point six (6) inches below the surface of the ground and/or box cover. The operating nut shall be located in a floor box.

B. Extension stems shall be two (2) inch 304L stainless steel. Provide support brackets for spans greater than five (5) feet. All extension stems and/or operating nuts shall be provided with universal joints and pin couplings when longer than ten (10) feet. All stem adaptors shall be provided as required. All extension stems and operating nuts shall have a rating of at least five (5) times the maximum operating torque.

C. All stem guides shall be high strength stainless steel. The stem guides shall be of the adjustable wall bracket type. The guide shall be provided with bronze bushings where the extension stem passes through. The maximum spacing shall be ten (10) feet. All stem guides shall be designed and constructed in accordance with the following:

1. Bracket: 304L Stainless Steel

2. Guide: 304L Stainless Steel

3. Bushing: Brass CDA 360

4. Bolts & Nuts: 316 Stainless Steel ASTM A 276

5. Operator: 2 inch square nut or Handwheel as shown on Drawings

D. All stem guides & extension stems of the same type, style, and duty shall be supplied by a single Manufacturer. Where applicable, stem guides and extension stems shall be provided by the Manufacturer of the valve being served. All manufacturers, named or otherwise, shall comply with that specified for the valves. The stem guides and extension stems shall be a product of the following Manufacturer:

1. Clow Valve Company

2. Troy Valve Company

3. M&H Valve Company

4. Kennedy Valve Company

5. Engineer Approved Equal

2.13 VALVE BOXES (OUTDOOR SUB-GRADE VALVES)

A. Each exterior valve shall be provided with a valve box. Valve boxes shall be cast iron and of the adjustable, telescoping, heavy-pattern type. They shall be designed and constructed to prevent the direct transmission of traffic loads to the pipe or valve.

B. Cast-iron valve boxes shall have minimum metal thickness of 3/16 inch. All boxes shall be extension type with slide-type adjustment and a flared base. The bell end of the valve box shall be sufficiently large enough to fit over the stuffing box of the respective valve.

C. The boxes shall be adjustable through at least six (6) inches vertically without reduction of lap between sections to less than four (4) inches. The length shall be as necessary to suit the finish grade elevation.

D. The inside diameter of the box shall be at least 5-1/4 inches. The covers shall be close fitting and dirt-tight. The top of the cover shall be flush with the top of the box rim.

E. A minimum of two (2) T-handles for two (2) inch square operating nuts shall be provided. The T-handle wrenches shall be sized for the box length. Concrete boxes shall be the standard product of a Manufacturer of precast concrete structures.

F. The box length shall adapt to the length required for the depth of the line and to the depth of cover required over the pipe at the valve location without full extension. Concrete boxes shall be installed only in locations not subjected to vehicular traffic. The boxes shall have housings of sufficient size to completely cover the valve or service stop and shall be complete with covers.

G. All iron valve boxes of the same type, style, and duty shall be supplied by a single Manufacturer. All manufacturers, named or otherwise, shall comply with that specified for the valve boxes. The iron valve boxes shall be a product of the following Manufacturer:

1. Crescent Foundry Company

2. East Jordan Iron Works Inc.

3. Engineer Approved Equal

2.14 FLOOR STANDS

A. Provide rising or non-rising stem (NRS) floor stands as required and as shown on the Drawings. The stands shall be provided with a factory applied rust-inhibiting prime coating as per Section 09 90 00 PAINTING AND COATING. The Contractor shall provide adapters as recommended by the Manufacturer. The floor stand shall be indicating type; complete with stem, coupling, handwheel, stem guide brackets, and yoke attachment. The stem guide shall be spaced such that stem

L/R ratio does not exceed 200. Anchors shall be supplied as required by the floor stand Manufacturer.

B. The floor stand assembly shall be provided with an etched or cast arrow to show the direction of rotation to open the valve. A resilient moisture-resistant seal shall be provided around the stem penetration through the slab. Provide cantilevered floor stand supports as required or as shown on the Drawings. Provide hand wheel extension stems as required or as shown on the Drawings.

C. Where the operator for a quarter-turn valve is located on a floor stand, an extension stem torque tube shall be provided and properly sized for the maximum torque capacity of the valve. All floor stands shall be designed and constructed in accordance with the following:

1. Type: Non-Rising Stem - Indicator Type

2. Stand: Cast Iron ASTM A 126 Class B 65-45-12

3. Stem: 304 Stainless Steel ASTM A 276

4. Bushing & Indicator Nut: Bronze

5. Drive Screw: Stainless Steel ASTM A 276

6. Bolts, Nuts, & Anchors: 316 Stainless Steel ASTM A 276

7. Operator: Handwheel or Hand Crank as Shown on Drawings

8. Closed Tag: Aluminum

9. Extension Stem (If Required): 304L Stainless Steel ASTM A 276

D. All floor stands of the same type, style, and duty shall be supplied by a single Manufacturer. Where applicable, floor stands shall be provided by the Manufacturer of the valve being served. All manufacturers, named or otherwise, shall comply completely with the Contract Documents. The floor stands shall be a product of the following Manufacturer:

1. Clow Valve Company

2. Troy Valve Company

3. M&H Valve Company

4. Kennedy Valve Company

5. Engineer Approved Equal

2.15 FINISHINGS & COATINGS

A. All coatings and lubricants in contact with "Potable Water" shall be certified as acceptable for use with that fluid. If the valve Manufacturer does not require finished coating on any interior surfaces, then the Manufacturer shall state so in writing and no finish coating shall be required, if approved by the Engineer.

B. Unless otherwise specified, all iron body valves shall be exterior primed with a shop coat of an Engineer approved rust-inhibitive primer. The primer shall be applied in accordance with the instructions of the paint Manufacturer. The primer shall be compatible with the finish coat provided. Unless otherwise specified, the finish coat shall match the coating of connecting pipe in type and color. All field painting shall be in accordance with Section 09 90 00 PAINTING & COATING. Stainless steel, brass, bronze, and plastic body valves shall not require coating.

C. Unless otherwise specified or noted, all interior ferrous surfaces shall be given a shop finish of an asphalt varnish or epoxy coating in accordance with AWWA C550 and AWWA C509 standards.

D. The epoxy paint shall be either a two-part liquid material or a heat-activated (fusion) material except that only a heat-activated material shall apply if a valve coating is specified as "fusion" or "fusion bonded" epoxy. The epoxy lining and coating shall have a minimum 4.0 mils dry film thickness except where it is limited by valve operating tolerances. Safety isolation valves and lockout valves with handles, handwheel's, or chain wheels shall be painted "Safety Yellow."

E. Ferrous surfaces obviously not to be painted shall be given a shop coat of grease or other acceptable rust-inhibitive coating.

2.16 FLOOR BOXES

A. The Contractor shall provide floor boxes for valve operating nuts recessed in the concrete as specified and as shown on the Drawings. The valve floor boxes shall be standard cast iron type, cast-in-place with a fastening top. The floor boxes shall be designed for use with non-rising stem valves (NRS). The floor boxes shall be designed to provide support for the extension stem and a cover for the operating nut on the stem. The floor boxes shall be designed and constructed in accordance with the following criteria:

1. Body: Cast Iron ASTM A 126 Class B

2. Cover: Cast Iron ASTM A 126 Class B

3. Bushing: Brass CDA 360

4. Length: As required and as shown on Drawings

B. All floor boxes of the same type, style, and duty shall be supplied by a single Manufacturer. Where applicable, floor boxes shall be provided by the Manufacturer

of the valve being served. All manufacturers, named or otherwise, shall comply Completely with the Contract Documents. The floor boxes shall be a product of the following Manufacturer:

1. Clow Valve Company
2. Troy Valve Company
3. M&H Valve Company
4. Kennedy Valve Company
5. Engineer Approved Equal

2.17 VALVE IDENTIFICATION TAGS

A. All valves in piping including individual valves provided with equipment shall be tagged in accordance with the Drawings. The valve tags shall be provided with identifying numbers and letters to match the designations shown on the Drawings. All valve tags shall be provided with sufficient lengths of chain for attachment to the respective valve. All valve tags shall be designed and constructed in accordance with the following:

1. Tag Size: 2 Inch Square
2. Tag Material: Stainless Steel
3. Chain: #16 Stainless Steel Jack Chain
4. Lettering: Engraved

B. All buried valves shall be provided with tags embedded in a concrete pad surrounding the valve box.

C. **The Contractor shall confirm the final numbering sequence with the Engineer prior to ordering any tags.**

D. All valve tags of the same type, style, and duty shall be supplied by a single Manufacturer. All manufacturers, named or otherwise, shall comply completely with the Contract Documents. All valve tags shall be a product of the following Manufacturer:

1. Seton Identification Products Inc.
2. Emedco Inc.
3. Engineer Approved Equal

PART 3 – PART 3 – EXECUTION

3.01 INSTALLATION

A. Install valves as shown on the Drawings and in strict accordance with the Manufacturer's recommendations. Install valves with stems pointed up, in vertical position where possible, but in no case with stems pointed downward of the horizontal plane. Allow sufficient room for maintenance, removal and proper operation. All valves shall be located and oriented to permit easy access to the valve operator, and to avoid interferences.

B. All valves shall be independently supported. Valves shall not be supported by the connecting piping.

C. Flanged valve bolt holes shall be installed to straddle the vertical centerline of the pipe. Flanged faces shall be cleaned prior to inserting the gasket and bolts. All nuts shall be tightened progressively and uniformly. Threaded ends shall have the threads cleaned by wire brushing or swabbing prior to installation.

D. Where any valve or appurtenance installation is covered by a standard, the Contractor shall install such equipment in accordance with the standard unless otherwise specified or indicated on the Drawings. The Contractor shall certify any such installations are in accordance with all applicable standards.

E. Unless otherwise specified or shown on the Drawings, all valve connections/joints shall be installed in accordance with the specified and applicable standards. The Contractor shall be Responsible for all verification of Manufacturer's torque requirements.

3.02 VALVE ORIENTATION

A. The operating stem of a manual valve shall be installed in a vertical position when the valve is installed in horizontal runs of pipe having centerline elevations of **4.5 feet** or less above the finished floor, unless otherwise shown on Drawings. The operating stem of a manual valve shall be installed in a horizontal position in horizontal runs of pipe having centerline elevations between **4.5 feet 6 feet** above the finish floor, unless otherwise shown on Drawings.

B. All manually actuated valves three (3) inches and smaller shall have the valve indicators and operators located to display toward the normal operational locations.

C. Butterfly valves: Orientation of butterfly valves shall take into account changes in pipe direction. Valve shafts shall be oriented so that unbalanced flows caused by pipe direction changes or other disturbances are equally divided to each half of the disc.

D. Plug Valves: If a plug valve seat position is not shown in the Drawings, locate the seat position as follows: for horizontal flow, the flow shall produce an "unseating"

pressure, and the plug shall open into the top half of valve; and for vertical flow, the seat shall be installed in the highest portion of the valve.

3.03 VALVE TESTING

A. Test all valves visually for leaks and proper operation under pressure. The Contractor shall also test the valves to ensure proper valve function and actuation. All valves shall be tested as part of the respective piping system or segment in accordance with Section 40 05 13.01 PROCESS PIPE AND FITTINGS.

B. Valves may either be tested while testing pipelines, or as a separate test. It shall be demonstrated that valves open and close smoothly with operating pressure on one side and atmospheric pressure on the other, and in both directions for two-way valve applications. The Contractor shall count and record the number of turns required to open and close each valve, and account for any discrepancies with the Manufacturer's data.

C. Air and vacuum relief valves shall be examined as the associated pipe is being filled to verify venting and seating is fully functional. The Contractor shall set, verify, and record set pressures for all relief and regulating valves. Self-contained automatic valves shall be tested at both maximum and minimum operating ranges, and reset upon completion of test to the design value.

D. The Contractor shall take care not to overpressure any valve and appurtenances during testing.

3.04 RETESTING

A. If the equipment does not successfully pass the tests listed above, the Manufacturer/Contractor shall repair the equipment and perform the tests again until passing the tests successfully. If any deficiencies are revealed during any test, such deficiencies shall be corrected and the tests shall be reconducted at no additional cost to the Owner or Engineer.

3.05 CLEANING

A. All items, including but not limited to all valves & valve interiors, shall be thoroughly cleaned prior to installation, testing, and final acceptance. All dirt, debris, and other foreign materials shall be removed.

3.06 TESTING OF BACKFLOW PREVENTERS

A. The Contractor shall provide certified testing of each backflow prevention assembly. Each assembly shall be tested using gauges and equipment specifically designed for the testing of backflow prevention assemblies. Each assembly shall be tested by an independent backflow prevention assembly testing agency.

B. Each backflow prevention assembly shall be tested for accuracy and proper functionality in accordance with the requirements of State or local regulatory agencies. If there is no State or local regulatory agency requirements, each assembly shall be tested for accuracy and proper functionality in accordance with the requirements of University of Southern California's Foundation of Cross Connection Control and Hydraulic Research or the American Water Works Association Manual of Cross Connection (Manual M-14), or any other approved testing laboratory having equivalent capabilities for both laboratory and field evaluation of backflow prevention assemblies. Provide a test report and form for each assembly. The test report shall include but is not limited to as a minimum; the following:

1. Data on Device
2. Type of Assembly
3. Manufacturer
4. Model #
5. Serial Number
6. Size
7. Location
8. Test Pressure Readings

C. The test report shall also include data on the testing firm. The data shall include but is not limited to the following:

1. Name
2. Address
3. Certified Tester
4. Certified Tester Number
5. Date of Test
6. Serial Number and Test Data

D. If unit(s) fail to meet the test standard requirements, the unit shall be repaired and retested to correct working order at no additional cost to the Owner or Engineer. Provide retesting of each unit following repairs.

END OF SECTION

SECTION 40 05 23.10

SLUICE GATES

PART 1 – GENERAL

1.01 DESCRIPTION OF WORK

A. The Contractor shall furnish all labor, materials, equipment, and incidentals required and install, test, and make ready for operation, all sluice gates, guides, operators, accessories and appurtenances as shown on the Drawings and as specified herein. The Contractor shall also provide all related appurtenances, including but not limited to attachments, foundations, anchors, grouting, support brackets, hardware and all related accessories to provide complete operational sluice gate systems as specified herein and as shown on the Drawings. All appurtenances, accessory equipment, and auxiliaries for complete sluice gate systems shall be provided whether specifically mentioned or not.

1.02 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. Unless otherwise noted, the most recent version of the listed publications, including revisions, at time of bid opening shall apply.

B. ASTM INTERNATIONAL (ASTM)

1. ASTM A 126 (2004) Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings

2. ASTM A 276 (2008a) Standard Specification for Stainless Steel Bars and Shapes

3. ASTM B 584 (2008a) Standard Specification for Copper Alloy Sand Castings for General Applications

4. ASTM B 98/B 98M (2008) Standard Specification for Copper-Silicon Alloy Rod, Bar, and Shapes

C. THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)

1. SSPC SP 5 (2007) White Metal Blast Cleaning

1.03 SUBMITTALS

A. Submit the following in accordance with and in addition to Division 01 General Requirements:

1. Shop Drawings

a. Shop Drawings shall show layouts, dimensions, major components, key alignment locations, embedment details and locations of bolt holes. Drawings shall also indicate where access points for maintenance and operations are located on the equipment. Drawings shall show critical field dimensions identified by the Manufacturer and obtained by the Contractor.

b. Provide sufficient product data to verify compliance with the Specifications and to illustrate the construction and assembly of the products. Include compliance of materials and components with applicable CEAM, ASTM, AGMA and other standards. List the manufacture, model and weights of major components. Include catalog cuts, illustrations, schedules, diagrams, performance charts, instructions and brochures illustrating size, physical appearance and other characteristics of materials, systems or equipment.

2. Product Data

a. Product data shall include a complete list of equipment and materials; including Manufacturer's descriptive data and technical literature, performance charts and curves, catalog cuts, and installation instructions. Include warrantee language for the equipment and all related appurtenances.

b. Submit copies of Manufacturers' complete parts list showing all parts, spare parts, and bulletins for the pumping equipment. Clearly show all details, parts, and adequately describe parts or have proper identification marks. Photographs and/or catalog cuts of components shall be included for identification.

3. Manufacturer's Field Reports

a. The Manufacturer's field reports shall include all requirements of Division 01 General Requirements including but not limited to written certification of proper installation, initial adjustments, and satisfactory operations, dated and signed by a Manufacturer's representative.

4. Operation and Maintenance Data

a. Submit operation and maintenance data in accordance with Division 01 General Requirements. The manual shall include but is not limited to the following:

1) Startup, normal, shut down, and emergency operating instructions

2) Lubrication including specification and quantity for all lubricants.

3) Instructions for routine and major maintenance.

4) Guides to troubleshooting

5) A numbered parts list and predicted life of parts subject to wear

6) Test data and performance curves

7) Installation instructions

8) A written warrantee statement

b. Operation and Maintenance Data shall also include all required cuts, Drawings, equipment lists, descriptions, etc., which are required to instruct operation and maintenance personnel unfamiliar with such equipment.

5. Qualifications Statements

a. Submit a list of at least twenty (20) similar installations, including contact names and phone numbers. Equipment shall be supported by a service organization that is, in the opinion of the Engineer, reasonably convenient to the Site to ensure parts and service can be acquired in a timely fashion.

1.04 QUALIFICATIONS OF MANUFACTURER

A. Materials and equipment shall be the standard products of a Manufacturer regularly engaged in the production of such products and shall essentially duplicate items that have been in satisfactory use in identical applications in other wastewater treatment facilities. The Manufacturer shall have a minimum of ten (10) years of documented experience in the design and production of sluice gate equipment, and not less than five (5) years of experience in the production of equal or larger sized models of the exact equipment as specified herein.

1.05 DELIVERY, STORAGE, AND HANDLING

A. The Contractor shall off-load equipment at the installation Site using equipment of sufficient size and design to prevent damage to the units. Immediately after off-loading, the Contractor shall inspect all equipment and appurtenances for shipping damage or missing parts. Any damage or discrepancy shall be noted in a written claim with the shipper prior to accepting delivery. The Contractor shall validate all equipment serial numbers and parts lists with the shipping

documentation. The Contractor shall notify the Manufacturer of any unacceptable conditions noted with the shipper if required.

1.06 WARRANTY

A. The Manufacturer shall provide a full and comprehensive warranty for all equipment specified in this section. The equipment shall be warrantied to be free from defects in workmanship, design, and materials for a period of one (1) year. If any parts of the equipment supplied under this section should fail during the Manufacturer's Warranty Period, replacement of parts or the entire unit itself shall be provided. The units shall be restored to active working service at no expense to the Owner of the equipment. The Manufacturer shall incur all costs including but not limited to parts, labor, service, technicians, shipping, and handling required for restoration of equipment to active service as required under the Manufacturer's warranty.

B. The Manufacturer's warranty shall commence at the date of substantial completion or partial utilization.

1.07 FIELD MEASUREMENTS

A. The Contractor shall become familiar with all details of the Work, verify all dimensions in the field, and shall advise the Engineer of any discrepancies before performing the Work.

1.08 SPECIAL TOOLS

A. Furnish one (1) set of all special tools required to completely assemble, disassemble, or maintain the equipment. Special tools shall refer to oversized or specially dimensioned tools, special attachments or fixtures, or any similar items. One (1) set of special tools shall be provided for each size/model of equipment.

PART 2 – PRODUCTS

2.01 GENERAL

A. Leakage shall not exceed 0.05 gpm/ft of wetted seal perimeter in seating head and unseating head conditions and shall meet or exceed the requirements of AWWA C 513.

B. The gate shall utilize self-adjusting seals. Due to the difficulty of accessing gates when they are in service, gates that utilize adjustable wedges, wedging devices or pressure pads are not acceptable.

C. All structural components of the frame and sluice shall be fabricated of stainless steel having a minimum thickness of 1/4-inch and shall have adequate strength to prevent distortion during normal handling, during installation and while in service.

D. All welds shall be performed by welders with AWS certification.

E. Frame and Shaft Length (all units): Varies. Contractor shall field measure and provide stem extensions and intermediate stem guides as required.

F. Materials

1. Frame Assembly and Retainers: Stainless Steel, Type 304L, ASTM A240

2. Slide and Stiffeners: Stainless Steel, Type 304L, ASTM A240

3. Stem: Stainless Steel, Type 304, ASTM A276

4. Fasteners, Nuts and Bolts: Stainless Steel, Type 304, ASTM A276

5. Invert Seal (Upward Opening Gates Only): Stainless Steel, Type 304, ASTM A276

6. Seat/Seals and Facing: Ultra-High Molecular Weight Polyethylene, ASTM D4020

7. Lift Nuts: Bronze ASTM B584

8. Pedestals and Wall Brackets: Stainless Steel, Type 304L, ASTM A276

9. Operator Housing: Cast aluminum or ductile iron

2.02 UNIT DESCRIPTIONS

A. All gates shall be hand-wheel actuated, downward-closing.

B. SG-1004 is mounted under the stairs with limited clearance. Contractor to verify clearance and provide shorter frame (2.5 feet above floor) as needed. Non-rising stem.

C. Other gates are rising stem, standard actuator height (3 feet above floor).

D. Sluice Gate Schedule

Designation	SG-1001	SG-1002	SG-1003	SG-1004	SG-1005
Location/ Purpose	Influent Pipe	Influent Wet Well #1	Grinder Isolation	Influent to Wet Well #2	Between Wet Wells
Mounting Style	Pipe Flange	Face Mounted	Embedded	Face Mounted	Face Mounted
Actuator Style	Yoke (Self Containted)	Yoke (Self Containted)	Yoke (Self Containted)	Yoke (Self Containted)	Pedestal with Wall Bracket

Designation	SG-1001	SG-1002	SG-1003	SG-1004	SG-1005
Opening Size	18" Diam.	18" X 18"	36" X 36"	18" X 18"	18" X 18"
Max.Upstream Pressure (ft of water)	15'	5'	5'	5'	15'

2.03 GATE FRAMES

A. The frame assembly, including the guide members, invert member and yoke members, shall be constructed of formed stainless steel plate with a minimum thickness of 1/4-inch.

1. Frame design shall allow for mounting as required by the application and/or shown in the Sluice Gate Schedule:

   a. Face-mounted directly to a wall with stainless steel anchor bolts and grout.

   b. Flange-mounted to wall thimble or pipe flange: stainless steel mounting studs and a mastic gasket material.

   c. Embedded: frame grouted in to channel wall and invert.

2. All wall mounted or wall thimble mounted gates shall have a flange frame. Flat frame gates are not acceptable.

3. The structural portion of the frame that incorporates the seat/seals shall be formed into a one-piece shape for rigidity. Guide members that consist of two or more bolted structural members are not acceptable. Guide member designs where water loads are transferred through the assembly bolts are specifically not acceptable.

4. Gussets shall be provided as necessary to support the guide members in an unseating head condition. The gussets shall extend to support the outer portion of the guide assembly and shall be positioned to ensure that the load is transferred to the anchor bolts or the wall thimble studs.

5. The frame shall extend to accommodate the entire height of the slide when the slide is in the fully opened position on upward opening gates or downward opening weir gates.

6. On self-contained gates, a yoke shall be provided across the top of the frame. The yoke shall be formed by two structural members affixed to the top of the side frame members to provide a one-piece rigid assembly. The yoke shall be designed to allow removal of the slide.

7. A rigid stainless steel invert member shall be provided across the bottom of the opening. The invert member shall be of the flush bottom type on upward opening gates.

8. A rigid stainless steel top seal member shall be provided across the top of the opening on gates designed to cover submerged openings.

9. A rigid stainless steel member shall be provided across the invert of the opening on downward opening weir gates.

2.04 SLIDE

A. The slide and reinforcing stiffeners shall be constructed of stainless steel plate. All structural components shall have a minimum thickness of 1/4-inch.

1. The slide shall not deflect more than 1/360 of the span or 1/16 inch, whichever is smaller, under the maximum design head.

2. When the width of the gate opening multiplied by the maximum design head is 80 square feet or greater, the portion of the slide that engages the guide members shall be of a "thick edge" design. The thick edge portion of the slide shall have a minimum thickness of 3 inches.

3. Reinforcing stiffeners shall be welded to the slide and mounted horizontally. Vertical stiffeners shall be welded on the outside of the horizontal stiffeners for additional reinforcement.

4. The stem connector shall be constructed of two angles or plates. The stem connector shall be welded to the slide. A minimum of two bolts shall connect the stem to the stem connector.

2.05 SEALS

A. All gates shall be provided with a self-adjusting seal system to restrict leakage in accordance with the requirements listed in this specification.

1. All gates shall be equipped with UHMW polyethylene seat/seals to restrict leakage and to prevent metal to metal contact between the frame and slide.

2. The seat/seals shall extend to accommodate the 1-1/2 x the height of the slide when the slide is in the fully closed or fully opened position.

3. All upward opening gates shall be provided with a resilient seal to seal the bottom portion of the gate. The seal shall be attached to the invert member or the bottom of the slide and it shall be held in place with stainless steel attachment hardware.

4. All downward opening weir gates shall be provided with UHMW polyethylene seat/seals across the invert member.

5. The seal system shall be durable and shall be designed to accommodate high velocities and frequent cycling without loosening or suffering damage.

6. All seals must be bolted or otherwise mechanically fastened to the frame or slide. Arrangement with seals that are force fit or held in place with adhesives are unacceptable.

7. The seals shall be mounted so as not to obstruct the water way opening.

8. Gates that utilize rubber "J" seals or "P" seals are not acceptable.

9. The seal system shall have been factory tested to confirm negligible wear (less than 0.01") and proper sealing. The factory testing shall consist of an accelerated wear test comprised of a minimum of 25,000 open-close cycles using a well-agitated sand/water mixture to simulate fluidized grit.

2.06 STEM

A. A threaded operating stem shall be utilized to connect the operating mechanism to the slide. On rising stem gates, the threaded portion shall engage the operating nut in the manual operator or motor actuator. On non-rising stem gates, the threaded portion shall engage the nut on the slide.

1. The threaded portion of the stem shall have a minimum outside diameter of 1-1/2 inches. Stem extension pipes are not acceptable.

2. The stem shall be constructed of solid stainless steel bar for the entire length, the metal having a tensile strength of not less than 90,000 psi for stems that are 3 inches or less in diameter. Stems that are in excess of 3 inches in diameter shall have a tensile strength of 85,000 psi.

3. The stem shall be threaded to allow full travel of the slide unless the travel distance is otherwise shown on the Drawings.

4. Maximum L/R ratio for the unsupported part of the stem shall not exceed 200.

5. In compression, the stem shall be designed for a critical buckling load caused by a 40 lb effort on the crank or handwheel with a safety factor of 2, using the Euler column formula.

6. The stem shall be designed to withstand the tension load caused by the application of a 40 lb effort on the crank or handwheel without exceeding 1/5 of the ultimate tensile strength of the stem material.

7. The threaded portion of the stem shall have machine rolled threads of the full Acme type with a 16 micro inch finish or better. Stub threads are not acceptable.

8. Stems of more than one section shall be joined by stainless steel or bronze couplings. The coupling shall be bolted to the stems.

9. Stems, on manually operated gates, shall be provided with adjustable stop collars to prevent over closing of the slide.

2.07 STEM GUIDES

A. Stem guide shall be provided when necessary to ensure that the maximum L/R ratio for the unsupported part of the stem is 200 or less.

1. Stem guide brackets shall be fabricated of stainless steel and shall be outfitted with UHMW or bronze bushings.

2. Adjustable in two directions.

2.08 WALL THIMBLES

A. Wall thimbles shall be provided when shown on the Drawings.

1. The wall thimble depth shall be equal to the thickness of the concrete wall in which the thimble is to be mounted.

2. Wall thimbles shall be fabricated stainless steel construction of adequate section to withstand all operational and reasonable installation stresses.

3. Wall thimbles shall be constructed of 1/4-inch minimum thickness stainless steel and the front face shall have a minimum thickness of 1/4–inch.

4. The fabrication process shall ensure that the wall thimble is square and plumb and the front face is sufficiently flat to provide a proper mounting surface for the gate frame.

5. The face of the wall thimble shall only be machined if recommended by the gate manufacturer. If the wall thimble is to be machined, the front face shall have a minimum thickness of 1/4-inch after machining.

6. A water stop shall be welded around the periphery of the thimble. Wall thimbles shall be designed to allow thorough and uniform concrete placement during installation.

7. Studs and nuts shall be stainless steel. Water stop may be stitch welded.

8. A suitable gasket or mastic shall be provided to seal between the gate frame and the wall thimble.

2.09 MANUAL OPERATORS

A. Unless otherwise shown on the Drawings, gates shall be operated by a manual handwheel or a manual crank-operated gearbox. The operator shall be mounted on the yoke of self-contained gates or on the pedestal of non-self-contained gates.

1. The gate manufacturer shall select the proper gear ratio to ensure that the gate can be operated with no more than a 40 lb effort when the gate is in the closed position and experiencing the maximum operating head.

2. An arrow with the word "OPEN" shall be permanently attached or cast onto the operator to indicate the direction or rotation to open the gate.

3. Handwheel operators shall be fully enclosed and shall have a cast aluminum housing.

   a. Handwheel operators shall be provided with a threaded cast bronze lift nut to engage the operating stem.

   b. Handwheel operators shall be equipped with roller bearings above and below the operating nut.

   c. Positive mechanical seals shall be provided above and below the operating nut to exclude moisture and dirt and prevent leakage of lubricant out of the hoist.

   d. The handwheel shall be removable and shall have a minimum diameter of 15 inches.

4. Crank-operated gearboxes shall be fully enclosed and shall have a cast aluminum or ductile iron housing.

   a. Gearboxes shall have either single or double gear reduction depending upon the lifting capacity required.

   b. Gearboxes shall be provided with a threaded cast bronze lift nut to engage the operating stem.

   c. Bearings shall be provided above and below the flange on the operating nut to support both opening and closing thrusts.

   d. Gears shall be steel with machined cut teeth designed for smooth operation.

   e. The pinion shaft shall be stainless steel and shall be supported on ball or tapered roller bearings.

   f. Positive mechanical seals shall be provided on the operating nut and the pinion shafts to exclude moisture and dirt and prevent leakage of lubricant out of the hoist.

   g. The crank shall be cast aluminum or cast iron with a revolving nylon grip.

   h. The crank shall be removable.

5. All gates having widths in excess of 72 inches and widths greater than twice their height shall be provided with two gearboxes connected by an interconnecting shaft for simultaneous operation.

    a. Interconnecting shafting shall be constructed of aluminum or stainless steel.

    b. Flexible couplings shall be provided at each end of the interconnecting shaft.

    c. One crank shall be provided to mount on the pinion shaft of one of the gearboxes.

6. An extended operator system utilizing chain and sprockets shall be furnished by the manufacturer when the centerline of the crank or handwheel, on a non-geared operator, is located over 48-in above the operating floor. Chain wheels are not acceptable.

    a. A removable stainless steel or aluminum cover shall be provided to enclose chain and sprockets.

    b. The extended operator system shall lower the centerline of the pinion shaft to 36-in above the operating floor.

    c. A handwheel may be utilized in conjunction with a gearbox in lieu of the extended operator system if the centerline of the pinion shaft is 60-in or less above the operating floor.

7. Pedestals shall be constructed of stainless steel. Aluminum pedestals are not acceptable.

    a. The pedestal height shall be such that the handwheel or pinion shaft on the crank-operated gearbox is located approximately 36-in above the operating floor.

    b. Wall brackets shall be used to support floor stands where shown on the Drawings and shall be constructed of stainless steel.

    c. Wall brackets shall be reinforced to withstand in compression at least two times the rated output of the operator with a 40 lb effort on the crank or handwheel.

    d. The design and detail of the brackets and anchor bolts shall be provided by the gate manufacturer and shall be approved by the Engineer. The gate manufacturer shall supply the bracket, anchor bolts and accessories as part of the gate assembly.

8. Operators shall be equipped with fracture-resistant clear butyrate or lexan plastic stem covers.

    a. The top of the stem cover shall be closed.

    b. The bottom end of the stem cover shall be mounted in a housing or adapter for easy field mounting.

c. Stem covers shall be complete with indicator markings to indicate gate position.

9. When shown on the Drawings, provide 2 inch square nut, mounted in a floor box, with a non-rising stem.

a. The square nut shall be constructed of bronze.

b. The floor box shall be constructed of stainless steel or cast iron and shall be set in the concrete floor above the gate as shown.

c. Provide one aluminum or stainless steel T-handle wrench for operation.

2.10 ANCHOR BOLTS

A. Anchor bolts shall be provided by the gate manufacturer for mounting the gates and appurtenances.

1. Quantity and location shall be determined by the gate manufacturer.

2. If epoxy type anchor bolts are provided, the gate manufacturer shall provide the studs and nuts.

3. Anchor bolts shall have a minimum diameter of 1/2-inch.

2.11 FINISHING

A. Stainless steel: Mill finish.

B. Welds: sandblasted to remove weld burn and scale.

C. All external ferrous metal surfaces: Factory surface preparation in accordance with SPCC SP-10. Factory prime and finish with a total of two coats of Tnemec Series 66HS (or Engineer approved equal), 6 to 8 mills thickness each coat.

D. Brass, Bronze, Aluminum, FRP, Galvanized, and Plastic components: Not painted.

2.12 NAMEPLATES

A. Each major item of equipment shall have the Manufacturer's name, address, type or style, model or serial number, catalog number, and all other pertinent data clearly embossed on a stainless steel plate secured to the item of equipment.

2.13 SPARE PARTS

A. The Manufacturer shall furnish a total of one (1) set of the following spare parts for each of the gates specified in this section. At a minimum, a set of spare parts shall include the following:

1. One (1) set of rubber seals of each size

2.14 OILS AND LUBRICANTS

A. All lubricants for the equipment shall be non-proprietary and easily obtainable from a local source for operations staff convenience. Designs which utilize proprietary and/or special lubricants shall not be acceptable.

B. All lubrication fittings shall be brought to the outside of all equipment so that they are readily accessible from the outside without the necessity of removing covers, plates, housings, guards or other appurtenances. All lubrication fittings of all gates shall be readily accessible from operator level. Lubrication fittings which are located in areas requiring the Owner to enter tankage/vessels for access shall not be acceptable. Provide zerk type fittings for all lubrication points.

2.15 DESIGN BASIS MANUFACTURER

A. Submittals any variations from the Contract Documents in accordance with Division 01 General Conditions. Submittals which do not specifically outline variations will be rejected without review. Contractor shall be Responsible for all Work resulting from variations, weather submitted or not.

B. All gates of the same type, style, and duty shall be supplied by a single Manufacturer. All Manufacturer's named or otherwise shall comply completely with the Contract Documents. All sluice gates and weir gates shall be a product of the following Manufacturer:

1. Whipps, Inc.

2. Rodney Hunt Company

3. Hydro-Gate Corporation

4. Fontaine USA, Inc.

5. Engineer Approved Equal

PART 3 – EXECUTION

3.01 INSTALLATION

A. The Contractor shall install all sluice gates and appurtenances in accordance with the Manufacturer's instructions, recommendations, and Drawings. All frames and guides shall be installed in a true vertical plane with 90 degree corners. Prior to installation, the Contractor shall check all gate grooves and remove/clean off all foreign matter. The Contractor shall also clean all contact surfaces on each gate to ensure a proper fit and seal.

B. All gates shall be unloaded, hauled, handled, and installed with care. All coated components shall be handled in a manner so as to avoid damaging the coating. All damaged coatings shall be repaired.

C. Gates with embedded guides and inverts shall be installed in accordance with the recommendations of the Manufacturer and Engineer. All gates shall be aligned, secured, and checked for free operation prior to being grouted in place.

D. Where the gate is being mounted on a steel flange that has been welded to a pipe or adaptor, the front surface of the pipe or adaptor will not be sufficiently flat unless it has been machined after welding. By using a thick fibrated mastic between surfaces, it may be possible to prevent leakage between flanges. In no case should the gate flange be firmly tightened against a flange that is not flat. If the spacing is very large, the gate should be shimmed a small distance away from the flange. Space between the flanges can be caulked with non-shrink epoxy grout. This will allow the gate to be tightened to the steel flange without distortion or leakage between the flanges.

3.02 FIELD TESTING

A. The equipment startup and demonstration period for the sluice gates previously specified shall include the provisions Division 01 General Requirements; and also include but is not limited to that which is specified herein.

B. Tests shall include checks for proper alignment, proper operation (without binding or excessive handwheel force), proper connections, and satisfactory operational performance. The Contractor shall demonstrate the ability to operate each gate by opening and closing the gate without vibration or jamming.

C. The Contractor shall furnish all the requirements to conduct a proper field test which include but are not limited to: water, facilities, labor, materials, supplies and test instruments.

D. After installation, all gates shall be field tested at maximum upstream pressure specified above or as allowed by Engineer for a minimum period of two (2) hours to ensure that all items of the equipment are in compliance with the Contract Documents, including the minimum leakage requirements as specified herein.

3.03 RETESTING

A. In accordance with Division 01 General Conditions.

3.04 MANUFACTURER'S SERVICES

A. Services of a Manufacturer's representative who is experienced in the installation, adjustment, and operation of the equipment specified shall be provided. The Manufacturer shall submit qualifications of the representative for approval by the Engineer. The on Site man days listed below are exclusive of travel time and do not relieve the Contractor of the obligation to provide sufficient service to place the equipment into satisfactory operation.

B. Services of a Manufacturer's service technician who is experienced in the installation, adjustment, and operation of the equipment specified shall be provided. The service technician shall supervise the installation, adjustment, and testing of the equipment. The Manufacturer's service technician shall be present for a period of not less than two (2) days, to inspect the installed equipment, supervise the initial test run, and to provide instruction to the plant personnel.

C. The Manufacturer's representative shall provide a certification of proper installation and satisfactory operation to the Owner and Engineer. Certification shall be signed and dated by Manufacturer's representative.

D. The Manufacturer's representative shall make all necessary adjustments and settings to the controls. In particular, Service Engineer shall verify the wall thimble installation for each gate.

3.05 FIELD TRAINING

A. A field training course shall be provided for designated operating and maintenance staff members. The training shall be provided in conjunction with the Manufacturer's service visit. The field training shall start after the system is functionally complete but prior to final acceptance tests. Field training shall cover all of the items contained in the operating and maintenance manuals, including normal operations, trouble-shooting, maintenance, lubrication, and other related Work.

END OF SECTION

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SECTION 40 61 01

INSTRUMENTATION AND CONTROLS GENERAL REQUIREMENTS

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes

1. Provide equipment, instruments, services, appurtenances, and labor as specified and in the following associated Specifications and as shown on the Drawings in accordance with this Section.

B. Related Requirements

1. Division 40, Section 40 63 43 PROGRAMMABLE LOGIC CONTROLLERS

2. Division 40, Section 40 67 00 CONTROL SYSTEM EQUIPMENT PANELS AND RACKS

3. Division 40, Section 40 70 00 INSTRUMENTATION FOR PROCESS SYSTEMS

1.02 PRICE AND PAYMENT PROCEDURES

A. Measurement and payment requirements: per Division 01 General Requirements.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Coordination, Sequencing, and Scheduling: per Division 01 General Requirements.

1.04 SUBMITTALS

A. Submit in accordance with Division 01 General Requirements.

B. Prior to submittal to the Engineer, Shop Drawings and submittal information shall be thoroughly checked to ensure compliance with Contract Documents. Verify equipment, instruments, and materials submitted fit within available space and maintain specified physical clearances, and that equipment is compatible with the operation of the overall system. Submittal to the Engineer of Shop Drawings and submittal information implies that the Contractor has reviewed the information and requirements have been satisfied.

C. Submittals and Shop Drawings

1. Project name, location, and project number

2. Contractor name and address

3. Table of contents or index, including equipment, instruments or materials being submitted, utilizing identification consistent with Contract Documents (equipment designation, instrument tag number, control panel name, etc.), as well as proposed, manufacturer, style, model, and part number.

4. For Programmable Logic Controllers (PLC) and Operator Interface Terminals (OIT) submittals, refer to Section 40 63 43 PROGRAMMABLE LOGIC CONTROLLERS, for specific requirements.

5. For SCADA control panel Shop Drawing submittals, refer to Section 40 67 00 CONTROL SYSTEM EQUIPMENT PANELS AND RACKS, for specific requirements.

6. For instrumentation submittals, refer to Section 40 70 00 INSTRUMENTATION FOR PROCESS SYSTEMS, for specific requirements.

D. The submittal information for each section will be contained in a single submission. Incomplete or partial submissions are not accepted.

E. Closeout and Maintenance Material Submittals: per Division 01 General Requirements.

1. Operations and Maintenance (O&M) Materials

a. Include descriptions of equipment, the nature and intended modes of operation, testing procedures of units in the system, and safety measures to be taken during operation. Necessary procedures and methods for effective operation of the system shall be included.

b. Include record Drawings and instructions necessary for the planned maintenance of equipment in the system. The O&M Manuals will incorporate maintenance procedures and schedules, and they will coordinate and be cross-referenced to detailed operational procedures provided by the manufacturers.

c. Organize in three-ring binders, provided with labeled dividers, including a table of contents clearly describing the information included and order.

d. Include a list of local service departments of authorized distributors for equipment, instruments, services, and appurtenances. These

service departments shall stock the manufacturer's standard parts and equipment; provide local service options, etc.

e. For Programmable Logic Controllers (PLC) and Operator Interface Terminals (OIT) O&Ms, refer to Section 40 63 43 PROGRAMMABLE LOGIC CONTROLLERS, for specific requirements.

f. For SCADA control panel O&Ms, refer to Section 40 67 00 CONTROL SYSTEM EQUIPMENT PANELS AND RACKS, for specific requirements.

g. For instrumentation O&Ms, refer to Section 40 70 00, INSTRUMENTATION FOR PROCESS SYSTEMS, for specific requirements.

1.05 QUALITY ASSURANCE

A. Provide in accordance with Division 01 General Requirements.

B. Qualifications: per Division 01 General Requirements and as follows.

1. Completed Work of similar or greater complexity on at least 3 previous projects within the last 5 years. Successful completion is defined as a finished Project completed on time, without any outstanding claims or litigation involving the Contractor. Provide, for a period of not less than 12 months from Final Acceptance of the Project, all labor, tools, materials, and equipment necessary to address issues or defects in any system that result from faulty workmanship, installation, equipment, instruments or materials, and any resulting damage from said defects or faults, at the convenience of, and at no additional cost, to the Owner.

2. Furnish SCADA control panels fabricated per the Drawings (as shown on the "I" sheets), by an Underwriters Laboratories (UL) 508A approved panel shop regularly engaged in furnishing, installing, and wiring similar equipment for use in water and wastewater treatment facilities, and that has been in satisfactory operation for at least 5 years.

C. Instruments, SCADA control panels, and materials provided must comply with the Specifications, be supplied from manufacturers regularly engaged in the production of such products, be standard products wherever possible, and be the manufacturer's latest design.

D. Instruments, SCADA control panels, and materials supplied are subject to approval by the Engineer and demonstrate equal appearance, quality, and performance to that specified. Verify the availability of equipment, instruments and materials proposed for use prior to submission to Engineer for approval. If production of equipment, instrument, or material is discontinued submit an alternate of comparable quality to the Engineer for approval prior to execution of Work, and at no additional cost to Owner.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Provide in accordance with Division 01 General Requirements.

B. Coordinate equipment, instrument, and material delivery to coincide with the Project schedule. If the delivery schedule of any equipment, instrument, or material affects the overall Project schedule, notify the Engineer in writing immediately. Include in the written notification, documentation from the equipment Supplier indicating the revised delivery schedule and reason for the change.

C. When applicable, coordinate delivery of equipment, instruments, or materials to be delivered directly to another trade or vendor for installation in a system or control panel provided under another Specification section.

D. Exercise care while loading, unloading, and transporting equipment, instruments, and materials to avoid damage. Check all equipment, instruments, and materials for damage or defects within 7 days of delivery to the Project Site.

E. Equipment, instruments, and materials required to be stored on Site prior to installation will be stored in such a manner to avoid damage or exposure to water, dust, or construction debris.

F. Repair or replace, at no additional cost to the Owner, equipment, instruments and materials that are defective or damaged during delivery or installation, to the satisfaction of the Engineer.

1.07 SITE CONDITIONS

A. Existing Conditions: per Division 01 General Requirements.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.01 GENERAL

A. Instruments, SCADA control panels, equipment, and other materials provided, that come with a manufacturer's warranty, shall have the warranty transferred to the Owner upon final acceptance.

B. After installation, provided instruments and SCADA control panels shall be powered up, tested, and witnessed by the Engineer for proper termination and operation.

C. After installation, calibrate instruments that require calibration in accordance with the manufacturer's recommended procedure.

3.02 FIELD QUALITY CONTROL

A. Provide in accordance with Division 01 General Requirements.

3.03 STARTUP & COMMISSIONING

A. Provide in accordance with Division 01 General Requirements.

3.04 CLOSEOUT ACTIVITIES

A. Provide in accordance with Division 01 General Requirements.

END OF SECTION

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SECTION 40 63 43

PROGRAMMABLE LOGIC CONTROLLERS

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes

1. Provide labor, materials, equipment, and appurtenances to furnish and install the programmable logic controllers and operator interface terminals as specified and on the Drawings in accordance with this Section.

2. Definitions

a. PLC: Programmable Logic Controller

b. RIO: Remote Input/Output Rack

c. OIT: Operator Interface Terminal

d. HMI: Human Machine Interface

e. RTU: Remote Terminal Unit

f. I/O: Input Output

g. SCADA: Supervisory Control and Data Acquisition

B. Related Documents

1. Drawings and general provisions of the Contract, including General and Supplementary General Conditions and other Specification Sections, which apply to the Work of this Section.

1.02 PRICE AND PAYMENT PROCEDURES

A. Measurement and payment requirements: per Division 01 General Requirements.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Coordination, Sequencing, and Scheduling: per Division 01 General Requirements.

1.04 SUBMITTALS

A. Submit in accordance with Division 01 General Requirements.

B. Closeout and Maintenance Material Submittals: per Division 01 General Requirements.

1.05 QUALITY ASSURANCE

A. Provide in accordance with Division 01 General Requirements.

B. PLCs and OITs provided under this Contract shall comply with the Specifications, shall be supplied from manufacturers regularly engaged in the production of such products, shall be standard products wherever possible, and shall be of the manufacturer's latest design.

C. This Specification establishes minimum requirements for the solid-state PLCs and OITs designed to provide high reliability in industrial applications. All PLCs, OITs, and associated software provided under this Contract shall meet the requirements of this Specification unless approved by the Engineer. If production of equipment is discontinued submit an alternate of comparable quality to the Engineer for approval prior to execution of Work, and at no additional cost to Owner.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Provide in accordance with Division 01 General Requirements

1. Coordinate equipment, instrument, and material delivery to coincide with the Project schedule. If the delivery schedule of any equipment, instrument, or material shall affect the overall Project schedule, notify the Engineer in writing immediately. Include in the written notification, documentation from the equipment Supplier indicating the revised delivery schedule and reason for the change.

2. When applicable, coordinate delivery of equipment, instruments, or materials to be delivered directly to another trade or vendor for installation in a system or control panel provided under another Specification section.

3. Repair or replace, at no additional cost to the Owner, all equipment, instruments, and materials that are defective or damaged during delivery or installation to the satisfaction of the Engineer.

B. Packing, Shipping, Handling, and Unloading

1. Exercise care while loading, unloading and transporting equipment, instruments, and materials to avoid damage. Check all equipment, instruments, and materials for damage or defects within 7 days of delivery to the Project Site.

C. Storage and Protection

1. Equipment, instruments, and materials required to be stored on Site prior to installation shall be stored in such a manner to avoid damage or exposure to water, dust, or construction debris.

1.07 SITE CONDITIONS

A. Existing Conditions: per Division 01 General Requirements.

1.08 MAINTENANCE

A. Extra Materials: Furnish as specified below. Make interchangeable with and same material and workmanship as corresponding original parts.

1. Provide specific operations and maintenance data in accordance with Section 40 61 01 INSTRUMENTATION AND CONTROLS GENERAL REQUIREMENTS.

2. Provide the following additional data and information:

a. Configuration and programming manuals for each type of PLC provided.

b. Configuration and programming manuals for each type of OIT provided.

PART 2 – PRODUCTS

2.01 PROGRAMMABLE LOGIC CONTROLLERS

A. PLC hardware and programming software shall be by the same manufacturer.

B. All PLCs shall be housed in a new or existing control panel as specified per Section 40 67 00 CONTROL SYSTEM EQUIPMENT PANELS AND RACKS and in the Contract Drawings. Power provided to the control panel shall be 120VAC, 60 Hz, single phase.

C. Minimum PLC input/output (I/O) requirements are indicated on the Drawings. Provide, at a minimum, an additional 20 percent active spare I/O wired to terminal blocks, and in the case of relay outputs, wired to interposing relays.

D. PLC rack or mounting space provided shall accommodate, at a minimum, 20 percent spare slots for future expansion.

E. The PLCs shall be microprocessor based devices and shall be Provided with power supplies, processors, process input and output modules, communication cards as required, chassis' as required, mounted in the control panel.

1. Power supplies shall be sized to accommodate all analog signals including all spares. The power supply shall accommodate the card's entire I/O capacity (i.e., if 5 analog outputs is required, the power supply shall be sized to handle the full 8 analog outputs of an 8-point card).

F. The PLC shall be capable of stand-alone operation in the event of a SCADA network or SCADA computer failure.

G. The PLC system shall use a modular, field expandable design.

H. Modules are defined as devices that plug into a chassis or connect to an adjacent module and are keyed to allow installation in only one direction. The design shall prohibit upside down insertion or connection of the modules. Modules provided shall be compatible with the processor type specified.

I. All hardware of the programmable controller shall operate at an ambient temperature of 0 – 60°C (32 – 140°F), with an ambient temperature rating for storage of (minus 40) – 85°C ((minus 40) – 185°F).

J. The PLC hardware shall function continuously in the relative humidity range of 5 – 95 percent, non-condensing.

K. The PLC system shall be designed and tested to operate in the high electrical noise environment of an industrial plant.

L. The PLC system shall be Underwriters Laboratories (UL) listed.

M. Module-expandable PLCs and associated modules shall meet the following acceptable level of quality:

1. Processor: Allen Bradley CompactLogix 5370 L3 series, 1769-L33ER.

2. Discrete input modules: Allen Bradley 1769-IQ16.

3. Discrete output modules: Allen Bradley 1769-OW16.

4. Analog input modules: Allen Bradley 1769-IF8.

5. Analog output modules: Allen Bradley 1769-OF8C.

6. Memory module: Allen Bradley 1784-SD1.

N. Chassis-style (rack-mounted) PLCs and associated modules shall meet the following acceptable level of quality:

1. Processor: Allen Bradley ControlLogix, with minimum 2MB controller memory (part number 1756-L61).

2. Ethernet communication module: Allen Bradley 1756-EN2T.

3. Discrete input modules: Allen Bradley 1756-IA32.

4. Discrete output modules: Allen Bradley 1756-OW16I.

5. Analog input modules: Allen Bradley 1756-IF16.

6. Analog output modules: Allen Bradley 1756-OF8.

O. Module-expandable ‘micro’ PLCs and associated modules shall meet the following acceptable level of quality:

1. Base module: Allen Bradley MicroLogix 1100 or MicroLogix 1400.

2. Discrete input modules: Allen Bradley 1762-IA8 or 1762-IQ16.

3. Discrete output modules: Allen Bradley 1762-OW16.

4. Analog input modules: Allen Bradley 1762-IF4 or 1762SC-IF8U.

5. Analog output modules: Allen Bradley 1762-OF4.

6. Memory module: Allen Bradley 1763-MM1 or 1766-MM1.

P. ‘Micro’ PLCs utilized for emergency float backup systems shall meet the following acceptable level of quality:

1. Base module: Allen Bradley Micro830.

2. Memory module: Allen Bradley 2080-MEMBAK-RTC.

2.02 OPERATOR INTERFACE TERMINALS

A. All OITs shall be housed in a new or existing control panel as specified per Section 40 67 00 CONTROL SYSTEM EQUIPMENT PANELS AND RACKS and in the Contract Drawings.

B. The operator interface terminal shall be color graphic display that connects directly to the PLC's communication port or a communication module and allow viewing and changing of the PLC's parameters.

C. Shall be environmentally rated NEMA 4/4X.

D. The OIT shall be powered by 12-24VDC.

E. The OIT shall be provided with an integrated real time clock with battery backup.

F. The OIT shall have a minimum resolution of 800 x 600 SVGA graphics with 16-bit color graphics.

G. The OIT shall be provided with touch screen operation.

H. Display size shall be 8.4-inch diagonal with a display area of 6.71-inch by 5.03-inch (width by height).

I. The OIT shall be provided with 26MB internal Project memory. Unit shall also include SD port. Provide 1 GB SD Card for each operator terminal to store data.

J. The OIT shall provide real-time trending of process variables.

K. The OIT shall provide active and historical alarm screens with the ability to acknowledge and clear.

L. The OIT shall have the ability to go to a selectable screen based on specific alarm bits.

M. Provide all communications modules and cables for OIT – PLC communications as necessary. PLC interface shall be Ethernet/IP. RS-232 shall also be available for use.

N. Provide and coordinate all communications protocol drivers to establish reliable communications between PLC and OIT.

O. Provide OIT programming and configuration cables.

P. The OIT shall be provided with a licensed copy of programming software.

Q. OITs shall meet the following acceptable level of quality: Automation Direct C-More Color TFT Touch Panel, part number EA9-T8CL.

2.03 SPARE PARTS

A. Provide the following spare parts for the Project:

1. One of each type of PLC power supply used

2. One of each type of PLC processor and/or base module used

3. One of each type of I/O module used

4. One of each type of communication module used

5. One of each type of memory module used

2.04 SOURCE QUALITY CONTROL

A. Provide in accordance with Division 01 General Requirements.

PART 3 – EXECUTION (NOT USED)

END OF SECTION

SECTION 40 67 00

CONTROL SYSTEM EQUIPMENT PANELS AND RACKS

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes

1. Provide all wiring, labor, tools, materials, and equipment necessary to furnish, install, and test control panels and enclosures in accordance with this Section and applicable reference standards listed in Article 1.03.

2. Furnish, deliver, unload, and power up control panels and enclosures as specified on the Drawings.

B. Related Requirements

1. Refer to Division 40 for equipment furnished by other sections but require installation and startup to reflect complete integration of the systems, instrumentation, interlocking, interfacing, and installation under this section.

2. Refer to Division 26, Electrical for wiring standards and practices.

1.02 PRICE AND PAYMENT PROCEDURES

A. Measurement and payment requirements: per Division 01 General Requirements.

1.03 REFERENCES

A. Reference Standards

1. NATIONAL FIRE PROTECTION ASSOCIATION 79, ANNEX "D" STANDARDS (NFPA)

2. NATIONAL ELECTRICAL CODE (NEC)

3. NATIONAL ELECTRICAL MANUFACTURER'S ASSOCIATION STANDARDS (NEMA)

4. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

5. OPERATIONAL SAFETY AND HEALTH ADMINISTRATION REGULATIONS (OSHA)

6. UNDERWRITERS' LABORATORY, INC. (UL)

7. AMERICAN NATIONAL STANDARDS INSTITUTE, INC. (ANSI)

8. FACTORY MUTUAL (FM)

9. THE INSTRUMENTATION, SYSTEMS AND AUTOMATION SOCIETY (ISA)

10. State and Local code requirements.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination, Sequencing, and Scheduling: per Division 01 General Requirements.

1.05 SUBMITTALS

A. Submit in accordance with Division 01 General Requirements.

B. Submit detailed information for the process control panels and enclosures in accordance with Section 40 61 01 INSTRUMENTATION AND CONTROLS GENERAL REQUIREMENTS.

C. In addition to the requirements of Section 40 61 01, the submittals shall include

1. Prior to submittal to Engineer, Shop Drawings and submittal information shall be thoroughly checked to insure compliance with Contract Documents. Verify all equipment, instruments and materials submitted shall fit within available space and maintain specified physical clearances, and that all equipment is compatible with the operation of the overall system. Submittal to the Engineer of Shop Drawings and submittal information implies the Contractor has reviewed the information and all requirements have been satisfied.

2. Bill of Materials for each control panel, including panel tag name or number, and component description, quantity, manufacturer name and model number for each component used in the fabrication of the control panel. The Bill of Materials shall be keyed to easily correlate the components shown in the Bill of Materials with the components shown on the control panel Equipment Layout Drawings.

3. Manufacturer’s descriptive literature for each component called out on the Bill of Materials. Clearly designate the part number with highlights or arrows.

4. Equipment Layout Drawings for each control panel, indicating any deviations from the Contract Documents.

5. Panel communication diagrams for each control panel, indicating any deviations from the Contract Documents.

6. Power wiring diagrams for each control panel, indicating any deviations from the Contract Documents.

7. Programmable Logic Controllers (PLC) input/output (I/O) wiring diagrams, on a module-by-module basis, indicating any deviations from the Contract Documents.

8. Backup PLC wiring diagrams for each control panel, indicating any deviations from the Contract Documents.

D. If Shop Drawing level control panel Drawings were included in the Contract Documents, the Contractor shall have the option to submit a letter, included with a copy of the Drawings to be used for fabrication, indicating the control panel fabricator (panel shop) shall fabricate control panels as specified.

E. Substitutions of equipment or changes to panel design that deviate from the Drawings shall be submitted to Engineer for review prior to fabrication of control panels.

F. Procurement of materials and manufacture of the control panels shall not begin until related submittals have been reviewed and approved by the Engineer.

G. As-Built Drawings

1. After fabrication of the control panels and factory acceptance testing is complete, panel shop shall provide Drawings of the control panels, representing the as-built conditions. Submit panel Drawings in AutoCAD DWG and Adobe PDF file formats, on DVD-R media.

2. As-Built Drawings shall be submitted with the panel at delivery.

3. If the panel shop fabricated control panels per the Shop Drawings as specified in the Contract Documents, legible red-line markups shall be acceptable.

H. Operation and Maintenance (O&M) Information

1. Refer to Section 40 61 01 INSTRUMENTATION AND CONTROLS GENERAL REQUIREMENTS for O&M material requirements. In addition to the requirements in Section 40 61 01, the control panel section of the O&M manuals shall include:

a. Record Drawings of the control panels, updated to reflect the panels after checkout and startup.

b. Installation and operation manuals for all major control panel components, including the network switches, PLCs, I/O modules, communication equipment, etc.

I. Closeout and Maintenance Material Submittals: per Division 01 General Requirements.

1.06 QUALITY ASSURANCE

A. Provide in accordance with Division 01 General Requirements.

B. Control panel fabricator, panel shop, shall hold a valid Underwriters' Laboratory, Inc. (UL) UL-508A certification for their panel fabrication facility, and shall have executed a minimum of 3 Projects of similar scope in the municipal water and wastewater markets in the past 5 years.

C. Surge protection shall be provided by recognized manufacturer with a minimum of 5 years' experience in the production of this equipment.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Provide in accordance with Division 01 General Requirements.

B. Coordinate equipment, instrument, and material delivery to coincide with the Project schedule. If the delivery schedule of any equipment, instrument, or material shall affect the overall Project schedule, notify the Engineer in writing immediately. Include in the written notification, documentation from the equipment Supplier indicating the revised delivery schedule and reason for the change.

C. When applicable, coordinate delivery equipment, instruments, or materials to be delivered directly to another trade or vendor for installation in a system or control panel provided under another Specification section.

D. Exercise care while loading, unloading and transporting equipment, instruments and materials to avoid damage. Check all equipment, instruments, and materials for damage or defects within 7 days of delivery to the Project Site.

E. Equipment, instruments, and materials required to be stored on Site prior to installation shall be stored in such a manner to avoid damage or exposure to water, dust, or construction debris.

F. Repair or replace, at no additional cost to the Owner, all equipment, instruments and materials that are defective or damaged during installation, to the satisfaction of the Engineer.

1.08 SITE CONDITIONS

A. Existing Conditions: per Division 01 General Requirements.

PART 2 – PRODUCTS

2.01 CONTROL PANEL COMPONENTS

A. The following table contains control panel components and recommended manufacturers for each component.

CONTROL PANEL COMPONENTS	MANUFACTURER (OR APPROVED EQUIVALENT)	COMMENTS
Enclosures	Hoffman Hammond Saginaw	Shall be suitable for use in the environments that they will be located (NEMA, NFPA, etc.).
Programmable Logic Controllers (PLCs)		Refer to Section 40 63 43 PROGRAMMABLE LOGIC CONTROLLERS.
Operator Interface Terminals (OITs)		Refer to Section 40 63 43 PROGRAMMABLE LOGIC CONTROLLERS.
Wireway	Panduit Hoffman	
DIN Rail	Allen Bradley Phoenix Contact	
Radio Equipment		Match existing Site standards as necessary.
Terminal Blocks	Allen Bradley Phoenix Contact Entrelec	Utilize 2-tier terminal blocks wherever possible to conserve panel space.
Terminal Block Fuse Holders	Allen Bradley Phoenix Contact Entrelec	Specify fuse holders with blown fuse indicators.
Circuit Breakers	Square D Allen Bradley	
120VAC Surge Suppressors	Phoenix Contact Square D	
Analog Surge Suppressors	Phoenix Contact Citel	
Media Converters	N-Tron B&B Electronics L-Com	Provide with DIN rail mount converters as required on the network architecture.
Fuses	Bussman Ferraz Shawmut	All glass fuses in control panels shall be fast acting style. Motor circuit protection and/or inductive load fuses shall be time delay style.
Control Relays	Allen Bradley Square D Omron	Include all required bases, hardware, etc.

CONTROL PANEL COMPONENTS	MANUFACTURER (OR APPROVED EQUIVALENT)	COMMENTS
Power Supplies	Sola Phoenix Contact Allen Bradley	Provide with power supplies sized as required for equipment contained within the enclosures and to supply field equipment connected to the enclosure.
Intrinsic Safety Barriers	Pepperl & Fuchs MTL Phoenix Contact	Discrete barriers shall be 2-channel barriers. Analog barriers shall be 2-wire barriers.
Ethernet Switches (Unmanaged)	Moxa B&B Electronics	Switches shall be provided with direct-wired low voltage power source within the enclosure.
Ethernet Switches (Managed)	N-Tron B&B Electronics Allen Bradley	All switches comprising the ring topology throughout the facility shall be provided from the same manufacturer.
Fiber Patch Panels	L-Com B&B Electronics	Provide with panel mount patch panels for incoming fiber optic cables as required.
Emergency Power System	Sola Phoenix Contact Meanwell	Include uninterruptible power supply (UPS) in each control panel sized to furnish with at least 10 minutes of emergency power.
Panel Heaters	Hammond Hoffman	Provide with panel heaters for outside control panels where temperature is a concern for electronic components.
Receptacles	Pass & Seymour Hubbel Leviton	Provide with receptacle for UPS and convenience receptacle in each PLC control panel.
Pilot/Status Lights (Push to test)	Allen Bradley General Electric Square D	Color code as follows: Red-Fault, Green-Run.
HOR, On/Off, L/R switches and push buttons	Allen Bradley General Electric Square D	Refer to Section 26 27 26 WIRING DEVICES. Furnish switches and push buttons with matching nameplate.

2.02 SPARE PARTS

A. Provide the following spare parts for the Project:

1. One of each type of surge arrestor

2. 100 percent spare of each type of fuse used (minimum of 1 spare of each type of fuse used)

3. One of each type of 24VDC communication power supply

4. One of each type of intrinsic safety barrier

5. One of each type of radio

2.03 SOURCE QUALITY CONTROL

A. Provide in accordance with Division 01 General Requirements.

2.04 MAINTENANCE AND WARRANTY INFORMATION

A. Upon acceptance of installation of control panel(s), all maintenance information shall be handed over to the Owner and all warranties shall be transferred to the Owner.

PART 3 – EXECUTION

3.01 CONTROL PANEL FABRICATION

A. General

1. The control panels shall include programmable logic controller, required I/O modules with chassis (if applicable) and power supply, cables, and all appurtenances as specified in this and all applicable sections. The enclosures shall include switches, lights, annunciators and all appurtenances as specified in this and all applicable sections. The panels and miscellaneous materials shall be furnished by one Supplier.

2. All electronic equipment shall utilize printed circuitry and epoxy or equal coating to prevent contamination by dust, moisture, and fungus. Solid-state components shall be conservatively rated for their purpose, to provide reliable performance over ambient atmosphere fluctuations between 0 – 140°F and 0 – 95 percent relative humidity, non-condensing. The field mounted equipment and system components shall be designed for installation in dusty, humid, and slightly corrosive service conditions.

3. Equipment installed in a hazardous area shall meet Class, Group, and Division to comply with the NFPA 70 and CCR, Title 8, Electrical and General Safety Orders.

4. All equipment, cabinets, and devices provided shall be heavy duty type, designed for continuous industrial service. The PLC system shall contain products of a single manufacturer, and shall consist of equipment models which are currently in production.

5. The following paragraphs describe general fabrication requirements of control panels, enclosures, consoles, and cabinets. All control panel assemblies shall be UL listed, to comply with UL 508A standards.

6. Control panel enclosures shall be sized to provide at least 20 percent spare space, for future expansion, addition of panel components, etc. This shall minimize impact of the addition of unintended equipment during the checkout and startup phases.

7. PLC hardware provided shall accommodate a minimum 20 percent spare of each I/O type used in the panel, wired to terminals and/or interposing relays during the fabrication process. This shall minimize impact of unintended I/O requirements added during the checkout and startup phases of the Project.

B. Wiring

1. All interconnecting wiring shall be stranded and shall have 600-volt insulation and be rated for not less than 90°Celsius.

2. Power distribution wiring on the line side of fuses shall conform to Division 26 requirements.

3. Power and low voltage DC wiring systems shall be routed in separate wireways. Crossing of power distribution wiring and control wiring shall be at right angles. Different system wires routed parallel to each other shall be separated by at least 6 inches. Different wiring systems shall terminate on separate terminal blocks. Wiring troughs shall not be filled to more than 60 percent visible fill.

4. All wiring shall terminate onto single-or-double tier terminal blocks, where each terminal is uniquely and sequentially numbered. Direct interlock wiring between equipment is not allowed. The control panel shall be fabricated with minimum 20 percent spare terminals. Terminal blocks shall be arranged in vertical rows and separated into groups; power, AC control, DC signal. Terminal blocks shall be the compression screw type. Spring-clamp style terminals will not be accepted.

   a. Discrete inputs and outputs (DI and DO) shall have 2 terminals per point with adjacent terminal assignments. All active and spare points shall be wired to terminal blocks.

   b. Analog inputs/outputs (AI and AO) shall have a minimum of three 3 terminals per shielded pair. Three terminals shall be provided for direct connection of powered, 4-wire loops. Four terminals shall be provided for direct connection of loop powered, 2-wire loops. Five terminals shall be provided for connection of analog loops incorporating a local indicator or recorder. One terminal is for shielded ground connections for cable pairs. Ground the shielded signal cable at the PLC cabinet. All active and spare points shall be wired to terminal blocks.

   c. Wire and tube markers shall conform to Division 26 requirements.

   d. Only one side of a terminal block row shall be used for internal wiring. The field wiring side of the terminal shall not be within 6-inches of the side panel or adjacent terminal, or within 8-inches of the bottom of the panel.

e. Whenever possible, the terminals for field wiring shall be located to reduce the amount of routing through wireway necessary to carry the field wiring to the termination point.

5. All wiring, internal to the panel and field wiring, shall be provided with a service loop to allow for adjustment of the termination point in the future. The service loop shall be no more than 4-5 inches, and shall be stored in the associated wireway.

6. All wiring to hand switches, etc., which are live circuits independent of the panel's normal circuit breaker protection, shall be clearly identified as such.

7. All wiring shall be clearly tagged and color-coded in accordance with the National Electric Code (NEC). All tag numbers and color-coding shall correspond to the panel wiring diagrams prepared by the Engineer. All power wiring, control wiring, grounding, and DC wiring shall utilize different color insulation for each wiring system used. The color coding scheme shall be:

   a. Incoming 120 VAC Hot – Black

   b. 120 VAC Hot Wiring control circuit wires downstream of panel circuit breaker) – Red

   c. 120 VAC Neutral – White

   d. Ground – Green with yellow stripe

   e. DC Wiring – Blue

   f. DC Common – White with blue stripe

   g. Intrinsically Safe Wiring – Light Blue

   h. Foreign Voltage – Yellow

C. Control Panel Loss of Power

1. Each control panel containing a PLC shall have an input configured to alarm the operators upon loss of main control panel power. This alarm shall be displayed on the SCADA nodes to alert the operators that attention is required.

2. Each control panel containing a backup PLC for wetwell level control shall have an input configured on the main PLC to alarm the operators upon loss of backup PLC power.

D. Control Panel Overcurrent Protection

1. All overcurrent protection devices shall be properly sized to protect the devices and the loads to which they are associated.

2. Circuit Breakers

a. Circuit breakers in the panel shall be sized to protect the associated equipment, and to provide the necessary power to operate.

3. Fuses

a. Glass fuses not associated with motor circuit protection or inductive loads shall be specified as fast-acting style. Fuses associated with motor circuit protection or inductive loads shall be specified as time delay style.

E. Lightning/Surge Suppression

1. Lightning/surge suppression shall be provided to protect the control panel and associated equipment from surges on the incoming power circuits, or those induced by lightning strikes and propagated along the signal or power lines connected to the control panels. Surge protection shall be provided by a qualified manufacturer complying with requirements in Article 1.04. Surge protection shall be sized properly for its intended purpose.

2. 120VAC surge suppression

a. The incoming 120VAC power source for the control panel shall be provided with surge suppression in the control panel. Surge suppressors shall be provided with an auxiliary contact, connected to the PLC to indicate surge suppressor failure. Install surge suppression in strict accordance with manufacturer's recommendations. In the case of multiple circuits within the same control panel, each incoming 120VAC power source shall be provided with surge suppression.

3. Analog signal surge suppression

a. Analog signals connected to equipment or instrumentation that is located outside the building where the control panel is installed shall be supplied with German Institute for Standardization (DIN) rail mounted surge suppression in the control panel. Provide surge protection at both ends of the signal cable and mount surge protection as close to the equipment, instrument, or termination point as possible. Provide with a minimum of 10kA surge current suppression.

4. Telephone Line and Ethernet surge suppression

a. Copper-based telephone lines and Ethernet cabling connected to the control panel that leaves the building where the control panel is installed shall be provided with surge suppression in the control panel. Provide surge protection at both ends of the telephone or

Ethernet cabling and mount surge protection as close to the termination point as possible.

F. Selector Switches, Pushbuttons and Pilot Lights

1. All selector switches, pushbuttons, and pilot lights required for the enclosures shall be provided in accordance with Section 26 27 26 WIRING DEVICES.

G. Uninterruptible Power Supplies

1. Each control panel containing a PLC shall be provided with an uninterruptible power supply (UPS) sized to provide a minimum of 10 minutes of power in the event of main control power loss. The UPS shall be provided with relay contact outputs, connected to the PLC, to indicate UPS fault and UPS low battery conditions at a minimum.

H. Ethernet Switches

1. Ethernet switches shall be configured to accept the number of connections shown on the Drawings.

2. Ethernet switches shall be provided with a minimum of 20 percent spare RJ-45 ports available for future expansion.

I. Seal Fail and Motor Temperature Relays

1. Pumps, mixers, etc. equipped with proprietary seal fail and motor temperature relays, shall require these relays to be mounted in the SCADA control panel. The seal fail and motor over temperature alarm contacts shall be connected to the PLC as discrete inputs.

J. Intrinsic Safety Barrier Panels

1. Intrinsic safety barriers required for interfacing with equipment and instruments located in a classified area shall be mounted in a panel separate from the control panels.

2. Panels housing intrinsic safety barriers shall be laid out to facilitate separation of hazardous and non-hazardous wiring. Wireway containing hazardous area wiring shall be clearly indicated as such.

K. Equipment Mounting/Arrangement

1. All components shall be mounted in a manner that permits servicing, adjustment, testing and removal without disconnecting, moving or removing any other component. Components mounted on the inside of panels shall be mounted on removable plates and not directly to the enclosure. Mounting shall be rigid and stable unless shock mounting is

required by the manufacturer to protect equipment from vibration. Components shall be identified with suitable plastic or metal engraved tags attached with drive pins adjacent to each component, identifying the component in accordance with the Drawings and Specifications.

2. All exterior panel mounted equipment shall be installed with suitable gaskets, faceplates, etc., required to maintain the NEMA rating of the panel.

3. A minimum of 1-1/2 inches shall be provided between panel wireway and terminal blocks, to insure that wiring can be accessed easily.

4. Maintain manufacturer recommended spacing around panel-mounted equipment, for heating and ventilation concerns.

5. ISA Recommended Practice RP60.3 shall be used as a guide in layout and arrangement of panels and panel mounted components.

L. Nameplates

1. All panels and panel devices shall be supplied with suitable nameplates that identify the panel and individual devices as required. Each device nameplate shall include up to 3 lines, with the first line containing the device tag number as shown on the Drawings, the second line containing a functional description, and the third line containing a functional control description.

2. Unless escutcheon plates are specified or unless otherwise noted on the Drawings, nameplates shall be 3/32-inch thick, black and white, Lamacoid with engraved inscriptions. The letters shall be black against a white background. Edges of the nameplates shall be beveled and smooth. Nameplates with chipped or rough edges will not be acceptable. Nameplates shall be affixed to the panels using #4-40 threaded stainless steel button head hex screws.

3.02 CONTROL PANEL QUALITY ASSURANCE

A. Panel shop shall, upon fabrication of the control panels, apply power to each panel to ensure the panels are wired correctly and all devices contained within the panels power up properly. Panel shop shall provide written confirmation to the Engineer that a power up test was completed.

B. Panel shop shall complete a point-to-point wiring checkout for all wiring contained in the control panels and correct any errors or omissions found during that process. Panel shop shall provide written confirmation to the Engineer that checkout was completed.

C. Panel shop shall provide 5-days advance notice to the Engineer that control panel fabrication is complete, and shall make the control panels available in their facility

for completion of the Factory Acceptance Test by the Engineer or System Integrator. Panel shop shall not ship control panels prior to execution of the Factory Acceptance Test unless indicated in writing by the Engineer.

3.03 INSTALLATION AND MOUNTING

A. Provide all labor, tools, material, and equipment required to install the SCADA Panel in the locations shown on the Drawings, in accordance to manufacturer-recommended mounting practices. The location of control panel shown on the Drawings is approximate only. Exact location shall be approved by the Owner or Engineer during construction. Obtain in the field all information relevant to the placing of process control Work and in case of any interference with other Work, proceed as requested by the Engineer.

1. SCADA Panel shall be powered up upon delivery to the Owner.

B. All control panels shall be powered up upon installation, and all field wiring shall be tested for proper termination. All analog signals shall be simulated for a full-scale 4-20ma test.

3.04 FIELD QUALITY CONTROL

A. Provide in accordance with Division 01 General Requirements.

3.05 STARTUP & COMMISSIONING

A. Provide all labor, tools, materials and equipment necessary to assist in the startup and testing of the SCADA system with the Integrator after installation of control panels and instruments, and termination of field wiring to panels is complete. Start up and testing shall be witnessed by the Owner or Owner's representative.

3.06 CLOSEOUT ACTIVITIES

A. Provide in accordance with Division 01 General Requirements.

END OF SECTION

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SECTION 40 70 00

INSTRUMENTATION FOR PROCESS SYSTEMS

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes

Provide instrumentation, equipment mounting, vendor-supplied cables between elements and transmitters, and other related appurtenances as specified on the Drawings in accordance with this Section.

Provide labor, tools, materials, and equipment necessary to install and start up instruments as described on the Drawings.

1.02 PRICE AND PAYMENT PROCEDURES

A. Measurement and payment requirements: per Division 01 General Requirements.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Coordination, Sequencing, and Scheduling: per Division 01 General Requirements.

1.04 SUBMITTALS

A. Submit in accordance with Division 01 General Requirements.

B. Submit detailed information for each instrument or control device in accordance with Section 40 61 01 INSTRUMENTATION AND CONTROLS GENERAL REQUIREMENTS.

C. In addition to the requirements of Section 40 61 01, the submittals will include:

1. Instrument data sheet for each instrument

2. Product name and tag number as shown on the Drawings

3. Manufacturers complete model number

4. Location of device

5. Input - output characteristics

6. Range, size, and graduations

7. Physical size with dimensions, enclosure National Electrical Manufacturers Association (NEMA) classification, and mounting details

8. Materials of construction of components

9. Calibration certificates provided by manufacturer

10. Installation and operation manuals

D. Define exceptions or deviations to the Specifications or Drawings. Submit sufficient details to the Engineer for evaluation.

E. Closeout and Maintenance Material Submittals: per Division 01 General Requirements.

1. Operations and Maintenance (O&M) Materials

a. Operations and maintenance (O&M) information will be provided in accordance with Section 40 61 01 INSTRUMENTATION AND CONTROLS GENERAL REQUIREMENTS.

b. In addition to the requirements in Section 40 61 01, the instrumentation section of the O&M manuals will consist of the following:

1) Instrument list or ISA data sheets, including tag numbers.

1.05 QUALITY ASSURANCE

A. Provide in accordance with Division 01 General Requirements.

B. Instruments and appurtenances must comply with the Specifications, be supplied from manufacturers regularly engaged in the production of such products, be standard products wherever possible, and be the manufacturer’s latest design.

C. Instruments and appurtenances are subject to approval by the Engineer, and will demonstrate equal appearance, quality, and performance to that specified. Verify the availability of equipment, instruments and materials proposed for use prior to submission to Engineer for approval. If production of equipment, instrument, or material is discontinued, submit an alternate of comparable quality to the Engineer for approval prior to execution of Work, and at no additional cost to Owner.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Provide in accordance with Division 01 General Requirements.

B. Deliver, store, and handle products in accordance with manufacturer's recommendations and in accordance with Section 40 61 01 INSTRUMENTATION AND CONTROLS GENERAL REQUIREMENTS.

1.07 SITE CONDITIONS

A. Existing Conditions: per Division 01 General Requirements.

PART 2 – PRODUCTS

2.01 INSTRUMENTATION – GENERAL

A. Provide brackets and hangers for all equipment.

B. Instrumentation supplied must be the manufacturer's latest design and produce or be activated by signals that are established standards for the water and wastewater industries.

C. Instrumentation requiring power supplied from a source other than the control panel to which it is connected must operate on 120VAC, single phase, 60 HZ current, unless specifically indicated otherwise. This power will be supplied from the closest local electrical lighting panel with a breaker for each circuit.

D. Electronic instrumentation must be solid-state. Analog control signals shall be linear and be industry standard currents of 4 to 20 milliampere direct current (mA DC), however, signals between instruments within the same panel or cabinet may be 1-5 volts direct current (VDC), or the like. No zero based signals are allowed.

E. Outputs of equipment that are not of the standard signals as outlined, will have the output immediately raised or converted to compatible standards signals for remote transmission. No zero-based signals are allowed.

F. Instruments shall be provided with stainless steel mounting hardware or galvanized steel floor stands, wall brackets, or instrument racks as appropriate for each location.

G. Equipment installed in a hazardous area shall meet class, group, and division as shown on the electrical Drawings, to comply with the National Electrical Code.

H. Indicators and recorder readouts must be linear in the process units.

I. Transmitters shall be provided with either integral indicators or remote-mount indicators with process units accurate to plus or minus 2 percent.

J. Electronic equipment must be the manufacturer's latest design. Circuit boards and associated components must have suitable conformal coating to prevent contamination by dust, moisture, and fungus. Solid-state components must be conservatively rated for their purpose to assure optimum long-term performance and dependability over normally anticipated atmospheric conditions of temperature, pressure, and humidity. The field-mounted equipment and system components shall be designed for installation in dusty, humid, and slightly corrosive service conditions.

K. Instruments furnished shall be heavy-duty type, designed for continuous industrial service. The system shall contain products of a single manufacturer, insofar as possible, and will consist of equipment models that are currently in production. All

equipment provided shall be of modular construction and be capable of field expansion.

L. Lightning/Surge Suppression - Provide individual surge protection means for each field instrument mounted outside the building from the control panel to which they are connected. Instruments mounted inside the same building as the control panel to which they are connected shall not require surge protection.

M. Instruments shall be provided as indicated on the instrument index and in the Instrument Data Sheets, included as an attachment at the end of this Section. These documents include the instrument tag names, physical requirements, control requirement, and basis of design manufacturer and model number information.

2.02 FLOW INSTRUMENTATION

A. Magnetic Flow Meter – Refer to Instrument Data Sheet 2.02A.

2.03 LEVEL INSTRUMENTATION

A. Submersible Level Transducer – Refer to Instrument Data Sheet 2.03A.

B. Mechanical Tilt Float Switch – Refer to Instrument Data Sheet 2.03B.

C. Vertical Level Switch – Refer to Instrument Data Sheet 2.03C.

D. Ultrasonic Level Transmitter – Refer to Instrument Data Sheet 2.03D.

2.04 PRESSURE INSTRUMENTATION

A. Gage Pressure Transmitter – Refer to Instrument Data Sheet 2.04A.

2.05 GAS DETECTOR INSTRUMENTATION

A. Gas Detector Transmitter (LEL) – Refer to Instrument Data Sheet 2.05A.

B. Gas Detector Transmitter (H2S) – Refer to Instrument Data Sheet 2.05B.

C. Gas Detector Transmitter (O2) – Refer to Instrument Data Sheet 2.05C.

2.06 TEMPERATURE INSTRUMENTATION

A. Temperature Transmitter/Sensor – Refer to Instrument Data Sheet 2.06A.

2.07 ALARM INSTRUMENTATION

A. LED Light – Refer to Instrument Data Sheet 2.07A.

PART 3 – EXECUTION

3.01 INSTALLATION AND MOUNTING

A. Provide labor, tools, material, and equipment required to install instruments in the locations shown on the Drawings, in accordance with manufacturer-recommended installation and mounting practices. The location of equipment, transmitters, alarms, and similar devices shown on the Drawings are approximate only. Exact locations shall be approved by the Engineer during construction. Obtain in the field information relevant to the placing of process control Work and in case of any interference with other Work, proceed as requested by the Engineer.

B. Make necessary mechanical changes to install new instrumentation and associated equipment provided under this Contract. This Work includes fittings, fabrications, supports, guides, restraints, bolting, gaskets, and accessories.

C. The instrumentation Drawings indicate the intent of the interconnections between the individual instruments. Any exceptions should be noted and communicated to the Engineer in writing.

D. Instrument cabinets located outdoors or in unheated locations shall be provided with heating or cooling devices as necessary to maintain all instruments and/or electronics installed in those cabinets within their design temperature limits.

E. Install brackets and hangers to avoid interference with other equipment.

F. The shield on each process instrumentation cable shall be continuous from source to destination and be grounded as directed by the manufacturer of the instrumentation equipment, but in no case shall more than 1 ground point be employed for each shield.

G. Coordinate the installation, placing and location of system components, their connections to the process equipment panels, cabinets, and devices. Ensure field wiring for power and signal circuits is done in accordance with best Industry Practice and provide for necessary system grounding to ensure a satisfactory and functioning installation.

3.02 INSPECTION AND TESTING

A. Submit detailed test, procedure, and startup instructions for each instrument.

B. Provide the services of a qualified service representative for the instrumentation provided under this Contract, for checking the installation, making the necessary adjustments and calibrations, placing the equipment in operation, and performing the acceptance tests. The representative will be available for not less than 2 days to instruct operating personnel in the use, operation, and maintenance of the equipment during the initial operating period.

C. Test and calibrate in place the instrumentation to demonstrate that it meets the accuracy requirements for the conditions specified. Provide labor, equipment, and incidentals required for the tests, including electric power, water, instrument air, etc. required for tests. The Engineer will witness field tests and conduct field inspections. Provide the Engineer a minimum of 10 working days' notice of the dates and times scheduled for tests. Rectify any deficiencies found and retest Work affected by such deficiencies at the Contractor's expense. Record data from each field test will be recorded and documented in a formal field test report.

3.03 ATTACHMENTS

A. Instrument Index (1 pages)

B. Instrument Data Sheets (11 pages)

3.04 FIELD QUALITY CONTROL

A. Provide in accordance with Division 01 General Requirements.

3.05 STARTUP & COMMISSIONING

A. Provide in accordance with Division 01 General Requirements.

3.06 CLOSEOUT ACTIVITIES

A. Provide in accordance with Division 01 General Requirements.

END OF SECTION

INSTRUMENT INDEX				
Drawing Number	**Instrument Tag**	**Data Sheet**	**Instrument Description**	**Notes**
	FE/FIT-125	2.02A	Station Discharge Magnetic Flow Meter	
	LT-101A	2.03A	Wet Well #1 Submersible Level Transducer	
	LT-101B	2.03A	Wet Well #2 Submersible Level Transducer	
	LSHH-100A	2.03B	Wet Well #1 High-High Mechanical Tilt Float Switch	
	LSLL-100A	2.03B	Wet Well #1 Low-Low Mechanical Tilt Float Switch	
	LSHH-100B	2.03B	Wet Well #2 High-High Mechanical Tilt Float Switch	
	LSLL-100B	2.03B	Wet Well #2 Low-Low Mechanical Tilt Float Switch	
	LSH-121	2.03C	Wet Well Flooding Vertical Level Float Switch	
	LSH-122	2.03C	Dry Well High-High Vertical Level Switch	
	LIT-112	2.03D	Influent Channel Ultrasonic Level Transmitter	
	PIT-124	2.04A	Discharge Header Gauge Pressure Transmitter	
	AIT-101A	2.05A	Wet Well Gas Detector (LEL)	
	AIT-102A	2.05A	Odor Control Room Gas Detector (LEL)	
	AIT-101B	2.05B	Wet Well Gas Detector (H_2S)	
	AIT-102B	2.05B	Odor Control Room Gas Detector (H_2S)	
	AIT-101C	2.05C	Wet Well Gas Detector (0_2)	
	AIT-102C	2.05C	Odor Control Room Gas Detector (0_2)	
	TIT-131	2.06A	Control Room Temperature Transmitter	
	YI-138	2.07A	General Gas Alarm LED Light	

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INSTRUMENT DATA SHEET 2.02A – MAGNETIC FLOW METER

WOODARD &CURRAN	MAGNETIC FLOWMETERS	TAG NO:	*FE/FIT 125*	PAGE:	*1 of 11*
		P&ID #:	*N/A*	PRINTED:	*1/30/2017*
		SPEC. NO:	*40 70 00*		

PROJECT NUMBER:	*227872.00*	REV	REVISION DESCRIPTION	BY	DATE
DESCRIPTION:	*Lafayette Road Pump Station Upgrades*	*0*	*Issued for Bid*	*SK*	*February, 2017*

SERVICE:	*Station Wastewater Flow – Normal Duty*			
FLOWTUBE	Meter Size:	*12"*	Electrode Material:	*316SS*
	Flow Range:	*350-10,600gal/min*	Ground Type:	*Electrode/Grounding Ring*
	End Connections:	*150# RF Flanges*	Ground Material:	*316L*
	Tube Material:	*SS / CS*	Line Size:	*12"*
	Liner Material:	*Polyurethane*	Line Material:	*SS*
	Electrode Type:	*Standard*	Enclosure Rating:	*NEMA 4X*
TRANSMITTER	Mounting:	*Remote, wall mount*	Enclosure Material:	*ABS / Aluminum*
	Cable Length:	*See note 1*	Enclosure Rating:	*NEMA 4X*
	Power Supply:	*120VAC*	Accuracy:	*+-0.2 %*
	Local Indicator/Style:	*LCD*	Alarm Relays/Rating:	*2 Relays*
			Comm. Protocol:	*Ethernet IP*
CALIBRATION	Process (0% / 100%):	*350-5000gal/min*	Pulse Output / Value:	*24VDC*
	Output (4mA / 20mA):	*350-5000gal/min*		

PROCESS DATA	Proc Fluid / State:	*Water / Liquid*	Flow (Min/Oper/Max):	*0*		*10,567*
	Specific Gravity:	*Water Like*	Flow Units:	*gpm*		
	Percent Solids:	-	Pressure (Min/Oper/Max):		*Amb.*	
	Conductivity:	*Water Like*	Pressure Units:	*psig*		
	Viscosity:	*Water Like*	Temperature (Min/Oper/Max):		*Amb.*	
	Line Size / Sched.:	*12" / DI*	Temperature Units:	*°F*		
	Line No.:	-				

ACCESSORIES	Empty Tube Detection:	*Yes*	Option:	
	Instrument Tag:	*SS-engraved*	Option:	
	Calibration Standard:		Option:	
MANUFACTURER	*Manufacturer:*	*Endress & Hauser Proline Promag 400 Series*		
COMMENT				
NOTES	*1. Cable length to be verified in the field prior to ordering.*			

INSTRUMENT DATA SHEET 2.03A – SUBMERSIBLE LEVEL TRANSDUCER

WOODARD &CURRAN	SUBMERSIBLE LEVEL TRANSDUCER	TAG NO:	*See Note 3*	PAGE:	*2 of 11*
		P&ID #:	*N/A*	PRINTED:	*1/30/2017*
		SPEC. NO:	*40 70 00*		

PROJECT NUMBER:	*227872.00*	REV	REVISION DESCRIPTION	BY	DATE
DESCRIPTION:	*Lafayette Road Pump Station Upgrades*	*0*	*Issued for Bid*	*SK*	*February, 2017*

SERVICE: *Wet Well Level*

GENERAL	Type:	*Bullet Style*	Body Material	*316SS*
	Mounting:	*Immersion*	Diaphragm Material:	*316SS*
	Span Range Min/Max:	*0-23.07 ft*	Cable Jacket Material:	*Polyurethane*
	Press/Temp Rating:	*3x FSPR / 0 - 140°F*	Cable Length	*40', see note 2*
	Accuracy:	*0.5% Full scale*	Power Supply:	*24VDC, loop-powered*
	Area Classification:	*Unclassified*	Transmitter/Local Ind.:	*N/A*
	Sealed/Vent Tube:	*Vent Tube*	Stilling Well:	*N/A*

CALIBRATION	Process (0% / 100%):	*0-23.07 ft*				
	Output (4mA/20mA):	*0-20 ft*				
PROCESS DATA	Proc Fluid / State:	*Water / Liquid*	Level (Min/Oper/Max):	*0*	*5*	*23.07*
	Specific Gravity:	*Water Like*	Level Units:	*ft*		
	Density:	*Water Like*	Pressure (Min/Oper/Max):	*Ambient*		
	Conductivity:	*Water Like*	Pressure Units:	*psi*		
	Viscosity:	*Water Like*	Temperature (Min/Oper/Max):	*Ambient*		
	Tank Material:	-	Temperature Units:	*°F*		
	Tank No.:	-				

ACCESSORIES	Ind. Scale/Range:		Option-1:	
	Device Tag:	*SS, engraved*	Option-2:	

MANUFACTURER OR APPROVED EQUAL	*Manufacturer 1:*	*ProSense STL1-010-L40*
	Manufacturer 2:	
	Manufacturer 3:	

COMMENT

NOTES

1. Provide strain relief and weight & chain assembly as shown on the Drawings.
2. Cable length to be verified in the field prior to ordering.
3. Refer to Instrument Index for quantity and tag numbers

INSTRUMENT DATA SHEET 2.03B – MECHANICAL TILT FLOAT SWITCH

WOODARD &CURRAN	MECHANICAL TILT FLOAT SWITCHES	TAG NO:	*See Note 1*	PAGE:	*3 of 11*
		P&ID #:	*N/A*	PRINTED:	*1/30/2017*
		SPEC. NO:	*40 70 00*		

PROJECT NUMBER:	*227872.00*	REV	REVISION DESCRIPTION	BY	DATE
DESCRIPTION:	*Lafayette Road Pump Station Upgrades*	*0*	*Issued for Bid*	*SK*	*February, 2017*

SERVICE:	*Wet Well Level*			
GENERAL	Type:	*Mechanical Tilt*	Tilt Angle:	*Wide*
	Mounting Style:	*Independent Weight*	Contact Type:	*SPDT*
	Area Classification:	*Unclassified*	Contact Rating:	*10A @ 120VAC*
	Float/Disp. Material:	*Polypropylene / ABS / EPDM*	Cable Length:	*40', see note 2*
	Float/Displacer Size:	*3.5" X 5"*	Cable Jacket Mat'l:	*Polyethylene*
	Press/Temp Rating:	*None / 32 - 170°F*	Stilling Well:	
CALIBRATION	1st Switch Level:	*See Note 4*	3rd Switch Level:	-
	2nd Switch Level:	*See Note 4*		
PROCESS DATA	Proc Fluid / State:	*Water / Liquid*	Level (Min/Oper/Max):	*See Note 4*
	Specific Gravity:	*Water Like*	Level Units:	*ft*
	Percent Solids:	*Water Like*	Pressure (Min/Oper/Max):	*Amb.*
	Conductivity:	*Water Like*	Pressure Units:	*psig*
	Di-Electric Const.:	*Water Like*	Temperature (Min/Oper/Max):	*Amb.*
	Viscosity:	*Water Like*	Temperature Units:	*°F*
	Tank Material:	-		
	Tank No.:	-		
	Tank Agitated:	-		
ACCESSORIES	Tether/Weight:	*Weight*	Option-1:	*4FB Float Bracket – See Note 5*
	Loc. Indicators/Style:	-	Option-2:	-
	Instrument Tag:	*See Note 1*	Option-3:	-
MANUFACTURER OR APPROVED EQUAL	Manufacturer 1:	Conery B8 Series (basis of design)		
	Manufacturer 2:	*Warrick Series M*		
	Manufacturer 3:	*Madison M45 Series*		

COMMENTS

NOTES

1. Refer to Instrument Index for quantity and tag numbers.
2. Confirm cable length required prior to ordering.
3. Provide weight mounting equipment for floats; Independently hang floats.
4. Install Float Switches at the previously demolished heights
5. One 4FB will be installed in each wet well to hold cords of two float switches and one level transducer

INSTRUMENT DATA SHEET 2.03C – VERTICAL LEVEL SWITCH

WOODARD &CURRAN	VERTICAL LEVEL SWITCHES	TAG NO:	*LSH-121, LSH-122*	PAGE:	*4 of 11*
		P&ID #:	*N/A*	PRINTED:	*1/30/2017*
		SPEC. NO:	*40 70 00*		

PROJECT NUMBER:	*227872.00*	REV	REVISION DESCRIPTION	BY	DATE
DESCRIPTION:	*Lafayette Road Pump Station Upgrades*	*0*	*Issued for Bid*	*SK*	*February, 2017*

SERVICE: *Dry Well Flooding Level Switch, Wet Well Flooding Level Switch*

GENERAL	Type:	*Magnetic Reed w/slosh shield*	Power Supply:	*115 VAC*
	Mounting:	*Wall Mount*	Area Classification:	*C1/D2*
	Press/Temp Rating:		Switch Type:	*SPST / NO or NC (selectable)*
	Rod Length/Material:	*PVDF / Polypropylene*	Sw. Contact Rating:	*20VA @ 120VAC*
	Float/Disp. Material:	*PVDF / Polypropylene*	Conduit Connection:	*1/8" NPT*
	Float/Displacer Size:		Cable Length:	*10 ft.*
	Actuation Length:	*9/16"*	Cable Jacket Mat'l:	
CALIBRATION	Switch Level:	*4" AFF*		

PROCESS DATA	Proc Fluid / State:	*Water / Liquid*	Level (Min/Oper/Max)	*0*		*1*
	Specific Gravity:	*Water-like*	Level Units:	*ft.*		
	Percent Solids:	*Water-like*	Pressure (Min/Oper/Max):		*Amb*	
	Conductivity:	*Water-like*	Pressure Units:	*psig*		
	Di-Electric Const.:	*Water-like*	Temperature (Min/Oper/Max):	*40*		*120*
	Viscosity:	*Water-like*	Temperature Units:	*°F*		

ACCESSORIES	Instrument Tag:	*SS-engraved*	Option-2:	
	Option-1:		Option-3:	

MANUFACTURER OR APPROVED EQUAL	Manufacturer 1:	*Madison MSB8800 (basis of design)*
	Manufacturer 2:	*Gems Sensors LS-3 Series*
	Manufacturer 3:	*Flowline Switch-Tek LV20 Series*

NOTES

1. Provide NEMA 4X junction box to terminate switch leads, and required mounting hardware.

INSTRUMENT DATA SHEET 2.03D – ULTRASONIC LEVEL TRANSMITTER

WOODARD &CURRAN	ULTRASONIC LEVEL TRANSMITTER	TAG NO:	*LIT-112*	PAGE:	*5 of 11*
		P&ID #:	*N/A*	PRINTE:	*1/30/2017*
		SPEC. NO:	*40 70 00*		

PROJECT NUMBER:	*227872.00*	REV	REVISION DESCRIPTION	BY	DATE
DESCRIPTION:	*Lafayette Road Pump Station Upgrades*	*0*	*Issued for Bid*	*SK*	*February, 2017*

SERVICE:	Influent Channel High Level Alarm			
MANUFACTURED ACCEPTABLE LEVEL OF QUALITY	Manufacturer: Flowline			
	Model Number: DL24			
TRANSDUCER	Mounting:	*2" NPT Flange*	Housing Mat'l (Wet):	*PVDF*
	Span (min/max):	*0 to 9.8 Feet*	Housing Mat'l (Non-Wet):	*Polycarbonate*
	Press/Temp Rating:	*-4 to 140°F*	Flange/Bracket Material:	*2" NPT Stainless Steel Bracket*
	Area Classification:	*Non-Hazardous*	Cable Length:	*See Note 1*
	Beam Width:	*2"*		
	Frequency:	*44 / 50kHz*		
TRANSMITTER	Mounting:	*Integral to transducer*	Enclosure Material:	*Polycarbonate*
	Cable Length:	*N/A*	Enclosure Rating:	*NEMA 4X*
	Power Supply:	*24VDC, loop-powered*	Accuracy:	*0.2% of range*
	Local Indicator/Style:	*N/A*	Alarm Relays/Rating:	*N/A*
	No. of Transducers	*One (1)*	Comm. Protocol:	*4-20 mA*
CALIBRATION	Process (0%/ 100%):	*0-9.8 Feet*		
	Output (4mA/20mA)	*0-5 Feet*		
PROCESS DATA	Proc Fluid / State:	*Sanitary Wastewater*	Level (Min/Oper/Max):	*0* / *4*
	Specific Gravity:	*Water-like*	Level Units:	*Feet*
	Percent Solids:	*Water-like*	Pressure (Min/Oper/Max):	*Ambient*
	Conductivity:	*Water-like*	Pressure Units:	*PSI*
	Viscosity:	*Water-like*	Temperature (Min/Oper/Max):	*40* / *70* / *120*
	Tank Material.:	*Concrete*	Temperature Units:	*°F*
	Tank No.:			
ACCESSORIES	Instrument Tag:	*SS-engraved*	Option-1:	*DL24-01 Fob USB adapter*
	Calibration Standard:	*0.2% Standard*	Option-2:	*N/A*
COMMENT				
NOTES	*1. Cable length to be verified in the field prior to ordering.*			

INSTRUMENT DATA SHEET 2.04A – GAUGE PRESSURE TRANSMITTER

WOODARD &CURRAN	PRESSURE TRANSMITTERS	TAG NO:	*PIT-124*	PAGE:	*6 of 11*
		P&ID #:	*N/A*	PRINTED:	*1/30/2017*
		SPEC. NO:	*40 70 00*		

PROJECT NUMBER:	*227872.00*	REV	REVISION DESCRIPTION	BY	DATE
DESCRIPTION:	*Lafayette Road Pump Station Upgrades*	*0*	*Issued for Bid*	*SK*	*February, 2017*

SERVICE: *Discharge Header Pressure*

GENERAL	Type:	*Inline*	Connection-Process:	*½" NPT*
	Span Range Min/Max:	*-14.7 to 150psi*	XMTR Body Material:	*Aluminum / 316SS*
	Output Signal:	*4-20mA*	XMTR Element Material:	*316SS*
	Accuracy:	*0.075% of Span*	Sensor Fill Fluid:	*Silicone*
	Air/Power Supply:	*24VDC, loop powered*	Diaphragm Seal (Y/N):	*Yes*
	Max. Press. Rating:	*-14.7 to 150psi*	Seal Material (Non-Wet):	*316SS*
	Area Classification:	*Unclassified*	Dia/Housing (Wet):	*316SS*
	Enclosure Rating:	*NEMA 4X*	Fill Fluid:	*Silicone*
	Local Indicator/Type:	*LCD*	Capillary Length:	*N/A*
	Mounting – Elect.:	*Integral*	Capillary Material:	*N/A*
	Mounting – Sensor:		Capillary Armor:	*N/A*
CALIBRATION	Process (0% /100%):	*0-150 psi*		
	Output (4mA / 20mA):	*0-90 psi*		

PROCESS DATA	Proc Fluid / State:	*Water / Liquid*	Flow (Min/Oper/Max):		*Amb.*	
	Specific Gravity:	*Water Like*	Flow Units:	*gpm*		
	Percent Solids:	*Water Like*	Pressure (Min/Oper/Max):	*0*		*90*
	Conductivity:	*Water Like*	Pressure Units:	*Psig*		
	Viscosity:	*Water Like*	Temperature (Min/Oper/Max):		*Amb.*	
	Line Size / Sched.:		Temperature Units:	*°F*		
	Line No.:					

ACCESSORIES	Vent/Drain:		Option-1:	
	Instrument Tag:	*SS-engraved*	Option-2:	
	Manifold Valve:	*N/A*	Option-3:	

MANUFACTURER OR APPROVED EQUAL	*Manufacturer 1:*	*Rosemount 2051T Series (Basis of Design)*
	Manufacturer 2:	*Foxboro IGP10 Series*
	Manufacturer 3:	*Endress & Hauser PMP75 Series*

NOTES

1. Remote Indicator Mounted on Wall

INSTRUMENT DATA SHEET 2.05A – GAS DETECTOR TRANSMITTER

WOODARD &CURRAN	Gas Sensor/Transmitter	TAG NO:	*AE/AIT-101A & -102A*	PAGE:	*7 of 11*
		DRAWING #:	*N/A*	PRINTED:	*1/30/2017*
		SPEC. NO:	*40 70 00*		

PROJECT NUMBER:	*227872.00*	REV	REVISION DESCRIPTION	BY	DATE
DESCRIPTION:	*Lafayette Road Pump Station Upgrades*	*0*	*Issued for Bid*	*SK*	*February, 2017*

SERVICE: *Pump Station Wet Well and Control Room LEL Gas Monitors*

SENSOR	Type of Sensor:	*IR LEL*	Oxygen Requirement:	
	Sensor Mounting:	*Remote*	Body Material:	*316 SS*
	Sensor Connection:	*¾" NPT*	Enclosure Class:	*See Note 1*
	Sensor Range:	*0-100 %*	Cable Length:	*Max 25' Cable from Sensor to Transmitter*
	Temp Range:	*-40 through 140°F*		
TRANSMITTER	Device Tag:	*Yes- SS, engraved*	Accuracy:	*1% of Full Scale*
	Mounting:	*Remote*	Calibration:	*0-100%LEL*
	Enclosure Rating:	*See Note 1*	Local Indicator/Style:	*LCD*
	Enclosure Material:	*316 SS*	Digital Comm. Protocol:	*4-20 mA*
	Power Supply:	*7-30 VDC*	Alarm Relays/No.:	*N/A*
			Relay Type/Rating:	*N/A*
PROCESS DATA	Proc Fluid / State:	*Methane/Gas*	Flow (Min/Oper/Max):	*N/A* *N/A* *N/A*
	Specific Gravity:	-	Flow Units:	*N/A*
	Percent Solids:	-	Pressure (Min/Oper/Max):	*Ambient*
	Conductivity:	-	Pressure Units:	*psi*
	Viscosity:	-	Temperature (Min/Oper/Max):	*Ambient*
	Line Size / Sched.:	-	Temperature Units:	*°F*
	Line No.:	-		

ACCESSORIES	4-Channel Controller:	*N/A*	Option-1:	*N/A*
	ToD Gas Generator:	*N/A*	Option-2:	*N/A*
	Moisture Barrier:	*N/A*	Option-3:	*N/A*
	Baffled Rainshield:	*N/A*	Option-4:	*N/A*

MANUFACTURER

Manufacturer 1: *MSA (Ultima XE Series)*

NOTES

1. AE/AIT-101B will need to be explosion proof rated. AE/AIT-100B will need to be NEMA 4X rated.

2.Sensor for both AE/AIT-100B & -101B will need to be mounted 18" from the ceiling.

INSTRUMENT DATA SHEET 2.05B – GAS DETECTOR TRANSMITTER

WOODARD &CURRAN	Gas Sensor/Transmitter	TAG NO:	*AE/AIT-101B, -102B*	PAGE:	*8 of 11*
		DRAWING #:	*N/A*	PRINTED:	*1/30/2017*
		SPEC. NO:	*40 70 00*		

PROJECT NUMBER:	*227872.00*	REV	REVISION DESCRIPTION	BY	DATE
DESCRIPTION:	*Lafayette Road Pump Station Upgrades*	*0*	*Issued for Bid*	*SK*	*February, 2017*

SERVICE: *Pump Station Wet Well and Control Room H_2S Gas Monitors*

SENSOR	Type of Sensor:	*Hydrogen Sulfide*	Oxygen Requirement:	
	Sensor Mounting:	*Remote*	Body Material:	*316 SS*
	Sensor Connection:	*¾" NPT*	Enclosure Class:	*See Note 1*
	Sensor Range:	*0-50 ppm*	Cable Length:	*Max 25' Cable from Sensor to Transmitter*
	Temp Range:	*-40 through 140°F*		
TRANSMITTER	Device Tag:	*Yes- SS, engraved*	Accuracy:	*1% of Full Scale*
	Mounting:	*Remote*	Calibration:	
	Enclosure Rating:	*See Note 1*	Local Indicator/Style:	*LCD*
	Enclosure Material:	*316 SS*	Digital Comm. Protocol:	*4-20 mA*
	Power Supply:	*7-30 VDC*	Alarm Relays/No.:	*N/A*
			Relay Type/Rating:	*N/A*
PROCESS DATA	Proc Fluid / State:	*Hydrogen Sulfide/Gas*	Flow (Min/Oper/Max):	*N/A* *N/A* *N/A*
	Specific Gravity:	-	Flow Units:	*N/A*
	Percent Solids:	-	Pressure (Min/Oper/Max):	*Ambient*
	Conductivity:	-	Pressure Units:	*psi*
	Viscosity:	-	Temperature (Min/Oper/Max):	*Ambient*
	Line Size / Sched.:	-	Temperature Units:	*°F*
	Line No.:	-		

ACCESSORIES	4-Channel Controller:	*N/A*	Option-1:	*N/A*
	ToD Gas Generator:	*N/A*	Option-2:	*N/A*
	Moisture Barrier:	*N/A*	Option-3:	*N/A*
	Baffled Rainshield:	*N/A*	Option-4:	*N/A*

MANUFACTURER OR APPROVED EQUAL	*Manufacturer 1:*	*MSA (Ultima XE Series)*
	Manufacturer 2:	*Sierra Monitor Corp.*
	Manufacturer 3:	

NOTES

1. AE/AIT-101A will need to be explosion proof rated. AE/AIT-100A will need to be NEMA 4X rated.

2. Sensor for both AE/AIT-100B & -101B will need to be mounted 18" off the floor.

INSTRUMENT DATA SHEET 2.05C – GAS DETECTOR TRANSMITTER

WOODARD &CURRAN	Gas Sensor/Transmitter	TAG NO:	*AE/AIT-101C, -102C*	PAGE:	*9 of 11*
		DRAWING #:	*N/A*	PRINTED:	*1/30/2017*
		SPEC. NO:	*40 70 00*		

PROJECT NUMBER:	*227872.00*	REV	REVISION DESCRIPTION	BY	DATE
DESCRIPTION:	*Lafayette Road Pump Station Upgrades*	*0*	*Issued for Bid*	*SK*	*February, 2017*

SERVICE: *Pump Station Wet Well and Control Room Oxygen Gas Monitors*

SENSOR	Type of Sensor:	*Oxygen*	Oxygen Requirement:	
	Sensor Mounting:	*Remote*	Body Material:	*316 SS*
	Sensor Connection:	*¾" NPT*	Enclosure Class:	*See Note 1*
	Sensor Range:	*0-25%*	Cable Length:	*N/A*
	Temp Range:	*-40 through 140°F*		
TRANSMITTER	Device Tag:	*Yes- SS, engraved*	Accuracy:	*1% of Full Scale*
	Mounting:	*Remote*	Calibration:	
	Enclosure Rating:	*See Note 1*	Local Indicator/Style:	*LCD*
	Enclosure Material:	*316 SS*	Digital Comm. Protocol:	*4-20 mA*
	Power Supply:	*7-30 VDC*	Alarm Relays/No.:	*N/A*
			Relay Type/Rating:	*N/A*
PROCESS DATA	Proc Fluid / State:	*Oxygen/Gas*	Flow (Min/Oper/Max):	*N/A* / *N/A* / *N/A*
	Specific Gravity:	-	Flow Units:	*N/A*
	Percent Solids:	-	Pressure (Min/Oper/Max):	*Ambient*
	Conductivity:	-	Pressure Units:	*psi*
	Viscosity:	-	Temperature (Min/Oper/Max):	*Ambient*
	Line Size / Sched.:	-	Temperature Units:	*°F*
	Line No.:	-		
ACCESSORIES	4-Channel Controller:	*N/A*	Option-1:	*N/A*
	ToD Gas Generator:	*N/A*	Option-2:	*N/A*
	Moisture Barrier:	*N/A*	Option-3:	*N/A*
	Baffled Rainshield:	*N/A*	Option-4:	*N/A*

MANUFACTURER OR APPROVED EQUAL	*Manufacturer 1:*	*MSA (Ultima XE Series)*
	Manufacturer 2:	*Sierra Monitor Corp.*
	Manufacturer 3:	

NOTES

1. AE/AIT-101C will need to be explosion proof rated. AE/AIT-100C will need to be NEMA 4X rated.

INSTRUMENT DATA SHEET 2.06A – TEMPERATURE TRANSMITTER

WOODARD &CURRAN	TEMPERATURE TRANSMITTERS/SENSOR	TAG NO:	*TIT-133*	PAGE:	*10 of 11*
		P&ID #:	*N/A*	PRINTED:	*1/30/2017*
		SPEC. NO:	*40 70 00*		

PROJECT NUMBER:	*227872.00*	REV	REVISION DESCRIPTION	BY	DATE
DESCRIPTION:	*Lafayette Road Pump Station Upgrades*	*0*	*Issued for Bid*	*SK*	*February, 2017*

SERVICE:	*Control Room Temperature*			
MANUFACTURER OR APPROVED EQUAL	*Manufacturer: DEVAR*			
	Model Number: RTTI			
TRANSMITTER	Type:	*RTD*	Area Classification:	*Unclassified*
	Zero/Span (Non-Inter):	*+-0.02%/Span/ °F*	Enclosure Class:	*Unclassified*
	Output Signal:	*4 to 20mA*	Meter Span (Max/Min):	
	Power Supply:	*13 to 40VDC Loop*	Zero (Max/Min):	
	Element Burnout:		Impedance Limitation:	
	Input/Output Isolat'n:			
	Accuracy:	*+-0.5°F plus +-0.2 of span*		
CALIBRATION	Input (0 / 100%):	*0 to 100°F*	Process (0 / 100%):	*-40 to 167 °F*
	Output (0 / 100%):	*-10 to 120°F*		
SENSOR	Type:	*100 Ohm Platinum*	Leads Configuration:	
	Temp Curve/Type:		Number of Elements:	
	Sheath Length/Mat'l:		Leads Size/Color:	
	Insulation:	*ABS Plastic*	Spring Loaded:	
THERMOWELL	Type:		Process Connection:	
	Material:		Instrument Connect.:	
	Bore:		Insertion Length (U):	
			Lag Length (T):	
PROCESS DATA	Proc Fluid / State:	*Air / Gas*	Flow (Min/Oper/Max):	*N/A*
	Specific Gravity:	*Gas Like*	Flow Units:	*gpm*
	Percent Solids:	*Gas Like*	Pressure (Min/Oper/Max):	*N/A*
	Conductivity:	*Gas Like*	Pressure Units:	*psig*
	Viscosity:	*Gas Like*	Temperature (Min/Oper/Max):	*Amb.*
	Line Size / Sched.:	*Gas Like*	Temperature Units:	*°F*
	Line No.:			
OPTIONS	RTD/Thermowell:			
	Indicator:	3.5" LED Display		
	Vent & Drain:			
NOTES				

INSTRUMENT DATA SHEET 2.07A – LED LIGHT

WOODARD &CURRAN	CHART RECORDER	TAG NO:	*FR-125*	PAGE:	*11 of 11*
		P&ID #:	*N/A*	PRINTED:	*1/30/2017*
		SPEC. NO:	*40 70 00*		

PROJECT NUMBER:	*227872.00*	REV	REVISION DESCRIPTION	BY	DATE
DESCRIPTION:	*Lafayette Road Pump Station Upgrades*	*0*	*Issued for Bid*	*SK*	*February, 2017*

SERVICE:	*General Gas Detection Alarm Light*			
DEVICE	Mounting:	*Outlet Box Attachment*	Current:	*0.062A*
	Lens:	*Double Fresnel - Polycarbonate*	Lens Color:	*Red*
	Power Supply:	*120VAC*	Enclosure Rating:	*NEMA 4X*
	Module Type:	*Steady-On LED*	Accuracy:	*0.1%*
	Lamp Ratings:	*120,000 hours[1,2]*	Alarm Relays/Rating:	*120VAC*
ACCESSORIES	Instrument Tag:	*Yes*	Option:	
	Calibration Standard:		Option:	
			Option:	
MANUFACTURER ACCEPTABLE LEVEL OF QUALITY	*Manufacturer:*	*Edwards 105DHISTC-FJ 105SLED*-G1*		
NOTES	*1. Quantity of (1) is required*			

END OF SECTION

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SECTION 40 81 00

SYSTEM INTEGRATOR QUALIFICATIONS AND SUMMARY OF WORK

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes

1. Provide the services of a system integrator who shall provide all labor and incidentals as required to program, test, and start-up and make operational a complete Supervisory Control and Data Acquisition (SCADA) system in accordance with this Section and applicable reference standards listed in Article 1.03.

2. The system shall be as specified in the Contract Documents. The system integrator provides all programmable logic controllers (PLC) programming, human-machine interface (HMI) screen development, operator interface terminals (OIT) screen development, testing, and startup services. The physical installation and wiring of the instrumentation is by the design-builder's installation Contractor.

3. Owner shall provide internet protocol (IP) addresses to be used for networked devices.

B. Systems Integrator

1. The System Integrator shall be Electrical Installations, Inc. of Moultonborough, NH.

1.02 PRICE AND PAYMENT PROCEDURES

A. Measurement and payment requirements: per Division 01 General Requirements.

1.03 REFERENCES

A. Reference Standards

1. The Instrumentation, Systems and Automation Society (ISA)

2. Underwriters' Laboratories, Inc. (UL)

3. American Water Works Association (AWWA)

4. National Electrical Manufacturer's Association (NEMA)

5. Occupational Safety and Health Administration (OSHA)

6. American National Standards Institute (ANSI)

7. National Fire Protection Association (NFPA)

8. National Fire Protection Association 79, Annex "D" Standards (NFPA)

9. Institute of Electrical and Electronic Engineers (IEEE)

10. National Electrical Code (NEC)

11. Factory Mutual (FM)

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination, Sequencing, and Scheduling: per Division 01 General Requirements.

1.05 SUBMITTALS

A. Submit in accordance with Division 01 General Requirements.

B. Qualifications Package Submittal

1. Not Required.

C. PLC Program OIT and HMI Screen Submittals

1. Within 2 weeks of notice to proceed, provide templates or examples of PLC programs, HMI screens, and OIT screens to the construction manager for review and comment. These submittals shall reflect the intended approach to execute the Work under this Contract, and comply with all requirements of these Contract Documents.

2. Coordinate a meeting with the construction manager to review templates and examples and associated design-builder comments and questions no more than 2 weeks after submission.

3. Submit to construction manager 90 percent PLC programs, HMI screens and OIT screens a minimum of 3 weeks prior to scheduled commissioning of system.

4. Coordinate final review meeting no less than 1 week after, and no more than 2 weeks after 90 percent submission. At this meeting, the construction manager will review 90 percent submittal. After all comments are addressed, final edits can be made.

D. SCADA Reporting Submittals

1. Coordinate and schedule a meeting with the construction manager, design-builder, and plant personnel to review reporting requirements. Submit a proposed schedule and agenda for a SCADA Reporting Kickoff Meeting with the construction manager and design-builder. The meeting shall include all compliance reports and any internal reports required by the construction manager and plant personnel, identification of report users and administrators. NOTE: Plant personnel shall be given the option to input data manually into reports and not be limited to data available automatically from the SCADA system.

2. Provide a schedule and meeting agenda to review with the construction manager and plant personnel a first draft of the reports and subsequent meeting to review a 90 percent complete version of the reports.

3. Submit a proposed schedule and agenda for a SCADA reports first draft review meeting with the construction manager and plant personnel. The meeting shall include review of the compliance reports and other reports identified in the Kickoff meeting. The submittal shall include examples of the first draft reports. The meeting shall identify any changes to the first draft reports to be used in finalizing the reports.

4. Submit a proposed schedule and agenda for a SCADA reporting final edits review meeting with the construction manager and plant personnel. The meeting shall include review of final state of the reports. The submittal shall include examples of the final reports.

5. Implement reports as approved by the construction manager and plant personnel during final edits review meeting and provide 4 hours of report user training to the plant operations staff.

E. Operation and Maintenance Data

1. Provide Operation and Maintenance Manuals (O&M) in draft form prior to final system startup.

2. Furnish Operation and Maintenance Manuals (O&M) as listed below and in accordance with Section 40 81 35 SCADA SYSTME PROGRAMMING and 40 81 40 SCADA SYSTEM REPORTING, for minimum design standards.

3. The O&M manual shall include installation, set-up, and troubleshooting manuals for the Project instrumentation.

4. The O&M manual shall include fully documented as-built PLC programs printouts including file name and date, control panel name, processor information, message configuration, PID control block configuration,

communications channel configuration, program file list, status file, data file list, address/symbol database, and program files. It shall include data file tables for all tables storing set points, for constant values used to configure the rack equipment, for timers and counters. It shall include the processor serial number, current firmware revision.

5. The O&M manual shall include fully documented as-built OIT programs printouts including file name and date, control panel name, application settings including terminal setup, communications setup, tag database, alarms, security setup, serial number, and current firmware revision. Also, include the screen dump report identifying the objects with their associated tags and functions.

6. The O&M manual shall include as built SCADA system AutoCAD Drawings.

7. The O&M manual shall include an operations section with a step-by-step procedure for starting up and shutting down the SCADA computers and SCADA application software. It shall contain procedures for logging into the SCADA system, SCADA screen navigation, alarms interpretation and acknowledgment, equipment control functions, set point modification and use of historical trends.

8. The O&M manual shall include a maintenance section showing typical trouble shooting procedures for SCADA computers, software, control panels, and communications equipment.

9. The O&M manual shall include DVDs labeled Emergency Recovery Files, which shall have fully documented PLC, OIT, HMI, alarm notification and reporting files in their native format and an image file of each SCADA computer for the restoration of the system.

1.06 QUALITY ASSURANCE

A. Provide in accordance with Division 01 General Requirements.

B. Qualifications: per Division 01 General Requirements for System Integrator and as follows:

1. Employ personnel on this Project who have a minimum of 5 years' experience programming and starting up SCADA related hardware, computers, voice cards, and alarm dialers, Allen-Bradley PLC and OIT, power monitors, radios, routers and other network communications equipment.

2. Employ personnel on this Project who have completed factory training in development of the SCADA software for HMI, PLC, OIT programming, alarm notification software and reporting software.

3. Personnel shall be experienced configuring process instrumentation typically found in a water or wastewater treatment plant. Key personnel shall include, at a minimum, the lead field technician.

4. Successfully completed Work of equal or greater complexity on at least 3 other water or wastewater treatment projects within the last 5 years.

5. The system integrator shall maintain a permanent, fully staffed, and equipped office within 2 hours travel time of the Project Site with full time employees capable of programming, troubleshooting and testing the SCADA system specified.

6. For the duration of the Project (during system startup until one month after startup completion) the system integrator shall provide an on Site response within 4 hours of notification. For the remainder of the Warranty Period, the system integrator shall provide on Site response within 1 business day.

7. The system integrator responsibilities include but are not limited to

    a. Integrating all SCADA computer hardware and software that are part of the SCADA system.

    b. Integrating all communications equipment including modems, routers, Ethernet switches, alarm dialers and remote access equipment.

    c. Integrating all SCADA control panels (with the exception of process equipment vendor supplied panels) needed for the complete monitoring and control of the SCADA system as described in the Contract Plans, equipment O&M manuals and submittals, Specifications and applicable codes.

    d. Installation, programming and testing of all software (with the exception of process equipment vendor supplied panels) needed for the complete monitoring and control of the SCADA system as described in the Contract Plans, Specifications and applicable codes by or under the supervision of qualified personnel.

    e. Preparation, assembly, and correction of all submittals in accordance with the Contract Documents.

    f. Proper interfacing of the SCADA hardware, software, field devices and panels, including required interfacing with packaged control systems furnished by other equipment Suppliers, and with the plant electrical system.

    g. Supervision of the installation of SCADA, instrument tests, control panels, wiring checkout to the SCADA control panels, and other components required by or under the supervision of qualified personnel.

h. Documentation of I/O testing and startup of the SCADA system.

i. Training of the Owner's personnel in operation and maintenance of the SCADA system. A minimum of 8 hours formal training is required for all SCADA operations staff. Formal training can be a combination of on Site classroom style with handouts, whiteboard or projector and hands on usage of the SCADA system. Training shall include one, 4-hour session, 1 week prior to system startup, as well as two, 2-hour follow-up sessions after the system is successfully started up and accepted by the construction manager. The system integrator shall submit training agendas for all sessions to the construction manager for review and approval prior to scheduling the training sessions.

j. Coordination with the design-builder's installation Contractor on handling of all warranty obligations for the SCADA system components or any errors or omissions related to SCADA programming for a period of 12 months

k. Maintaining one on Site, up to date, copy of the integration plan and applications including fully documented programs for use in restoring the system during startup should part of the SCADA control system fail. The documented programs can be backups of the native electronic files. See Section 40 81 35 SCADA SYSTEM PROGRAMMING and 40 81 40 SCADA SYSTEM REPORTING, for minimum design standards.

l. One hard copy and one electronic copy, on DVD, of the SCADA Operations and Maintenance Manual.

8. System Integrator Project Personnel

a. Project Manager

1) The system integrator shall appoint a Project manager who shall coordinate and schedule all SCADA Work and assure that the Project schedule is met.

2) The Project manager shall act as the liaison with the design-builder's installation Contractor and the construction manager, for the integration, testing and startup of the SCADA system and shall assist in all matters required for proper coordination and interfacing of the equipment and processes.

b. Field Engineer

1) The system integrator shall appoint a field Engineer with responsibilities as follows

a) Installed system checkout, adjustment, and start up including tuning of all control loops.

b) SCADA support services for the duration of any equipment or system availability trials.

c) Involvement in the on Site system training of plant personnel.

d) Resolving of control problems encountered during initial startup and testing of all SCADA equipment.

C. Integration

1. The integration tasks include, but are not limited to, the following

a. Treatment Plant: Modify configuration and programming of polling master radio to accept communication from new Lafayette Road Pump Station SCADA panel. Modify PLC program for PLC connected to polling master to interface with new PLC at Lafayette Road Pump Station. Modify existing HMI screens to display equipment status, process variables and alarms from Lafayette Road Pump Station, similar to other pump stations in the existing SCADA system. Modify existing automated reports to collect and display information from the Lafayette Road Pump Station SCADA panel. Modify existing remote alarm notification software to contact operators for alarms from new Lafayette Road Pump Station SCADA panel.

b. Lafayette Road Pump Station: Integrate new pump station control panel with associated PLC, OIT, Ethernet switch, and radio equipment for supervisory monitoring and control of equipment and processes installed under this Contract. Coordinate programming to interface with treatment plant equipment and SCADA computers.

c. Configuration of all programs in accordance with the Contract Drawings, including but not limited to Section 40 81 35 SCADA SYSTEM PROGRAMMING, Section 40 81 40 SCADA SYSTEM REPORTING, Section 40 81 50 SCADA SYSTEM FACTORY TESTING, and Section 40 81 51 SCADA SYSTEM CHECKOUT AND STARTUP.

d. Input/output (I/O) counts and details shown in Section 40 67 00 CONTROL SYSTEM EQUIPMENT PANELS AND RACKS, are for design and estimating purposes only. The system integrator shall be responsible for configuration of all I/O within control panels required to provide a complete and functional SCADA system.

e. Participate in startup testing of all equipment, instruments and controls to ensure operation of systems.

D. Testing

1. The system integrator shall allocate time for control panel testing, full field-testing of instrumentation, PLC, OIT, and HMI, and reporting programs in accordance with the Contract Documents. The system integrator shall provide documentation as a record of testing I/O points through to OIT and HMI screens.

E. Coordination and Progress Meetings

1. The system integrator shall be responsible for the scheduling with the design-builder's installation Contractor and coordinating the system integration with regard to all other Work on the Site and in accordance with the provisions of the General Conditions. The coordination shall be documented on the Project Schedule.

2. The system integrator shall be responsible for scheduling with the construction manager all PLC, HMI, OIT, and reporting submittal review meetings as described in paragraph 1.05 of this Section.

3. Routine progress and coordination meetings will be scheduled by the construction manager. The system integrator shall be required to attend weekly meetings, or as scheduled by construction manager.

4. The purpose of the meetings shall be to review the progress of the Work involving the controls system and provide coordination for integration of the equipment to ensure Project schedule is met.

5. Representatives at the meetings shall have the authority to make all necessary decisions. Decisions and statements made at the meetings shall commit the system integrator to agreed procedures and schedules.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Provide in accordance with Division 01 General Requirements.

1.08 SITE CONDITIONS

A. Existing Conditions: per Division 01 General Requirements.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION

SECTION 40 81 35

SCADA SYSTEM PROGRAMMING

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes

1. Provide programming provided using the Supervisory Control and Data Acquisition (SCADA) computers, SCADA software, the SCADA control panels and communications equipment (Ethernet and radio) specified by the Contract Documents. Provide all the labor and any equipment or materials not listed above as needed to program this equipment in accordance with this Section.

2. It is not the intent of this Specification to define exactly how the System Integrator shall integrate this Project. The flexibility of the software allows the programmer to accomplish the same task by using a number of different methods. The System Integrator is required to create modules of program code and use them consistently throughout the programs.

3. The Human Machine Interface (HMI) programming shall be for the SCADA computers in the main control room. The programming includes process screens, database, communication driver, historical trending, alarm handling, security, networking, and reporting.

    a. New Screen List

        1) Lafayette Road Pump Station Screen

B. Control Narrative

1. Refer to Attachment A of this Section for details of the proposed controls for pump station operation.

1.02 PRICE AND PAYMENT PROCEDURES

A. Measurement and payment requirements: per Division 01 General Requirements.

1.03 REFERENCE STANDARDS

A. Reference Standards

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination, Sequencing, and Scheduling: per Division 01 General Requirements.

1.05 SUBMITTALS

A. Submit in accordance with Division 01 General Requirements.

B. Refer to Section 40 81 00 SYSTEM INTEGRATOR QUALIFICATIONS AND SUMMARY OF WORK.

1.06 QUALITY ASSURANCE

A. Provide in accordance with Division 01 General Requirements.

1.07 DELIVERY, STORAGE AND HANDLING

A. Provide in accordance with Division 01 General Requirements.

1.08 SITE CONDITIONS

A. Existing Conditions: per Division 01 General Requirements.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.01 PLC PROGRAMMING STANDARDS

A. PLC Program Structure

1. The Programmable Logic Controller (PLC) programs shall be organized in subroutines that aid troubleshooting and maintenance, including:

    a. Analog input scaling (to engineering units) subroutine
    b. Fault detection and de-bounce timer subroutine
    c. Alarm handling subroutine
    d. Flow total subroutine
    e. Equipment runtime hour's subroutine
    f. Separate major equipment monitoring and control subroutines
    g. HMI set points subroutine
    h. Communications subroutine
    i. Include a minimum of six spare subroutines for future use.

B. Data Files

1. Reserve a minimum of 2 data files for use in passing status to or from vendor supplied PLC systems.

2. Use separate data files; commands to the PLC, and status from the PLC.

3. Organize memory such that status bits and words used by the Office of Information Technology (OIT) or HMI are in contiguous registers within their own data files, and organize the command bits and set point words used by the OIT or HMI in contiguous registers within their own data files so as to optimize communication efficiency.

4. All math and scaling shall be handled in PLC logic, not in the OIT or HMI, and shall return results in engineering units consistent with the OIT and HMI display.

C. PLC Program Documentation

1. The PLC program shall be clearly documented using rung comments, instruction comments, and tags. Documentation shall be clear, provide descriptions, and comments as needed to simplify support and future development of the system. The System Integrator shall use address symbols consistent with OIT and HMI tag name programming. Rung comments shall be used to describe functions of areas of code.

D. PLC Program Basic Features

1. All PLC programs shall include basic error trapping such that preventable errors do not fault the processor.

2. The main program subroutine file shall include a health bit to indicate the processor is in RUN mode. This bit shall be monitored as a fault in the HMI.

3. The program shall track using counters the success or failure of each attempt to communicate via message blocks to other between PLCs. The counters shall be logged historically, and displayed on trend screens.

4. The program shall include alarm-handling logic that incorporates adjustable delay timers for each alarm, unacknowledged alarm bits for each alarm and acknowledged (but still in alarm) bits for each alarm.

5. Alarm timers shall include a SCADA HMI screen adjustable set point. Each alarm shall include an Alarm Disable code that can be enabled or disabled from a SCADA HMI screen.

6. All motor driven equipment, except motorized valves, shall have daily run hours accurate to tenths of hours and total run hours up to 99,000 hours. The daily run hour counter shall reset at midnight.

7. Each flow meter shall display on SCADA instantaneous flow, total flow, today's flow total and yesterdays flow total. The transition from today's to yesterdays flow totals shall typically occur at midnight.

3.02 LOCAL OIT PROGRAMMING STANDARDS

A. LOCAL OIT Program Structure

1. The OIT is intended as a local backup to the SCADA HMI system for the graphics and text links used to display status of equipment, process conditions, and set points that shall be developed and organized so as to be as consistent as possible with the plant SCADA HMI.

2. Each OIT shall include an overview screen, an alarm summary screen and a process screen for each major piece of equipment or process associated with that PLC cabinet. A secure login shall be provided for all set points, control buttons and alarm acknowledgement.

3. The OIT database tag names and descriptions shall be consistent with the associated PLC logic where practical. All tags shall display and pass process variables and set points scaled to engineering units consistent with the PLC logic.

4. All mathematical, comparison, or scaling functions shall be programmed at the PLC code level, and not at the OIT tag or database level.

B. Local OIT Program Basic Features

1. When initialized, the OIT shall default to an overview screen that displays date, time and critical process information for its associated PLC.

2. The Alarm Summary shall display unacknowledged alarms and acknowledged active alarms. Alarms acknowledged at the OIT shall synchronize with all SCADA HMI alarm summaries.

3.03 COMPUTER HMI PROGRAMMING STANDARDS

A. HMI Program Structure - Security

1. The SCADA HMI security shall be configured with a minimum of five groups. The Construction Manager shall provide a list of users to enter into each group. The groups shall be Guest, Operator, Supervisor, Maintenance, and Administrator.

2. The Guest group shall allow navigation to process and trend screens only. A Guest shall not have the ability to modify set points, operate screen controls, acknowledge alarms, disable alarms, navigate to other applications, or access operating system tools.

3. The Operator group shall include all Guest group rights with the additional ability to modify defined set points and screen controls, acknowledge alarms, and navigate to other applications.

4. The Supervisor group shall include all Operator group rights with the additional ability to modify all set points and all screen controls, access operating system tools and disable alarms.

5. The Maintenance group shall include all Supervisor group rights. Additional maintenance group rights shall be defined by the Construction Manager.

6. The Administrator group shall allow full access to all SCADA functions and is typically reserved for the Owner's SCADA administrator and System Integrator.

B. HMI Program Structure - Screen Development

1. The integrator shall use a hierarchical layout with overviews for each process area and major pieces of equipment. Overviews shall include equipment status and current process values. Navigation buttons from the overviews shall navigate to screen or pop-ups that provide set points and controls. Overview screens shall mimic actual plant equipment layout and orientation.

2. All screens shall include a banner at the top of the screen containing the system date and time, a screen name identifying what is found on the screen, the user who is logged into the HMI, an Alarm indicator that flashes whenever a new alarm is detected and a link to the menu system screen.

3. There shall be an Alarm Summary screen showing all current acknowledged and unacknowledged alarms. Each alarm shall show date and time of the alarm, the tag name and description, alarm priority and alarm area. The Alarm Summary shall post newest alarms at the top. Unacknowledged alarms shall use white text on a flashing red background. Acknowledged alarms shall use red text on a steady red background. All alarm activity shall be logged to a historical file.

C. HMI Program Structure - Tag Names

1. Database tag names and descriptions shall be consistent with the design Drawings, the sequence of operations description, and the equipment and

instrument list. Where possible, the tag name shall include the instrument tag. When configuring the database tag names, consideration shall be given to the integration of other remote pumping stations in future Projects.

D. HMI program Structure - Historical Collection and Trending

1. All process analog signals shall be historically collected for trending and reporting purposes. Historical files shall not be configured to automatically delete or overwrite.

2. Historical trend screen shall include a calendar object that allows operators to select the start date of the trend. The trend duration shall also be selectable. Typical durations shall include 1 hour, 4 hour, 8 hour, 1 day, and a custom duration option.

E. HMI Program Structure - Redundancy

1. The SCADA nodes shall be configured to be redundant. If one SCADA node fails, Operators shall be able to use the second SCADA node to review the process and control data.

2. SCADA HMI client nodes shall be configured so they can source their data from either SCADA node.

F. HMI Program Structure - Alarm Handling

1. The display of SCADA alarms shall be constant across all SCADA HMI and OIT alarm summaries. Alarms shall have the ability to be acknowledged from any HMI or OIT, then synchronize to all others.

G. HMI Program Structure - Graphic Objects

1. The HMI screens shall primarily use the graphical objects provided with the development package library. Embedded graphic files (bitmaps, CAD files) can be used. The use of third party graphical objects is prohibited without Construction Manager authorization.

2. The graphic objects representing equipment and instruments shall be programmed so that, when clicked on, shall open a screen or pop-up menu. This pop-up menu shall allow access to the following information for that specific equipment or instrument:

a. Construction Drawings

b. Catalog cut sheet/data sheet

c. O&M/instruction manual

d. These files shall be stored locally on each SCADA HMI, and shall be presented in PDF format.

H. HMI Program Structure - Font Size

1. Font size and type shall be bold text, True Type Arial font, size 12. Process variable descriptions and associated engineering unit symbols shall be True Type Arial font, size 10. Exceptions may be made for clarity.

I. HMI Program Structure - Graphic Size

1. The standard HMI graphic screens shall be 1024 x 768 resolution. Larger standard widescreen resolutions may be acceptable if the System Integrator demonstrates the compatibility and stability of the format with the computer display and the remote support Keyboard Video & Mouse (KVM) solution.

2. Standard color palates shall be used for all HMI and OIT screens.

J. HMI Program Operations and Maintenance manual (O&M)

1. The O&M manual shall include:

a. An operations section describing step-by-step procedures for starting up and shutting down the SCADA computers and SCADA software.

b. How to log into the system security, navigate through the screens, interpret equipment status and alarms, modify set points and screen controls, and use historical trends.

c. The manual shall describe how to open and use other SCADA related applications.

d. How to modify the SCADA system security

e. How to troubleshoot SCADA communications drivers and database

f. How to backup and restore SCADA application files in a common format and native format.

g. How to create and restore a computer system backup image file

h. Printouts of the screens' database communication driver. A record of software and computer hardware version numbers, computer configuration, file locations and complete license registrations including support Contract information.

K. HMI Program Basic Features

1. Equipment monitored or controlled by the SCADA system shall have its status displayed on a SCADA screen, either graphically, textually, or both.

Where a graphical object is used to represent status, the object shall change shape or color based on status. Note: While it is useful to have animated graphical objects, this shall not be a substitution for a numerical or text indication of the status.

2. Examples for displaying dynamic graphical objects include:

   a. Graphical Object Status - color change

   b. Running/On = Green

   c. Stopped/Off = Red

   d. Open = Green

   e. Moving = Yellow

   f. Closed = Red

3. Typical examples for displaying dynamic text links include:

   a. Text Object Status - label change

      1) Running status = Running/Stopped, On/Off

      2) Position status = Open/Moving/Closed, Local/Remote

      3) Selector status = Hand/Off/Auto

      4) Commands = Required, Not Required

4. The use of objects for selection or control shall be consistent throughout the Project. Command buttons shall have a label on or above the button indicating their function. They shall include either a border around the button or a text link that indicates that the button has been selected.

5. Text links used for entering set points shall be consistent throughout the Project. Text links shall have a label above, on, or next to them indicating their function. Numerical or alphanumerical text displaying current values shall use black text inside a gray box. Data entry links, numerical or alphanumerical, shall use yellow text inside a black box.

6. Tank or storage objects shall have a text link indicating the measured amount of media in the tank. Tick marks on the side of the tank shall show the upper and lower limits of measurement. All units shall be consistent with those shown in the Plans and Specifications.

7. Command buttons and data entry links shall be secured using the HMI security. Text links shall be limited such that the user cannot enter a value outside an acceptable range. The limits of the data entry range shall be displayed when the operator enters the new value. Set point text links shall always show the value currently being used by the process.

3.04 ALARM MONITOR PROGRAMMING STANDARDS

A. The alarm monitoring software shall be configured to include a list of alarms based on the plant processes and communication. The list shall include alarms for each piece of equipment and process area of the treatment plant and remote stations. It shall include watchdog alarms for whenever a PLC is taken out of RUN mode, when a control panel or drive is powered OFF or not communicating, and if the Alarm Monitor software loses communication with the SCADA HMI software.

B. The alarm monitoring software shall be configured to include a list of Operators, Maintenance and Administration personnel. Each name in the list shall include unique login access code and a unique alarm acknowledgement code. Each name shall be associated with either a home phone number, a cell phone number, a pager number, or backup numbers (police, fire, plant PA system).

C. The alarm monitoring software shall be configured to include a list of schedules, which reflect normal weekday operations, night operations and weekend operations.

D. The alarm monitoring software shall be configured to allow an administrator to add or remove names from the list of available staff to call and change the order of calling.

3.05 FIELD QUALITY CONTROL

A. Provide in accordance with Division 01 General Requirements.

3.06 STARTUP & COMMISSIONING

A. Provide in accordance with Division 01 General Requirements.

3.07 CLOSEOUT ACTIVITIES

A. Provide in accordance with Division 01 General Requirements.

END OF SECTION

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APPENDIX A

TABLE OF CONTENTS

1. INTRODUCTION

A programmer shall integrate the control system and complete the necessary PLC and Human Machine Interface (HMI) programming. The following descriptions are provided to assist the Engineer during the integration process and are a supplement to the Process and Instrumentation Diagrams and Control Wiring Diagrams provided in the Drawings.

The PLC and HMI programmer needs to become familiar with the aforementioned documents and incorporate the controls related information contained in these into the programming.

Note all HMI screens shall be submitted for review and approval by the Engineer and Owner before field deployment and startup.

1.1 ABBREVIATIONS & DEFINIITIONS

- SCADA: Supervisory Control and Data Acquisition.
- HMI: Human machine interface.
- OIT: Operator interface terminal.
- HOA: Hand-Off-Auto
- PLC: Programmable Logic Controller
- Control System: The Control System shall consist of all hardware, software, programming and equipment/instrumentation setup required to implement controls described in the Specifications.
- "Local" or "Hand" operations shall be initiated by a push button or selector switch located either adjacent to the piece equipment or on the starter cabinet.
- "Remote Manual" operations shall allow an operator to control the operation of a piece of equipment (e.g. start/stop or open/close) from the HMI.
- "Remote Automatic" operations shall control the operation of a piece of equipment (e.g. start/stop or open/close) based on control logic programmed into the PLC.
- {SP}: operator adjustable set point
- {##.# units}: operator adjustable set point and recommended initial value for the set point, including the recommended units and decimal places

1.2 CONTROL SYSTEM GENERAL REQUIREMENTS

The following sections outline general requirements for local control panels, OIT terminals and the monitoring and control of equipment and processes. It also describes the coordination and data transfer on the Ethernet network between control panels and other displays.

1.2.1 Hand-Off-Auto

Hand-Off-Auto (H-O-A) switches are provided adjacent to equipment as indicated on the Drawings or as specified. Unless specified otherwise all H-O-A switches shall operate as follows:

- When in "Hand" the equipment shall run at full speed or based on a manually input speed setting entered via the VFD if a VFD is provided. Hand operation is intended only for maintenance purposes, for equipment jog and testing/troubleshooting procedures. In the event of a problem with the control system, it is recommended that the process be bypassed until the problem can be corrected. When the equipment is running with the HOA in the hand position, only the basic

equipment safety measures are operable. These safety measures will keep the system from damage (e.g. motor overloads and basic interlocks) but will not provide equivalent functionality to the PLC based control system.

- When in "Off" the equipment will be off.
- When in "Auto" the equipment shall be operated through the PLC system.

1.2.2 Open-Close-Remote

Open-Close-Remote (OCR) switches are not provided for automated control valves, however the programmer shall provide an electronic OCR within SCADA as indicated:

- When in "Open" the valve is commanded to open.
- When in "Close" the valve is commanded to close.
- When in "Remote" the valve is operated based on process conditions

1.2.3 Motor Run Time Monitoring

The SCADA system shall monitor and display the total 'lifetime' running time for all motors indicated on the Process & Instrumentation Diagrams (pumps, mixers, blowers) in units of ##,###.# hours.

1.2.4 Equipment Status Indication

The SCADA system shall display the status of all HOA switches, equipment, valves, and analog instrumentation described herein. Status indication shall include whether or not the motor is energized/running, valve position/command open/closed, and the value of analog inputs in the units indicated herein. All analog inputs shall include a graphical depiction of the measured quantity in proportion to the scale of the range (e.g. water level in a tank). All analog inputs shall include a graphical depiction of the measured quantity in proportion to the scale of the range.

1.2.5 Emergency Stops (E-Stops)

For all equipment with E-stop switches, the control system shall have an "E-stop switch engaged – (equipment name and tag number)" alarm if an emergency stop switch is engaged. The control loop shall clear the alarm when the E-stop switch is reset in the field. The E-stop circuit shall be normally closed such that the alarm will activate if the E-stop circuit loses power or fails for any other reason. The equipment shall be inoperable until the E-stop circuit is energized. The equipment shall de-energize immediately if the E-stop is engaged.

1.2.6 Motor Run Time Monitoring

The SCADA system shall monitor and display the total 'lifetime' running for all motors indicated on the Process & Instrumentation Diagrams (pumps, mixers, blowers) in units of ##,###.# run time hours.

1.2.7 Variable Frequency Drives (VFDs)

All VFDs shall be provided with Ethernet communications modules. In addition to the analog and/or discrete I/O called for on the Drawings and in the Equipment and Instrumentation list, the Contractor shall provide to the SCADA system the following information for every VFD installed, at a minimum:

- Speed reference set point in Remote.
- Display of speed feedback, 0-100%.

- Run time meters.
- General Fault Alarm

All VFD powered equipment shall include indication of over-amperage and over-torque alarms at the control system, unless noted otherwise.

1.2.8 Operator Adjustable Inputs & Allowable Range

Operator adjustable inputs are indicated throughout the narrative with {brackets}, and shall be required as indicated herein and in the Contract drawings. For each operator adjustable input, provide a range of allowable values that can be entered. The values of the high end and the low end of the range shall be as determined by the Engineer. The operator screens shall not accept set point changes outside the allowable range. Typical values for inputs are provided herein for reference purposes.

1.2.9 Password Protected Access

Provide at a minimum, the following levels of security access: 1) viewing but no adjustment of set points, 2) allows adjustment of set points excluding alarms and interlocks, 3) administrative access to all functionality, alarm limits, interlocks. Coordinate security settings with Engineer and Owner.

1.2.10 Motor Overloads

The majority of motor-driven equipment has overload devices to protect the equipment from overload condition. For all equipment with such devices, as shown on the Contract Drawings, the SCADA system shall monitor and provide alarms for all overload conditions. Each alarm shall be labeled with the corresponding equipment tag and description as noted on the Contract Drawings.

1.2.11 Analog Signal Out of Range

For all equipment with 4-20mA signals connected to the PLC, as shown on the Contract Drawings, the SCADA system shall monitor and provide an alarm if the signal goes out of that range (i.e. less than 4mA or greater than 20mA). Each alarm shall be labeled with the corresponding equipment tag and description as noted on the Contract Drawings.

1.2.12 Failure or Fault Alarms

Generate failure or fault alarms for equipment and processes using physical status and/or based on all applicable conditions. Label faults and alarms with the specific device tags and descriptions.

1.2.13 Alarm Management

Display all alarms on the HMI including new unacknowledged alarms and acknowledged alarms that are still in active alarm state. Display the tag name, description, date and time.

The HMI shall include a means to activate or suppress individual alarms for each piece of equipment. Unless otherwise noted, all alarms shall have an operator adjustable delay prior to alarm activation. The length of the delay period shall be determined based on signal response times and shall be designed to provide system protection while avoiding nuisance alarms. The initial delay period shall be determined by the system Contractor and approved by the Engineer.

Alarm enable/disable, delays, and setpoint adjustment shall be password protected.

All alarms shall be labeled with functional descriptions and the device's equipment tag (see the Contract Drawings for equipment tagging). The alarm descriptions shall be submitted for reviewed and approval by the Engineer.

1.2.14 Interlocks

The control loops for equipment that have motor overloads, current sensitive relays, high temperature sensors or any other interlock shall have interlocks built into the PLC control logic to prevent the equipment from running in the Automatic mode if the interlock condition occurs. Interlocks shall not prevent running equipment in Manual.

1.2.15 Project Screens and Trending

The following listing provides a summary of the screens to be provided, including but not limited to the screen listing in the Contract:

* Overall System Screen: Develop screens that show the overall system, status of each piece of equipment, key flow rates, and water surface elevations.
* Process screens: for each unit process, provide and indicate if a piece of equipment has an alarm or fault associated with it and what the alarm/fault is.
* Run time totalizers: for every piece of equipment, provide a display of total run time (##,###.# hours). Provide the equipment tag number and description next to each display.
* Alarm log and management.
* Communications system and PLC status.
* Trend Screens: provide trend screens for instruments and analog level, flow, pressure and temperature inputs, as specified herein.

2. EQUIPMENT

2.1 INFLUENT CHANNEL LEVEL MONITORING

Control System/Panel: Station SCADA Control Panel

Drawing: E-201

Overview: The SCADA control system will provide continuous display (in feet) of the level in the influent channel using ultrasonic level transmitter (LIT-112).

Setpoints: Influent Channel High Level {3 feet}

Operation: None.

Alarms: Trigger Influent Channel High Level alarm when level exceeds setpoint for more than selectable time delay {10 seconds}.

2.2 WETWELL LEVEL MEASUREMENT

Control System/Panel: Station SCADA Control Panel

Drawing: E-201

Overview: The SCADA control system will provide continuous display (in feet) of the level in wetwells 1 and 2 using submersible level transmitters (LT-101A and LT-101B). Display the status of the wetwell float level switches (LSLL-100A, LSHH-100A, LSLL-100B, LSHH-100B).

Setpoints: (Values common for both wetwells 1 and 2)

<u>One Pump, Constant Speed Setpoints</u>

Wetwell Low Level {3.75 feet}

All Pumps Off Level {4.0 feet}

Lead Pump On Level {5.0 feet}

<u>One Pump, Variable Speed Setpoints</u>

Variable Speed Stop Operation Level {4.5 feet}

Variable Speed Operation Max Level {5.5 feet}

<u>Two Pumps, Variable Speed Setpoints</u>

2 Pump Variable Speed Stop Operation Level {5.0 feet}

2 Pump Variable Speed Max Operation Level {6.0 feet}

Wetwell High Level {6.25 feet}

Operation: A selector switch will be displayed on the HMI and OIT to allow the operator to choose the wetwell level transmitter that is 'lead' (i.e. the PLC uses that measurement for comparison to setpoints and make process decisions).

The PLC will constantly compare the level measured by both LT-101A and LT-101B, and if the difference in measured values exceeds 10%, trigger a 'Wetwell Level Instrument Disagreement' alarm.

Alarms: (Values common for both wetwells 1 and 2)

Trigger Wetwell Low-Low Level alarm {mount switch at 3.5 feet} when float is active for more than selectable time delay {10 seconds}.

Trigger Wetwell High-High Level alarm {mount switch at 6.5 feet} when float is active for more than selectable time delay {10 seconds}.

Trigger Wetwell Low Level alarm when level is less than setpoint for more than selectable time delay {10 seconds}.

Trigger Wetwell High Level alarm when level is greater than setpoint for more than selectable time delay {10 seconds}.

Interlocks: **'**Wetwell Low Level' alarms will stop all operating pumps.

'Wetwell Low-Low Level' alarms will stop all operating pumps.

2.3 WETWELL PUMP CONTROL

Control system/Panel: Main Control Panel

Drawing: E-201

Overview: The SCADA control system will provide continuous monitoring and control of the three wetwell pumps (P-101, P-102, P-103), including run status, start/stop control, VFD fault status, speed control and feedback, and include on screen selection for automatic and manual pump control.

Setpoints: Pump P-101 Speed Command {0-60Hz}

Pump P-102 Speed Command {0-60Hz}

Pump P-103 Speed Command {0-60Hz}

Operation: When the physical HOA switches for the wetwell pumps are in the Automatic position, operations staff will have the ability to place the pumps in 'Hand' or 'Auto' via an on-screen selector at the HMI and OIT. Placing a pump in 'Hand' at the HMI or OIT allows the operator to start and stop the pump and manually select the VFD speed. Any pumps in the 'Auto' mode will be included in the pump cycle and controlled by the PLC as described below.

Operators will have the ability to select the pump rotation sequence at the HMI and OIT, by assigning Pump 1, Pump 2 and Pump 3 to the Lead, Lag and Standby positions available. All pumps with onscreen selectors in the 'Auto' position have to be assigned in the rotation sequence. If a pump is in the 'Hand' position it will not be included in the rotation sequence.

Constant Speed Mode: In 'Auto' mode, when the level in the wetwell is equal to or greater than the 'Lead Pump On' setpoint, the PLC will command the Lead pump to start at its minimum speed. The PLC will continue to operate the lead pump at minimum speed until one of two outcomes occur. If the level in the wetwell becomes less than the 'All Pumps Off' setpoint for more than a selectable time period {10 seconds}, the PLC will stop the lead pump. If the level in the wetwell becomes greater than the 'Lead Pump On Level' for more than a selectable time period {30 seconds}, the PLC will switch the pump to the One Pump, Variable Speed operation mode. The pump speed will be set proportional to the range between the 'Variable Speed Stop Operation Level' (minimum speed) and the 'Variable Speed Max Operation Level' (maximum speed).

One Pump, Variable Speed Mode: In this mode, the PLC will command the Lead pump to ramp between the 'Variable Speed Operation Stop Level' and 'Variable Speed Max Operation Level' setpoints from minimum speed to maximum speed, proportional to the change in level through that range. If the level in the wetwell becomes less than the 'Variable Speed Stop Operation Level' setpoint for more than a selectable period of time {30 seconds}, the PLC will switch the pump to Constant Speed mode. If the level in the wetwell becomes greater than the 'Variable Speed Max Operation Level' for more than a selectable time period {30 seconds}, the PLC will start the Lag pump and switch to the Two Pump, Variable Speed operation mode. The pumps' speed will be set proportional to the range between the '2 Pump Variable Speed Stop Operation Level' (minimum speed) and the '2 Pump Variable Speed Max Operation Level' (maximum speed).

Two Pump, Variable Speed Mode: In this mode, the PLC will command the Lead and Lag pumps to ramp between the '2 Pump Variable Speed Operation Stop Level' and '2 Pump Variable Speed Max Operation Level' setpoints from minimum speed to maximum speed, proportional to the change in level through that range. If the level in the wetwell becomes less than the '2 Pump Variable Speed Stop Operation Level' setpoint for more than a selectable period of time {30 seconds}, the PLC will stop the Lag pump and switch to 1 Pump Variable Speed mode.

If a pump called run does not start within a selectable time delay {10 seconds}, the PLC will trigger a 'Pump Fail to Start' alarm and bump up the pump assignment; i.e. if the Lead Pump fails, the Lag Pump becomes Lead and the Standby pump becomes Lag.

There will be an optional mode in the PLC to switch the pump assignments, able to be toggled on and off by the operators. After a user selectable time {2:00am}, the PLC will automatically change the assignment of the pumps in the rotation sequence (i.e. the Lag pump becomes the Lead pump, the Standby pump becomes the Lag pump, and the Lead pump becomes the Standby pump) the next opportunity all pumps are stopped. This will spread wear over the pumps and ensure all pumps are exercised on a regular basis.

When a 'Wetwell High-High Level Alarm' is triggered by a float switch in the wetwell, the main PLC sends an output signal to each VFD which instructs the VFD to run at the preset speed, and then starts the first pump. After a set time period programmed in the main PLC {60 seconds}, if the 'Wetwell High-High Level Alarm' is still active, the main PLC starts the second pump. The two pumps will continue to run until the 'Wetwell Low-Low Level Alarm' float is active, and then the mainPLC will stop the two pumps. This process will continue until the main PLC is able to restore operation from the analog level transmitters.

There is a backup PLC installed in the SCADA control panel, that monitors the health of the main PLC via discrete input 'heartbeat' signal. If the main PLC is unresponsive (i.e. no heartbeat signal is detected), when a 'Wetwell High-High Level Alarm' is triggered by a float switch in the wetwell, the backup PLC sends an output signal to each VFD which instructs the VFD to run at the preset speed, and then starts the first pump. After a set time period programmed in the backup PLC [1 minute], if the 'Wetwell High-High Level Alarm' is still active, the backup PLC starts the second pump. The two pumps will continue to run until the 'Wetwell Low-Low Level Alarm'

float is active, and then the backup PLC will stop the two pumps. This process will continue until the main PLC is responsive again.

Alarms: (Provide individual alarms for each pump. Include the pump tag in the alarm description.)

Trigger 'Pump Seal Fail Alarm' when the seal failure contact from the seal fail/overtemp relay is active.

Trigger 'Pump Overtemp Alarm' when the overtemperature contact from the seal fail/overtemp relay is active.

Interlocks: A **'**Wet Well Low-Low Level' alarm, as measured by the wetwell low-low level switches (LSLL-100A/100B), will turn off any operating pumps.

A 'Wet Well Low Level' alarm, as measured at the wetwell level transmitters (LT-101A/101B), will turn off any operating pumps.

A 'Pump Overtemp' alarm, as detected by the seal fail/overtemp relay, will turn off the associated pump.

2.4 PUMP CHECK VALVE LIMIT SWITCHES

Control System/Panel: Main Control Panel

Drawing: E-201

Overview: The SCADA control system will provide continuous display of pump inlet check valves (ZSC-101, ZSC-102, ZSC-103) closed status.

Setpoints: None.

Operation: The pump check valve limit switches indicate that the check valve is closed.

Alarms: (Common for all pump check valve limit switches)

Trigger a "Pump Check Valve Stuck Open" alarm if the check valve on a pump does not indicate a closed position for more than a selectable time delay {15 seconds} after a pump is stopped.

Trigger a "Pump Check Valve Failed to Open" alarm if the check valve on a pump does not indicate a open position for more than a selectable time delay {15 seconds} after a pump has started.

Interlocks: None.

2.5 GRINDER

Control System/Panel: Grinder Control Panel (provided by vendor)

Drawing: E-201

Overview: The SCADA control system will provide continuous display of the inlet channel grinder run and fault status from the vendor's grinder panel. No control of the grinder is prov

Setpoints: None.

Operation: None.

Alarms: Trigger 'Grinder Fault' when the fault contact from the vendor controls is active

Trigger 'Grinder Not Running' when the grinder run contact and the grinder fault contact are not active for a selectable time period {60 seconds}.

Interlocks: None

2.6 EFFLUENT FLOW MEASUREMENT

Control System/Panel: Main Control Panel

Drawing: E-201

Overview: The SCADA control system will provide continuous display (GPM) of the instantaneous flow from the effluent channel through the magnetic flow meter (FE/FIT-125), as well as the totalized flow through the meter.

Setpoints: None.

Operation: The PLC shall totalize the flow by counting the pulses from the pulse output of the flow meter, and multiplying that total by the gallons per pulse {20 gallons} configured at the flow transmitter. The total shall be reset every day at a selected time {12:00am} and the previous day's total shall be stored and displayed in addition to the current day's total.

The PLC record the minimum and maximum daily instantaneous flows, resetting the registers to 0 at the same time as the totalized flows are reset.

Interlocks: None

2.7 WETWELL FLOODING FLOAT SWITCH

Control System/Panel: Station SCADA Control Panel

Drawing: E-201

Overview: The SCADA control system will monitor the status of the wetwell flooding float switch (LSH-121).

Setpoints: None

Operation: The flooding float switch will become active when water fills the wetwell.

Alarms: Trigger 'Wetwell Flooding' alarm when wetwell flooding float switch {mount at 2 inches above finished floor} is active for more than selectable time delay {10 seconds}.

Interlocks: None

2.8 DRYWELL FLOODING FLOAT SWITCH

Control System/Panel: Station SCADA Control Panel

Drawing: E-201

Overview: The SCADA control system will monitor the status of the drywell flooding float switch (LSH-122).

Setpoints: None

Operation: The flooding float switch will become active when water fills the drywell

Alarms: Trigger 'Drywell Flooding' alarm when drywell flooding float switch {mount at 2 inches above finished floor} is active for more than selectable time delay {10 seconds}.

Interlocks: None

2.9 FIRE / HEAT / SMOKE DETECTION

Control System/Panel: Main Control Panel

Drawing: E-201

Overview: The SCADA control system will provide status of the Pump Room Heat Detector (XS-132), Control Room Smoke Detector (XS-133), Electrical Room Smoke Detector (XS-134) and Duct Smoke Detector (XS-135).

Setpoints: None.

Operation: The individual sensors monitor the individual rooms for the designated condition (smoke, excessive heat) and become active when that condition is detected.

Alarms: Trigger 'Pump Room Heat Detection Alarm' when the pump room heat detector is active for more than a selectable time delay {10 seconds}.

Trigger 'Control Room Smoke Detection Alarm' when the control room smoke detector is active for more than a selectable time delay {10 seconds}.

Trigger 'Electrical Room Smoke Detection Alarm' when the electrical room smoke detector is active for more than a selectable time delay {10 seconds}.

Trigger 'Duct Smoke Detection Alarm' when the duct smoke detector is active for more than a selectable time delay {10 seconds}.

Interlocks: Any active alarm in this section will shut down pumps and equipment in the pump station.

2.10 BUILDING TEMPERATURE

Control System/Panel: Main Control Panel

Drawing: E-201

Overview: The SCADA control system will provide continuous display of the Building Temperature transmitter (TIT-131).

Setpoints: Building High Temperature {100°F}

Building Low Temperature {40°F}

Operation: None.

Alarms: Trigger 'Building Low Temperature' alarm when the temperature is equal to or lower than the Building Low Temperature setpoint for more than a selectable time delay {10 seconds}.

Trigger 'Building HighTemperature' alarm when the temperature is equal to or greater than the Building High Temperature setpoint for more than a selectable time delay {10 seconds}.

Interlocks: None

2.11 DOOR INTRUSION SWITCHES

Control System/Panel: Main Control Panel

Drawing: E-201

Overview: The SCADA control system will provide indication of the Odor Room Door Intrusion Switch (XS-141), Control Room Door Intrusion Switch (XS-142), Wetwell Door Intrusion Switch (XS-143) and Front Door Intrusion Switch (XS-144).

Setpoints: None.

Operation: None.

Alarms: Trigger 'Odor Room Door Intrusion' alarm when odor room door intrusion switch is active for more than selectable time delay {10 seconds}.

Trigger 'Control Room Door Intrusion' alarm when control room door intrusion switch is active for more than selectable time delay {10 seconds}.

Trigger 'Wetwell Door Intrusion' alarm when wetwell door intrusion switch is active for more than selectable time delay {10 seconds}.

Interlocks: None.

2.12 GAS DETECTION

Control System/Panel: Main Control Panel

Drawing: E-201

Overview: The SCADA control system will provide continuous display of the wetwell gas detectors (LEL, AIT-101A; H_2S, AIT-101B; O_2 depletion, AIT-101C) and the odor control room gas detectors (LEL, AIT-102A; H_2S, AIT-102B; O_2 depletion, AIT-102C).

Setpoints: (Common for both rooms)

LEL Warning Alarm {10%}

LEL High Alarm {20%}

H_2S Warning Alarm {10ppm}

H_2S High Alarm {20ppm}

O_2 Low Alarm {19.5%}

O_2 High Alarm {23.5%}

Operation: The gas detectors monitor the designated area for their stated condition and transmit 4-20mA signals to the PLC corresponding to the value detected. Warning and alarm levels are set and displayed at the HMI and OIT.

Alarm contacts on each gas detector are wired in parallel to the Gas Detector Light mounted on the outside of the building, independent of the PLC monitoring and alarm levels. The alarm thresholds for these alarm contacts are configured at each gas detector. When an alarm condition is detected, the contact will close and light the Gas Detector Light, warning operators of a potentially hazardous condition. The alarm contacts will also connect to a digital input on the PLC.

Alarms: Trigger an 'LEL Warning Alarm' when the LEL detection in the designated room is greater than the setpoint for more than a selectable time delay {10 seconds}.

Trigger an 'LEL High Alarm' when the LEL detection in the designated room is greater than the setpoint for more than a selectable time delay {10 seconds}.

Trigger an 'H_2S Warning Alarm' when the H_2S detection in the designated room is greater than the setpoint for more than a selectable time delay {10 seconds}.

Trigger an 'H_2S High Alarm' when the H_2S detection in the designated room is greater than the setpoint for more than a selectable time delay {10 seconds}.

Trigger an 'O_2 Low Alarm' when the O_2 detection in the designated room is greater than the setpoint for more than a selectable time delay {10 seconds}.

Trigger an 'O_2 High Alarm' when the O_2 detection in the designated room is greater than the setpoint for more than a selectable time delay {10 seconds}.

Trigger a 'General Gas Detection' alarm when the digital input from the gas detectors is active for more than a selectable time delay {10 seconds}.

Interlocks: When a gas detection alarm is triggered in the wetwell, the PLC will start the wetwell supply fan.

2.13 HVAC SYSTEM INTERFACES

Control System/Panel: Main Control Panel

Drawing: E-201

Overview: The SCADA control system will monitor and control the operation of the Wetwell Supply Fan, the Odor Control Fan, the Dry Well Supply Fan and the Dry Well Exhaust Fan.

Setpoints: None.

Operation: The PLC will start the wetwell supply fan and odor control fan when the wetwell door is opened (indicated by the wetwell door intrusion switch being active) and continue to run for a selectable time delay {1 hour} after the wetwell door is closed (indicated by the wetwell door intrusion switch being inactive).

The PLC will start the wetwell supply fan and odor control fan when any wetwell gas warning or alarm is triggered, and continue to run until gas levels drop below alarm or warning level.

The PLC will run the wetwell supply fan and dry well exhaust fan for a selectable interval {15 minutes} and then stop the fans for a selectable time delay {45 minute}. The PLC will repeat this cycle.

The PLC will run the dry well supply fan and dry well exhaust fan for a selectable interval {15 minutes} and then stop the fans for a selectable time delay {45 minute}. The PLC will repeat this cycle.

The odor room supply fan and the odor room exhaust fans ran continuously with no control from the PLC.

Alarms: Trigger and 'Odor Room Exhaust Fan No Air Flow' if EF-1 is running and no flow is detected (FS-XXX) for more than a selectable time delay {10 seconds}.

Interlocks: None.

2.14 SITE GENERATOR AND ATS

Control System/Panel: Main Control Panel

Drawing: E-201

Overview: The SCADA control system will monitor status and operation of the backup generator and the automatic transfer switch (ATS) for the pump station.

Setpoints: None.

Operation: The current ATS position, 'ATS in Normal' or 'ATS in Emergency', will be displayed on the HMI and OIT.

When the backup generator is running, a 'Generator Running' status will be displayed on the HMI and OIT.

Alarms: Trigger 'Generator Fault' alarm when the generator fault indication is active.

Trigger 'ATS Fault' alarm when neither the 'ATS in Normal' or 'ATS in Emergency' status points are active for more than selectable time delay {10 seconds}.

Interlocks: None.

*** END OF SECTION 40 81 35 - Appendix A ***

1. INTRODUCTION

A programmer shall integrate the control system and complete the necessary PLC and Human Machine Interface (HMI) programming. The following descriptions are provided to assist the Engineer during the integration process and are a supplement to the Process and Instrumentation Diagrams and Control Wiring Diagrams provided in the Drawings.

The PLC and HMI programmer needs to become familiar with the aforementioned documents and incorporate the controls related information contained in these into the programming.

Note all HMI screens shall be submitted for review and approval by the Engineer and Owner before field deployment and startup.

1.1 ABBREVIATIONS & DEFINIITIONS

- SCADA: Supervisory Control and Data Acquisition.
- HMI: Human machine interface.
- OIT: Operator interface terminal.
- HOA: Hand-Off-Auto
- PLC: Programmable Logic Controller
- Control System: The Control System shall consist of all hardware, software, programming and equipment/instrumentation setup required to implement controls described in the Specifications.
- "Local" or "Hand" operations shall be initiated by a push button or selector switch located either adjacent to the piece equipment or on the starter cabinet.
- "Remote Manual" operations shall allow an operator to control the operation of a piece of equipment (e.g. start/stop or open/close) from the HMI.
- "Remote Automatic" operations shall control the operation of a piece of equipment (e.g. start/stop or open/close) based on control logic programmed into the PLC.
- {SP}: operator adjustable set point
- {##.# units}: operator adjustable set point and recommended initial value for the set point, including the recommended units and decimal places

1.2 CONTROL SYSTEM GENERAL REQUIREMENTS

The following sections outline general requirements for local control panels, OIT terminals and the monitoring and control of equipment and processes. It also describes the coordination and data transfer on the Ethernet network between control panels and other displays.

1.2.1 Hand-Off-Auto

Hand-Off-Auto (H-O-A) switches are provided adjacent to equipment as indicated on the Drawings or as specified. Unless specified otherwise all H-O-A switches shall operate as follows:

- When in "Hand" the equipment shall run at full speed or based on a manually input speed setting entered via the VFD if a VFD is provided. Hand operation is intended only for maintenance purposes, for equipment jog and testing/troubleshooting procedures. In the event of a problem with the control system, it is recommended that the process be bypassed until the problem can be corrected. When the equipment is running with the HOA in the hand position, only the basic

equipment safety measures are operable. These safety measures will keep the system from damage (e.g. motor overloads and basic interlocks) but will not provide equivalent functionality to the PLC based control system.

- When in "Off" the equipment will be off.
- When in "Auto" the equipment shall be operated through the PLC system.

1.2.2 Open-Close-Remote

Open-Close-Remote (OCR) switches are not provided for automated control valves, however the programmer shall provide an electronic OCR within SCADA as indicated:

- When in "Open" the valve is commanded to open.
- When in "Close" the valve is commanded to close.
- When in "Remote" the valve is operated based on process conditions

1.2.3 Motor Run Time Monitoring

The SCADA system shall monitor and display the total 'lifetime' running time for all motors indicated on the Process & Instrumentation Diagrams (pumps, mixers, blowers) in units of ##,###.# hours.

1.2.4 Equipment Status Indication

The SCADA system shall display the status of all HOA switches, equipment, valves, and analog instrumentation described herein. Status indication shall include whether or not the motor is energized/running, valve position/command open/closed, and the value of analog inputs in the units indicated herein. All analog inputs shall include a graphical depiction of the measured quantity in proportion to the scale of the range (e.g. water level in a tank). All analog inputs shall include a graphical depiction of the measured quantity in proportion to the scale of the range.

1.2.5 Emergency Stops (E-Stops)

For all equipment with E-stop switches, the control system shall have an "E-stop switch engaged – (equipment name and tag number)" alarm if an emergency stop switch is engaged. The control loop shall clear the alarm when the E-stop switch is reset in the field. The E-stop circuit shall be normally closed such that the alarm will activate if the E-stop circuit loses power or fails for any other reason. The equipment shall be inoperable until the E-stop circuit is energized. The equipment shall de-energize immediately if the E-stop is engaged.

1.2.6 Motor Run Time Monitoring

The SCADA system shall monitor and display the total 'lifetime' running for all motors indicated on the Process & Instrumentation Diagrams (pumps, mixers, blowers) in units of ##,###.# run time hours.

1.2.7 Variable Frequency Drives (VFDs)

All VFDs shall be provided with Ethernet communications modules. In addition to the analog and/or discrete I/O called for on the Drawings and in the Equipment and Instrumentation list, the Contractor shall provide to the SCADA system the following information for every VFD installed, at a minimum:

- Speed reference set point in Remote.
- Display of speed feedback, 0-100%.

- Run time meters.
- General Fault Alarm

All VFD powered equipment shall include indication of over-amperage and over-torque alarms at the control system, unless noted otherwise.

1.2.8 Operator Adjustable Inputs & Allowable Range

Operator adjustable inputs are indicated throughout the narrative with {brackets}, and shall be required as indicated herein and in the Contract drawings. For each operator adjustable input, provide a range of allowable values that can be entered. The values of the high end and the low end of the range shall be as determined by the Engineer. The operator screens shall not accept set point changes outside the allowable range. Typical values for inputs are provided herein for reference purposes.

1.2.9 Password Protected Access

Provide at a minimum, the following levels of security access: 1) viewing but no adjustment of set points, 2) allows adjustment of set points excluding alarms and interlocks, 3) administrative access to all functionality, alarm limits, interlocks. Coordinate security settings with Engineer and Owner.

1.2.10 Motor Overloads

The majority of motor-driven equipment has overload devices to protect the equipment from overload condition. For all equipment with such devices, as shown on the Contract Drawings, the SCADA system shall monitor and provide alarms for all overload conditions. Each alarm shall be labeled with the corresponding equipment tag and description as noted on the Contract Drawings.

1.2.11 Analog Signal Out of Range

For all equipment with 4-20mA signals connected to the PLC, as shown on the Contract Drawings, the SCADA system shall monitor and provide an alarm if the signal goes out of that range (i.e. less than 4mA or greater than 20mA). Each alarm shall be labeled with the corresponding equipment tag and description as noted on the Contract Drawings.

1.2.12 Failure or Fault Alarms

Generate failure or fault alarms for equipment and processes using physical status and/or based on all applicable conditions. Label faults and alarms with the specific device tags and descriptions.

1.2.13 Alarm Management

Display all alarms on the HMI including new unacknowledged alarms and acknowledged alarms that are still in active alarm state. Display the tag name, description, date and time.

The HMI shall include a means to activate or suppress individual alarms for each piece of equipment. Unless otherwise noted, all alarms shall have an operator adjustable delay prior to alarm activation. The length of the delay period shall be determined based on signal response times and shall be designed to provide system protection while avoiding nuisance alarms. The initial delay period shall be determined by the system Contractor and approved by the Engineer.

Alarm enable/disable, delays, and setpoint adjustment shall be password protected.

All alarms shall be labeled with functional descriptions and the device's equipment tag (see the Contract Drawings for equipment tagging). The alarm descriptions shall be submitted for reviewed and approval by the Engineer.

1.2.14 Interlocks

The control loops for equipment that have motor overloads, current sensitive relays, high temperature sensors or any other interlock shall have interlocks built into the PLC control logic to prevent the equipment from running in the Automatic mode if the interlock condition occurs. Interlocks shall not prevent running equipment in Manual.

1.2.15 Project Screens and Trending

The following listing provides a summary of the screens to be provided, including but not limited to the screen listing in the Contract:

* Overall System Screen: Develop screens that show the overall system, status of each piece of equipment, key flow rates, and water surface elevations.
* Process screens: for each unit process, provide and indicate if a piece of equipment has an alarm or fault associated with it and what the alarm/fault is.
* Run time totalizers: for every piece of equipment, provide a display of total run time (##,###.# hours). Provide the equipment tag number and description next to each display.
* Alarm log and management.
* Communications system and PLC status.
* Trend Screens: provide trend screens for instruments and analog level, flow, pressure and temperature inputs, as specified herein.

2. EQUIPMENT

2.1 INFLUENT CHANNEL LEVEL MONITORING

Control System/Panel: Station SCADA Control Panel

Drawing: E-201

Overview: The SCADA control system will provide continuous display (in feet) of the level in the influent channel using ultrasonic level transmitter (LIT-112).

Setpoints: Influent Channel High Level {3 feet}

Operation: None.

Alarms: Trigger Influent Channel High Level alarm when level exceeds setpoint for more than selectable time delay {10 seconds}.

2.2 WETWELL LEVEL MEASUREMENT

Control System/Panel: Station SCADA Control Panel

Drawing: E-201

Overview: The SCADA control system will provide continuous display (in feet) of the level in wetwells 1 and 2 using submersible level transmitters (LT-101A and LT-101B). Display the status of the wetwell float level switches (LSLL-100A, LSHH-100A, LSLL-100B, LSHH-100B).

Setpoints: (Values common for both wetwells 1 and 2)

<u>One Pump, Constant Speed Setpoints</u>

Wetwell Low Level {3.75 feet}

All Pumps Off Level {4.0 feet}

Lead Pump On Level {5.0 feet}

<u>One Pump, Variable Speed Setpoints</u>

Variable Speed Stop Operation Level {4.5 feet}

Variable Speed Operation Max Level {5.5 feet}

<u>Two Pumps, Variable Speed Setpoints</u>

2 Pump Variable Speed Stop Operation Level {5.0 feet}

2 Pump Variable Speed Max Operation Level {6.0 feet}

Wetwell High Level {6.25 feet}

Operation: A selector switch will be displayed on the HMI and OIT to allow the operator to choose the wetwell level transmitter that is 'lead' (i.e. the PLC uses that measurement for comparison to setpoints and make process decisions).

The PLC will constantly compare the level measured by both LT-101A and LT-101B, and if the difference in measured values exceeds 10%, trigger a 'Wetwell Level Instrument Disagreement' alarm.

Alarms: (Values common for both wetwells 1 and 2)

Trigger Wetwell Low-Low Level alarm {mount switch at 3.5 feet} when float is active for more than selectable time delay {10 seconds}.

Trigger Wetwell High-High Level alarm {mount switch at 6.5 feet} when float is active for more than selectable time delay {10 seconds}.

Trigger Wetwell Low Level alarm when level is less than setpoint for more than selectable time delay {10 seconds}.

Trigger Wetwell High Level alarm when level is greater than setpoint for more than selectable time delay {10 seconds}.

Interlocks: **'**Wetwell Low Level' alarms will stop all operating pumps.

'Wetwell Low-Low Level' alarms will stop all operating pumps.

2.3 WETWELL PUMP CONTROL

Control system/Panel: Main Control Panel

Drawing: E-201

Overview: The SCADA control system will provide continuous monitoring and control of the three wetwell pumps (P-101, P-102, P-103), including run status, start/stop control, VFD fault status, speed control and feedback, and include on screen selection for automatic and manual pump control.

Setpoints: Pump P-101 Speed Command {0-60Hz}

Pump P-102 Speed Command {0-60Hz}

Pump P-103 Speed Command {0-60Hz}

Operation: When the physical HOA switches for the wetwell pumps are in the Automatic position, operations staff will have the ability to place the pumps in 'Hand' or 'Auto' via an on-screen selector at the HMI and OIT. Placing a pump in 'Hand' at the HMI or OIT allows the operator to start and stop the pump and manually select the VFD speed. Any pumps in the 'Auto' mode will be included in the pump cycle and controlled by the PLC as described below.

Operators will have the ability to select the pump rotation sequence at the HMI and OIT, by assigning Pump 1, Pump 2 and Pump 3 to the Lead, Lag and Standby positions available. All pumps with onscreen selectors in the 'Auto' position have to be assigned in the rotation sequence. If a pump is in the 'Hand' position it will not be included in the rotation sequence.

Constant Speed Mode: In 'Auto' mode, when the level in the wetwell is equal to or greater than the 'Lead Pump On' setpoint, the PLC will command the Lead pump to start at its minimum speed. The PLC will continue to operate the lead pump at minimum speed until one of two outcomes occur. If the level in the wetwell becomes less than the 'All Pumps Off' setpoint for more than a selectable time period {10 seconds}, the PLC will stop the lead pump. If the level in the wetwell becomes greater than the 'Lead Pump On Level' for more than a selectable time period {30 seconds}, the PLC will switch the pump to the One Pump, Variable Speed operation mode. The pump speed will be set proportional to the range between the 'Variable Speed Stop Operation Level' (minimum speed) and the 'Variable Speed Max Operation Level' (maximum speed).

One Pump, Variable Speed Mode: In this mode, the PLC will command the Lead pump to ramp between the 'Variable Speed Operation Stop Level' and 'Variable Speed Max Operation Level' setpoints from minimum speed to maximum speed, proportional to the change in level through that range. If the level in the wetwell becomes less than the 'Variable Speed Stop Operation Level' setpoint for more than a selectable period of time {30 seconds}, the PLC will switch the pump to Constant Speed mode. If the level in the wetwell becomes greater than the 'Variable Speed Max Operation Level' for more than a selectable time period {30 seconds}, the PLC will start the Lag pump and switch to the Two Pump, Variable Speed operation mode. The pumps' speed will be set proportional to the range between the '2 Pump Variable Speed Stop Operation Level' (minimum speed) and the '2 Pump Variable Speed Max Operation Level' (maximum speed).

Two Pump, Variable Speed Mode: In this mode, the PLC will command the Lead and Lag pumps to ramp between the '2 Pump Variable Speed Operation Stop Level' and '2 Pump Variable Speed Max Operation Level' setpoints from minimum speed to maximum speed, proportional to the change in level through that range. If the level in the wetwell becomes less than the '2 Pump Variable Speed Stop Operation Level' setpoint for more than a selectable period of time {30 seconds}, the PLC will stop the Lag pump and switch to 1 Pump Variable Speed mode.

If a pump called run does not start within a selectable time delay {10 seconds}, the PLC will trigger a 'Pump Fail to Start' alarm and bump up the pump assignment; i.e. if the Lead Pump fails, the Lag Pump becomes Lead and the Standby pump becomes Lag.

There will be an optional mode in the PLC to switch the pump assignments, able to be toggled on and off by the operators. After a user selectable time {2:00am}, the PLC will automatically change the assignment of the pumps in the rotation sequence (i.e. the Lag pump becomes the Lead pump, the Standby pump becomes the Lag pump, and the Lead pump becomes the Standby pump) the next opportunity all pumps are stopped. This will spread wear over the pumps and ensure all pumps are exercised on a regular basis.

When a 'Wetwell High-High Level Alarm' is triggered by a float switch in the wetwell, the main PLC sends an output signal to each VFD which instructs the VFD to run at the preset speed, and then starts the first pump. After a set time period programmed in the main PLC {60 seconds}, if the 'Wetwell High-High Level Alarm' is still active, the main PLC starts the second pump. The two pumps will continue to run until the 'Wetwell Low-Low Level Alarm' float is active, and then the mainPLC will stop the two pumps. This process will continue until the main PLC is able to restore operation from the analog level transmitters.

There is a backup PLC installed in the SCADA control panel, that monitors the health of the main PLC via discrete input 'heartbeat' signal. If the main PLC is unresponsive (i.e. no heartbeat signal is detected), when a 'Wetwell High-High Level Alarm' is triggered by a float switch in the wetwell, the backup PLC sends an output signal to each VFD which instructs the VFD to run at the preset speed, and then starts the first pump. After a set time period programmed in the backup PLC [1 minute], if the 'Wetwell High-High Level Alarm' is still active, the backup PLC starts the second pump. The two pumps will continue to run until the 'Wetwell Low-Low Level Alarm'

float is active, and then the backup PLC will stop the two pumps. This process will continue until the main PLC is responsive again.

Alarms: (Provide individual alarms for each pump. Include the pump tag in the alarm description.)

Trigger 'Pump Seal Fail Alarm' when the seal failure contact from the seal fail/overtemp relay is active.

Trigger 'Pump Overtemp Alarm' when the overtemperature contact from the seal fail/overtemp relay is active.

Interlocks: A **'**Wet Well Low-Low Level' alarm, as measured by the wetwell low-low level switches (LSLL-100A/100B), will turn off any operating pumps.

A 'Wet Well Low Level' alarm, as measured at the wetwell level transmitters (LT-101A/101B), will turn off any operating pumps.

A 'Pump Overtemp' alarm, as detected by the seal fail/overtemp relay, will turn off the associated pump.

2.4 PUMP CHECK VALVE LIMIT SWITCHES

Control System/Panel: Main Control Panel

Drawing: E-201

Overview: The SCADA control system will provide continuous display of pump inlet check valves (ZSC-101, ZSC-102, ZSC-103) closed status.

Setpoints: None.

Operation: The pump check valve limit switches indicate that the check valve is closed.

Alarms: (Common for all pump check valve limit switches)

Trigger a "Pump Check Valve Stuck Open" alarm if the check valve on a pump does not indicate a closed position for more than a selectable time delay {15 seconds} after a pump is stopped.

Trigger a "Pump Check Valve Failed to Open" alarm if the check valve on a pump does not indicate a open position for more than a selectable time delay {15 seconds} after a pump has started.

Interlocks: None.

2.5 GRINDER

Control System/Panel: Grinder Control Panel (provided by vendor)

Drawing: E-201

Overview: The SCADA control system will provide continuous display of the inlet channel grinder run and fault status from the vendor's grinder panel. No control of the grinder is prov

Setpoints: None.

Operation: None.

Alarms: Trigger 'Grinder Fault' when the fault contact from the vendor controls is active

Trigger 'Grinder Not Running' when the grinder run contact and the grinder fault contact are not active for a selectable time period {60 seconds}.

Interlocks: None

2.6 EFFLUENT FLOW MEASUREMENT

Control System/Panel: Main Control Panel

Drawing: E-201

Overview: The SCADA control system will provide continuous display (GPM) of the instantaneous flow from the effluent channel through the magnetic flow meter (FE/FIT-125), as well as the totalized flow through the meter.

Setpoints: None.

Operation: The PLC shall totalize the flow by counting the pulses from the pulse output of the flow meter, and multiplying that total by the gallons per pulse {20 gallons} configured at the flow transmitter. The total shall be reset every day at a selected time {12:00am} and the previous day's total shall be stored and displayed in addition to the current day's total.

The PLC record the minimum and maximum daily instantaneous flows, resetting the registers to 0 at the same time as the totalized flows are reset.

Interlocks: None

2.7 WETWELL FLOODING FLOAT SWITCH

Control System/Panel: Station SCADA Control Panel

Drawing: E-201

Overview: The SCADA control system will monitor the status of the wetwell flooding float switch (LSH-121).

Setpoints: None

Operation: The flooding float switch will become active when water fills the wetwell.

Alarms: Trigger 'Wetwell Flooding' alarm when wetwell flooding float switch {mount at 2 inches above finished floor} is active for more than selectable time delay {10 seconds}.

Interlocks: None

2.8 DRYWELL FLOODING FLOAT SWITCH

Control System/Panel: Station SCADA Control Panel

Drawing: E-201

Overview: The SCADA control system will monitor the status of the drywell flooding float switch (LSH-122).

Setpoints: None

Operation: The flooding float switch will become active when water fills the drywell

Alarms: Trigger 'Drywell Flooding' alarm when drywell flooding float switch {mount at 2 inches above finished floor} is active for more than selectable time delay {10 seconds}.

Interlocks: None

2.9 FIRE / HEAT / SMOKE DETECTION

Control System/Panel: Main Control Panel

Drawing: E-201

Overview: The SCADA control system will provide status of the Pump Room Heat Detector (XS-132), Control Room Smoke Detector (XS-133), Electrical Room Smoke Detector (XS-134) and Duct Smoke Detector (XS-135).

Setpoints: None.

Operation: The individual sensors monitor the individual rooms for the designated condition (smoke, excessive heat) and become active when that condition is detected.

Alarms: Trigger 'Pump Room Heat Detection Alarm' when the pump room heat detector is active for more than a selectable time delay {10 seconds}.

Trigger 'Control Room Smoke Detection Alarm' when the control room smoke detector is active for more than a selectable time delay {10 seconds}.

Trigger 'Electrical Room Smoke Detection Alarm' when the electrical room smoke detector is active for more than a selectable time delay {10 seconds}.

Trigger 'Duct Smoke Detection Alarm' when the duct smoke detector is active for more than a selectable time delay {10 seconds}.

Interlocks: Any active alarm in this section will shut down pumps and equipment in the pump station.

2.10 BUILDING TEMPERATURE

Control System/Panel: Main Control Panel

Drawing: E-201

Overview: The SCADA control system will provide continuous display of the Building Temperature transmitter (TIT-131).

Setpoints: Building High Temperature {100°F}

Building Low Temperature {40°F}

Operation: None.

Alarms: Trigger 'Building Low Temperature' alarm when the temperature is equal to or lower than the Building Low Temperature setpoint for more than a selectable time delay {10 seconds}.

Trigger 'Building HighTemperature' alarm when the temperature is equal to or greater than the Building High Temperature setpoint for more than a selectable time delay {10 seconds}.

Interlocks: None

2.11 DOOR INTRUSION SWITCHES

Control System/Panel: Main Control Panel

Drawing: E-201

Overview: The SCADA control system will provide indication of the Odor Room Door Intrusion Switch (XS-141), Control Room Door Intrusion Switch (XS-142), Wetwell Door Intrusion Switch (XS-143) and Front Door Intrusion Switch (XS-144).

Setpoints: None.

Operation: None.

Alarms: Trigger 'Odor Room Door Intrusion' alarm when odor room door intrusion switch is active for more than selectable time delay {10 seconds}.

Trigger 'Control Room Door Intrusion' alarm when control room door intrusion switch is active for more than selectable time delay {10 seconds}.

Trigger 'Wetwell Door Intrusion' alarm when wetwell door intrusion switch is active for more than selectable time delay {10 seconds}.

Interlocks: None.

2.12 GAS DETECTION

Control System/Panel: Main Control Panel

Drawing: E-201

Overview: The SCADA control system will provide continuous display of the wetwell gas detectors (LEL, AIT-101A; H_2S, AIT-101B; O_2 depletion, AIT-101C) and the odor control room gas detectors (LEL, AIT-102A; H_2S, AIT-102B; O_2 depletion, AIT-102C).

Setpoints: (Common for both rooms)

LEL Warning Alarm {10%}

LEL High Alarm {20%}

H_2S Warning Alarm {10ppm}

H_2S High Alarm {20ppm}

O_2 Low Alarm {19.5%}

O_2 High Alarm {23.5%}

Operation: The gas detectors monitor the designated area for their stated condition and transmit 4-20mA signals to the PLC corresponding to the value detected. Warning and alarm levels are set and displayed at the HMI and OIT.

Alarm contacts on each gas detector are wired in parallel to the Gas Detector Light mounted on the outside of the building, independent of the PLC monitoring and alarm levels. The alarm thresholds for these alarm contacts are configured at each gas detector. When an alarm condition is detected, the contact will close and light the Gas Detector Light, warning operators of a potentially hazardous condition. The alarm contacts will also connect to a digital input on the PLC.

Alarms: Trigger an 'LEL Warning Alarm' when the LEL detection in the designated room is greater than the setpoint for more than a selectable time delay {10 seconds}.

Trigger an 'LEL High Alarm' when the LEL detection in the designated room is greater than the setpoint for more than a selectable time delay {10 seconds}.

Trigger an 'H_2S Warning Alarm' when the H_2S detection in the designated room is greater than the setpoint for more than a selectable time delay {10 seconds}.

Trigger an 'H_2S High Alarm' when the H_2S detection in the designated room is greater than the setpoint for more than a selectable time delay {10 seconds}.

Trigger an 'O_2 Low Alarm' when the O_2 detection in the designated room is greater than the setpoint for more than a selectable time delay {10 seconds}.

Trigger an 'O_2 High Alarm' when the O_2 detection in the designated room is greater than the setpoint for more than a selectable time delay {10 seconds}.

Trigger a 'General Gas Detection' alarm when the digital input from the gas detectors is active for more than a selectable time delay {10 seconds}.

Interlocks: When a gas detection alarm is triggered in the wetwell, the PLC will start the wetwell supply fan.

2.13 HVAC SYSTEM INTERFACES

Control System/Panel: Main Control Panel

Drawing: E-201

Overview: The SCADA control system will monitor and control the operation of the Wetwell Supply Fan, the Odor Control Fan, the Dry Well Supply Fan and the Dry Well Exhaust Fan.

Setpoints: None.

Operation: The PLC will start the wetwell supply fan and odor control fan when the wetwell door is opened (indicated by the wetwell door intrusion switch being active) and continue to run for a selectable time delay {1 hour} after the wetwell door is closed (indicated by the wetwell door intrusion switch being inactive).

The PLC will start the wetwell supply fan and odor control fan when any wetwell gas warning or alarm is triggered, and continue to run until gas levels drop below alarm or warning level.

The PLC will run the wetwell supply fan and dry well exhaust fan for a selectable interval {15 minutes} and then stop the fans for a selectable time delay {45 minute}. The PLC will repeat this cycle.

The PLC will run the dry well supply fan and dry well exhaust fan for a selectable interval {15 minutes} and then stop the fans for a selectable time delay {45 minute}. The PLC will repeat this cycle.

The odor room supply fan and the odor room exhaust fans ran continuously with no control from the PLC.

Alarms: Trigger and 'Odor Room Exhaust Fan No Air Flow' if EF-1 is running and no flow is detected (FS-XXX) for more than a selectable time delay {10 seconds}.

Interlocks: None.

2.14 SITE GENERATOR AND ATS

Control System/Panel: Main Control Panel

Drawing: E-201

Overview: The SCADA control system will monitor status and operation of the backup generator and the automatic transfer switch (ATS) for the pump station.

Setpoints: None.

Operation: The current ATS position, 'ATS in Normal' or 'ATS in Emergency', will be displayed on the HMI and OIT.

When the backup generator is running, a 'Generator Running' status will be displayed on the HMI and OIT.

Alarms: Trigger 'Generator Fault' alarm when the generator fault indication is active.

Trigger 'ATS Fault' alarm when neither the 'ATS in Normal' or 'ATS in Emergency' status points are active for more than selectable time delay {10 seconds}.

Interlocks: None.

*** END OF SECTION 40 81 35 - Appendix A ***

SECTION 40 81 40

SCADA SYSTEM REPORTING

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes

1. Provide Supervisory Control and Data Acquisition (SCADA) system reporting in accordance with this Section.

2. Modify existing automated reports to include data from the new Lafayette Road Pump Station SCADA panel, matching data collected from other stations in the existing SCADA system.

1.02 PRICE AND PAYMENT PROCEDURES

A. Measurement and payment requirements: per Division 01 General Requirements.

1.03 REFERENCES

A. Not used

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination, Sequencing, and Scheduling: per Division 01 General Requirements.

1.05 SUBMITTALS

A. Submit in accordance with Division 01 General Requirements.

B. Refer to Section 40 81 00 SYSTEM INTEGRATOR QUALIFICATIONS AND SUMMARY OF WORK.

1.06 QUALITY ASSURANCE

A. Provide in Accordance with Division 01 General Requirements.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Provide in accordance with Division 01 General Requirements.

1.08 SITE CONDITIONS

A. Existing Conditions: per Division 01 General Requirements.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.01 REPORTS

A. Compliance Reports

1. Create compliance reports per state regulations. Automate reports to query SCADA historical data, real time data, and lab data as needed. Use the scheduler tool to update the report daily.

2. All compliance reports shall include the state approved format including header, organization of data columns, station identifier, license and permit information, date and time, document number, form number, signature and comments field.

B. Operational Reports

1. Create operational reports to capture equipment runtime hours, chemical residuals, water quality, flow minimum, flow maximum, flow average, flow totals, levels, weather data and lab data. Automate reports to query historical data, real time data, and lab data as needed. Use the scheduler tool to update the reports daily.

2. Variables used in the reports shall use tag names and descriptions consistent with the Human Machine Interface (HMI), Programmable Logic Controller (PLC), and Office of Information Technology (OIT) databases.

3. Report spreadsheet cells shall be formatted to display data resolution consistent with the format used in the SCADA HMI.

4. Report spreadsheet cells that are used for manual data entry shall be identified by either a colored border or colored background.

5. Report workbooks shall have a pushbutton or other simple means for retrieving the data required to complete the report shall the scheduler be disabled or shut off.

6. Report workbooks shall include a sheet listing the complete tag name for each tag queried from the SCADA HMI.

7. The completed reports shall be installed on the designated SCADA computer. The scheduler shall use the Final Report templates to create all of the daily and monthly workbooks. These workbooks shall include the report name and period for the report in the file name. (Ex. September 2007 49-1 FORM SPREAD SHEET.XLSX)

8. The reports shall be demonstrated using SCADA data.

3.02 FIELD QUALITY CONTROL

A. Provide in accordance with Division 01 General Requirements.

3.03 CLOSEOUT ACTIVITIES

A. Provide in accordance with Division 01 General Requirements.

END OF SECTION

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SECTION 40 81 50

SCADA SYSTEM FACTORY TESTING

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes

1. Provide all labor, materials, and equipment needed to demonstrate Supervisory Control and Data Acquisition (SCADA) panels and associated equipment to meet fabrication requirements in accordance with this Section.

2. This section defines the minimum factory testing requirements for the SCADA system.

3. The Work includes demonstrating the installation and configuration of SCADA hardware, software, computers and communications equipment. It includes proving the status for process, equipment, controls and set points are displayed as required. It includes demonstrating SCADA security and remote access. It includes proving the required monitoring and control information is successfully passed back and forth between the SCADA system and vendor supplied control panels.

1.02 PRICE AND PAYMENT PROCEDURES

A. Measurement and payment requirements: per Division 01 General Requirements.

1.03 REFERENCES

A. Reference Standards

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination, Sequencing, and Scheduling: per Division 01 General Requirements.

1.05 SUBMITTALS

A. Submit in accordance with Division 01 General Requirements.

B. The following shall be submitted in accordance with Section 40 81 00 SYSTEM INTEGRATOR QUALIFICATIONS AND SUMMARY OF WORK, as well as including specific submittal information as indicated herein.

C. Submit a proposed schedule, agenda, and procedures for performing an in-house Factory Acceptance Test (FAT). All of the tasks in the FAT should be demonstrated again to a more extensive level on Site when systems are started up. These tasks would include demonstrating proper communications, monitoring, control, and reporting as required by the Contract Documents.

D. After receiving approval for the test procedures, the System Integrator shall perform the in-house FAT for the Design-Builder and submit the test results to the Construction Manager.

E. Following successful FAT test and approval, the control panel manufacturer shall ship the control panels, computers, software, and hardware to the job Site.

F. The control panel manufacturer and systems integrator shall submit a memo to the Construction Manager documenting that all applicable SCADA hardware and software is registered to the Owner and that extended support programs are in place.

G. Closeout and Maintenance Material Submittals: per Division 01 General Requirements.

1.06 QUALITY ASSURANCE

A. Provide in accordance with Division 01 General Requirements.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Provide in accordance with Division 01 General Requirements.

1.08 SITE CONDITIONS

A. Existing Conditions: per Division 01 General Requirements.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.01 PROGRAMS AND HARDWARE TESTING

A. The programs and hardware testing shall include, but not be limited to

1. Control panel layout, wiring practice, completeness, and adherence to applicable codes

2. Programmable Logic Controllers (PLC) and their associated ladder logic files

3. Operator Interface Terminals (OIT) and their associated configuration software

4. SCADA computers and their associated operating system

5. Human Machine Interface (HMI) software configuration

6. Alarm Monitoring software configuration and their associated modems and voice cards

7. Reporting software and associated scheduler

8. Network communications equipment and associated configuration software.

3.02 COORDINATION

A. The Work includes the System Integrator coordinating a meeting with the Design-Builder's installation Contractor, Construction Manager, and Design-Builder to demonstrate the control panels, computers, and software. At a minimum, a factory acceptance test shall be performed.

3.03 FACTORY ACCEPTANCE TEST

A. The Contract requires that SCADA computers, control panels PLCs, OITs communicate via an Ethernet local area network. It requires all software starts automatically, hardware is recognized and functional and the software provides the monitoring, control, alarm handling, historical collection, trending and reporting as required by the Contract Documents and approved submittals.

B. The intent of the FAT is to confirm control panels and associated hardware are functional prior to installation in the field. The intent of the program test of the SCADA software and hardware is to demonstrate the acceptable structure and function of typical blocks of code. It is not the intent to test every possible point or screen or database tag. Complete testing of all points shall be done during Site checkout and startup testing.

C. FAT Application Acceptance Tests

1. SCADA computers: General setup, test, and confirm the following per the Specifications:

a. All computer hardware required by the Contract Documents is installed on SCADA computers

b. All SCADA software required by the Contract Documents is installed on SCADA computers

c. SCADA computers power up without error messages

d. Computer operating system security has been configured so they automatically login as guest user on startup

e. All SCADA applications load automatically in the correct sequence on startup

f. The SCADA computers are configured for the Ethernet network the SCADA system uses.

g. The alarm notification hardware and software is operational, dials out under alarm conditions, and receives incoming calls to query status and acknowledge alarms.

h. The remote access hardware and software has been configured to allow an authenticated user access to the SCADA system via the Internet.

D. SCADA control panel checkout: PLCs, OITs and radio, test and confirm the following per Specifications.

1. Confirm each control panel confirms with the Bill of Material (BOM) and panel layout Drawings.

2. Power up all panel equipment.

3. Confirm discrete input/output (I/O) points from terminal block to digital input and output cards.

4. Confirm analog input/output points from terminal block to analog input/output cards. Confirm correct 4-20 mA signal at 4 mA, 12 mA, and 20 mA.

5. Load PLC program, set PLC to RUN mode, cycle PLC power and confirm PLC returns to run mode.

6. Configure and test PLC communication on the SCADA network.

7. Load OIT program, cycle OIT power, confirm OIT returns to RUN mode.

8. Confirm OIT is configured to communicate on the SCADA network.

9. The battery backup, uninterruptible power supply (UPS) is charged, provides backup power and the required status contacts are operational.

E. Monitoring and control program checkout: Test and confirm the following per the Specifications:

1. HMI screens, set points and command controls have the correct security configuration

2. HMI screen navigation operates correctly between all screens

3. OIT screens, set points and command controls have correct security applied

4. OIT screen navigation works correctly on all screens

5. Confirm connectivity of PLC I/O to correct displays on HMI screens.

6. Confirm connectivity from HMI screen controls to PLC registers.

7. Confirm discreet messaging from PLC to PLC, and PLC to OIT operates correctly.

8. Confirm HMI tag database to PLC driver configuration is optimized.

F. Alarm monitoring program checkout: Test and confirm the following per the Specifications:

1. Confirm alarms display correctly in the Alarm Summary, HMI navigation bar and alarm monitoring software.

2. Confirm alarms are logged correctly to the historical alarm file.

3. Confirm alarms annunciate correctly and audibly on SCADA computers.

4. Confirm voice and alarm pager messages operate correctly per the callout list.

5. Confirm alarm-monitoring software accepts incoming voice calls, properly authenticates user, announces alarms and accepts remote acknowledgement.

G. Historical collection program checkout: Test and confirm the following per the Specifications:

1. Confirm analog process tags and required set points historically collected in correct files.

2. Confirm historical collection archives at correct intervals with correct deadband.

3. Confirm HMI trend screens allow correct selection and display of collected data.

H. Reporting program checkout: Test and confirm the following per the Specifications:

1. Confirm all configured reports post required data accurately.

2. Confirm manually entered report data functions correctly.

3. Confirm report scheduler executes correctly.

4. Confirm report print function operates correctly.

5. Confirm report database and report files archive to the correct location.

6. Confirm reports can execute manually in the event of a scheduler error.

3.04 FIELD QUALITY CONTROL

A. Provide in accordance with Division 01 General Requirements.

3.05 STARTUP & COMMISSIONING

A. Provide in accordance with Division 01 General Requirements.

3.06 CLOSEOUT ACTIVITIES

A. Provide in accordance with Division 01 General Requirements.

END OF SECTION

SECTION 40 81 51

SCADA SYSTEM CHECKOUT AND STARTUP

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes

1. Perform demonstration of the acceptable configuration of Supervisory Control and Data Acquisition (SCADA) hardware, software, computers and communications equipment in accordance with this Section.

1.02 PRICE AND PAYMENT PROCEDURES

A. Measurement and Payment requirements: per Division 01 General Requirements.

1.03 REFERENCES

A. Reference Standards

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination, Sequencing, and Scheduling: per Division 01 General Requirements.

1.05 SUBMITTALS

A. Submit in accordance with Division 01 General Requirements.

B. The following shall be submitted in accordance with Section 40 81 00 SYSTEM INTEGRATOR QUALIFICATIONS AND SUMMARY OF WORK, as well as including specific submittal information as indicated herein.

C. Submit a proposed schedule and agenda for a startup meeting with the Construction Manager. The meeting shall include review of team members, their responsibilities, and a timeline coordinated with the Design-Builder's installation contractor for proposed dates to test of all major SCADA components.

D. Submit a proposed schedule, agenda, and test procedures for performing an on Site Application Acceptance Test (AAT) to be witnessed by the Construction Manager. All tasks in the AAT shall demonstrate correct communications, monitoring, control, and reporting.

E. Submit templates of the documentation that the System Integrator will use to record results of testing activities described in this Section to the Construction

Manager. Only the Construction Manager-reviewed documentation shall be permissible for recording test results.

1.06 QUALITY ASSURANCE

A. Provide in accordance with Division 01 General Requirements.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Provide in accordance with Division 01 General Requirements.

1.08 SITE CONDITIONS

A. Existing Conditions: per Division 01 General Requirements.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.01 PROGRAMS AND HARDWARE TESTING

A. The programs and hardware testing shall include**,** but not limited to:

1. SCADA Control panels and their associated wiring
2. Programmable Logic Controllers (PLC) and their associated ladder logic files
3. Operator Interface Terminals (OIT) and their associated configuration software
4. SCADA computers and their associated operating systems
5. Human Machine Interface (HMI) software
6. Alarm Monitoring software and associated modems and voice cards
7. Reporting software and associated scheduler
8. Network and radio communications equipment and associated configuration software.
9. Remote access hardware and associated configuration software
10. Variable Frequency Drives (VFD)

3.02 COORDINATION

A. The System Integrator is required to coordinate with and assist the Design-Builder’s electrical contractor and instrumentation technician during on Site

testing of equipment and instrumentation. Commissioning shall include confirming that all field wiring is terminated in the control panel correctly and confirming equipment status signals and instrumentation signals are received correctly.

B. The System Integrator is required to participate in progress and coordination meetings with the Design-Builder's installation contractor, construction manager, and design-builder to schedule commissioning in a way that ensures the safe and proper operation of the treatment plant and process, in a manner that is convenient to the Owner. At a minimum, the System Integrator shall attend the following meetings

1. Kickoff meeting

2. Weekly progress and scheduling meeting

3. Daily construction startup meetings as required

3.03 TESTS

A. SCADA computers are configured to communicate to the control panel PLCs, OITs, power monitors, and each other over an Ethernet network within the treatment plant. All systems communicating remotely shall be configured and tested to ensure all necessary communication between remote Sites, occurs correctly. All software shall start automatically, hardware is recognized and functional, and the software provides the monitoring, control, alarm handling, historical collection, trending, and reporting as required by the approved submittals. The tests shall include:

1. Application Acceptance Tests (AAT)

2. SCADA computers: General setup, test, and confirm the following per Specifications:

   a. All SCADA computer hardware is installed on all SCADA computers

   b. All SCADA software is installed on all SCADA computers

   c. All SCADA computers power up correctly

   d. All SCADA node operating system security is configured to automatically log in as guest when powered up

   e. All SCADA computer applications load automatically in the correct sequence on power up

   f. The SCADA alarm notification hardware operates correctly and dials out and receives incoming calls correctly

g. The SCADA remote access hardware has been configured to allow an authenticated user access to the SCADA computers via the Internet

3. SCADA control panel checkout: PLCs & OITs, test and confirm the following per Specifications:

   a. Confirm each panel installation against the Bill of Material (BOM) and panel layout Drawings.

   b. Power all panel equipment and confirm correct operation.

   c. Confirm all discrete input/output (I/O) points between field device and PLC digital input and output cards operate correctly.

   d. Confirm all analog input points between field device and analog input channels operate correctly.

   e. Confirm the PLC processor has the correct program installed and is in RUN mode.

   f. Confirm the PLC is communicating correctly via the SCADA Ethernet network and communicating correctly via the licensed frequency radio network to remote Sites.

   g. Confirm all OIT devices are loaded with the correct programs and are in RUN mode.

   h. Confirm all OIT devices are communicating correctly.

   i. Confirm all devices acting as an uninterruptible power supply (UPS) are operating correctly.

4. Monitoring and control program checkout: Test and confirm the following per the Specifications:

   a. Confirm all HMI screens, set points and command controls have the correct security configured.

   b. Confirm all HMI screen navigation operates correctly.

   c. Confirm all OIT screen, set points and command controls have the correct security configured.

   d. Confirm all OIT screen navigation operates correctly.

   e. Confirm operation of each I/O point from PLCs to correct display on HMI screens.

   f. Confirm correct operation of each set point and command control from the HMI to PLC.

   g. Confirm correct operation of messages from PLC to PLC and PLC to OIT.

   h. Confirm correct operation of HMI tag database and driver polling, phasing and deadbands of PLC.

5. Alarm monitoring program checkout: Test and confirm the following per the Specifications:

    a. Confirm correct operation of alarm in the Alarm Summary, HMI navigation bar, applicable OIT, and the alarm monitoring software.

    b. Confirm alarms are logged correctly in the historical alarm file.

    c. Confirm alarms annunciate correctly on SCADA computers.

    d. Confirm voice and alarm pager calls operate correctly per the required schedule.

    e. Confirm alarm-monitoring software accepts incoming voice calls, properly authenticates user, announces alarms and accepts remote acknowledgement from the incoming caller or HMI Alarm Summary screen.

    f. Confirm alarms acknowledged from the OIT appear acknowledged in the SCADA HMI and alarm monitoring software.

6. Historical collection program checkout: Test and confirm the following per Specifications:

    a. Confirm all analog process tags and required set points historically collected in appropriate files.

    b. Confirm the historical collector archives at specified intervals correctly.

    c. Confirm HMI trend screens allow proper selection and display of historical data.

7. Reporting program checkout: Test and confirm the following per Specifications:

    a. Confirm all configured reports post required data accurately.

    b. Confirm manually entered report data functions correctly.

    c. Confirm report scheduler executes correctly.

    d. Confirm report print function operates correctly.

    e. Confirm report database and report files archive to the correct location.

    f. Confirm reports can execute manually in the event of a scheduler error.

3.04 FIELD QUALITY CONTROL

A. Provide in accordance with Division 01 General Requirements.

3.05 STARTUP & COMMISSIONING

A. Provide in accordance with Division 01 General Requirements.

3.06 CLOSEOUT ACTIVITIES

A. Provide in accordance with Division 01 General Requirements.

END OF SECTION

SECTION 41 22 23

MONORAILS AND HOISTS

PART 1 – GENERAL

1.01 SUMMARY

A. Provide monorail hosts, trolleys and bridge crane in accordance with this Section and applicable reference standards listed in Article 1.03.

B. Related Sections

1. Division 05, Section 05 50 00 METAL FABRICATIONS

2. Division 09, Section 09 90 00 PAINTING AND COATING

1.02 PRICE AND PAYMENT PROCEDURES

A. Measurement and payment requirements: per Division 01 General Requirements.

1.03 REFERENCES

A. Reference Standards

1. ASME B30.11 Monorails and Underhung Cranes

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination, Sequencing, and Scheduling: per Division 01 General Requirements.

1.05 SUBMITTALS

A. Submit in accordance with Division 01 General Requirements.

B. Shop Drawings

1. Submit drawings showing general arrangement of the track beam system.

C. Product Data

1. Hoist

2. Trolley

3. Bridge Crane System include tracks, stop angles, and supports.

D. Design Certification

1. Bridge Crane System - Letter of Design Certification signed and sealed by a Professional Engineer licensed in the Project state

E. Certificates

1. Hoist Load Chain Factory Certification

F. Closeout and Maintenance Material Submittals: per Division 01 General Requirements.

1.06 QUALITY ASSURANCE

A. Provide in accordance with Division 01 General Requirements.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Provide in accordance with Division 01 General Requirements.

1.08 WARRANTY

A. Warranty:

1. 2-year manufacturer's warranty covering proper operation and defects in material or workmanship.

PART 2 – PRODUCTS

2.01 MANUAL HOIST AND TROLLEY ASSEMBLY

A. Provide manual hoists and trolleys where specified. Trolley and wheels shall be suitable for operation on the steel monorail beam provided under Division 05, and shall have not less than four wheels.

1. Manufacturer: Harrington Hoists, Inc. or approved equal.

2. Models

a. Trolley: PT Push Trolley or approved equal

b. Hoist: CF Chain Hoist or approved equaL

3. Capacity: 1 Ton

4. Hook: Forged steel with spring loaded steel throat opening safety device; swivel freely thought 360 degrees rotation with full load without twisting chain.

5. Chain: High strength steel links, flexible; minimum safety factor of 5 to 1 based on ratio of minimum.

    a. Length: See Hoist Schedule on Drawings

2.02 ELECTRIC HOIST AND TROLLEY ASSEMBLY

A. Provide single speed electric hoists and trolleys where specified. Trolley and wheels shall be suitable for operation on the steel monorail beam provided under Division 05, and shall have not less than four wheels.

1. Manufacturer: Harrington Hoists, Inc. or approved equal.

2. Models

    a. Trolley: MR Trolley or approved equal

    b. Hoist: NERM Electric Chain Hoist or approved equal

3. Capacity: 1 Ton

4. Hook: Forged steel with spring loaded steel throat opening safety device; swivel freely thought 360 degrees rotation with full load without twisting chain.

5. Chain: High strength steel links, flexible; minimum safety factor of 5 to 1 based on ratio of minimum.

    a. Length: See Hoist Schedule on Drawings

2.03 BRIDGE CRANE SYSTEM

A. Design and provide a complete bridge crane system where specified.

1. Design

    a. Retain the services of a Professional Engineer licensed in the project state with a minimum 5-years of experience in the design of bridge crane systems and similar structures.

    b. Provide stamped Design Drawings for bridge crane system and attachment to existing structure capable of carrying the required process equipment overhead.

    c. Design bridge crane system in accordance with applicable building codes.

2. Manufacturer: American Crane and Hoist Corp., Spanco, Inc., or approved equal.

3. Bridge Crane System Components

a. Track, Stop Angles, Connections and Supports Beams.

b. Electric Hoist

1) Hook: Forged steel with spring loaded steel throat opening safety device; swivel freely thought 360 degrees rotation with full load without twisting chain.

2) Chain: High strength steel links, flexible; minimum safety factor of 5 to 1 based on ratio of minimum.

a) Length: See Hoist Schedule on Drawings

c. Motorized Trolley

4. Bridge Crane System Capacity: 1 Ton

2.04 SOURCE OF QUALITY CONTROL

A. Provide in accordance with Division 01 General Requirements.

PART 3 – EXECUTION

3.01 ERECTION AND INSTALLATION

A. The Contractor shall erect and install the bridge crane systems, hoists, and trolleys in accordance with manufacturer's written instructions, and the contract drawings.

3.02 OPERATION INSPECTION AND LOAD TEST

A. Upon completion, and before final acceptable, the bridge crane system, hoists, and trolleys shall be given the rated load test specified in ASME B30.11, carry 125 percent (plus 5 percent, minus 0 percent) of the rated capacity. The systems shall be thoroughly tested in service to determine that each component of the system operates as specified, is properly installed and adjusted, and is free from defects in material, manufacturer, installation and workmanship. The test and final adjustments of the equipment will be under the supervision of the Engineer. The Contractor shall rectify any deficiencies found and completely retest work affected by such deficiencies.

3.03 FIELD QUALITY CONTROL

A. Provide in accordance with Division 01 General Requirements.

3.04 CLOSEOUT ACTIVITIES

A. Provide in accordance with Division 01 General Requirements.

END OF SECTION

SECTION 43 21 40

SUBMERSIBLE WASTEWATER PUMPS

PART 1 – GENERAL

1.01 SUMMARY

A. The Contractor shall provide all labor, materials, equipment, and incidentals to furnish, install, startup, and test three dry-pit submersible wastewater pumps as shown on the Drawings and specified herein.

1.02 PRICE AND PAYMENT PROCEDURES

A. Measurement and payment requirements: per Division 01 General Requirements.

1.03 REFERENCES

A. AMERICAN BEARING MANUFACTURERS ASSOCIATION (ABMA)

B. AMERICAN GEAR MANUFACTURER' ASSOCIATION (AGMA)

C. AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

D. AMERICAN SOCIETY FOR TESTING MATERIALS (ASTM)

E. STANDARDS OF THE AMERICAN WATER WORKS ASSOCIATION (AWWA)

F. INSTITUTE OF ELECTRICAL AND ELECTRONIC ENGINEERS (IEEE)

G. STANDARDS OF THE HYDRAULIC INSTITUTE (HI)

H. NATIONAL ELECTRIC CODE (NEC)

I. STANDARDS OF THE NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

J. ISO 9001:2000

K. THE SOCIETY OF PROTECTIVE COATINGS (SSPC) SURFACE PREPARATION STANDARDS

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination, Sequencing, and Scheduling: per Division 01 General Requirements.

1.05 SUBMITTALS

A. Submit in accordance with Division 01 General Requirements.

B. Product Data

1. Complete list of all items to be provided including Supplier and delivery schedule.

2. Manufacturer's Specifications and product data required to demonstrate compliance with requirements which shall include complete parts listing showing materials of construction with applicable HI, ANSI, ASTM and other standards.

3. Certified dimension prints showing all details of fabrication, assembly, installation including anchorage details.

4. Data on characteristics and performance of each pump. Data shall include guaranteed performance curves based on actual test data of duplicate units which show compliance with the specified requirements. Variable speed units shall include capacity/head curves and best efficiency point (BEP) for a minimum of five reduced speeds between minimum to maximum speed. Curves shall be plotted capacity versus head, NPSH required, pump efficiency, brake horsepower, and motor horsepower. BEP and all specified operating points shall also be shown. Data at all operating points shall also be tabulated.

5. The weight of each major component and the total weight of the equipment.

6. A list of the manufacturer’s recommended spare parts including gaskets, bearings, and seals.

7. Complete data on motors including complete performance characteristics.

8. Complete wiring diagrams and control schematics.

9. Deviations from the Contract Documents.

C. Shop Drawings

1. None required

D. Samples and Mockups

1. None required

E. Certificates

1. Submit warranty statement.

F. Design Data/Submittals

1. As required under “Product Data” above.

G. Sample Test Reports and Evaluations

1. None required.

H. Manufacturer Instructions

1. Manufacturer's recommended shipping, unloading, storage, installation, testing, operation and maintenance procedures including a list of special tools and equipment required to maintain the units.

I. Source and Field Quality Control Submittals

1. As required above.

J. Manufacturer Reports

1. Factory test report including test pump curves for the supplied units, following fabrication and prior to shipment, demonstrating compliance with the factory test requirements in Part 3 of this section.

K. Qualification Statements

1. Submit installation lists of installations with contact information demonstrating compliance with Section 1.06 below.

L. Closeout and Maintenance Material Submittals per Division 01 General Requirements.

1.06 QUALITY ASSURANCE

A. All equipment specified in this section shall be from a single Manufacturer that has been regularly engaged in the design and manufacture of submersible wastewater pumps for a minimum of 20 years. The Manufacturer shall have a minimum of 20 other municipal installations of similar size dry-pit submersible wastewater pumps that have been in successful operation for a minimum of 10 years. Pumps, motors and bases shall be provided as a single unit from the pump manufacturer.

B. Pumps are to be engineered and manufactured under a written Quality Assurance program certified to ISO 9001:2000 Quality System Standard. The pumps shall conform to all applicable requirements of ASTM, ANSI, AWWA, and Hydraulic Institute.

C. All equipment shall be designed and built for 24-hour continuous service at any and all points within the specified range of operation, without overheating, cavitation, excessive vibration or strain.

D. The pumping units required under this section shall be complete. All parts shall be so designed and proportioned as to have liberal strength, stability, and stiffness and to be especially adapted for the service to be performed.

E. All working parts of the pumps and motors, such as bearings, wearing rings, shaft, and sleeves shall be standard dimensions built to limit gauges or formed to templates, such that parts will be interchangeable between like units and such that the Owner may, at any time in the future, obtain replacement and repair parts.

F. The nameplate ratings of the motors shall not be exceeded, nor shall the design service factor be reduced when the pump is operating at any point on its characteristic curve at maximum speed.

G. Mechanical equipment, including drives and electric motors shall be supplied and installed in accordance with applicable OSHA Regulations. The noise level of the pumps, unless otherwise noted, shall not exceed 85 dBA measured 3 meters from the unit under free field conditions while operating on utility power.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Provide in accordance with Division 01 General Requirements and manufacturer instructions.

1.08 SITE CONDITIONS

A. In accordance with Division 01 General Requirements and as shown on the Drawings. Contractor and Manufacturer shall pay particular attention to tight clearances in existing pump room and shall notify Engineer of any conflicts prior to placing order for equipment.

1.09 MAINTENANCE

A. Provide spare parts, special tools, and operations and maintenance instructions as specified elsewhere in this Specification and in Division 01 General Requirements.

1.10 WARRANTY

A. Provide 5-year pro-rated warrantee for each pump. Warrantee shall commence upon successful pump start up. Warranty shall cover the following percentages of all costs associated with parts, labor and shipping required for repair to normal operation: 100% of all costs for the first 18 months, 50% of all costs between months 19 and 39 and 25% of all costs between months 40 and 60.

PART 2 – PRODUCTS

2.01 GENERAL

A. All pumps shall be vertically-oriented, dry-pit submersible, capable of continuous operation in a non-submerged condition and permanently connected to inlet and outlet pipes as shown on the Drawings. Pump motors shall be glycol cooled and shall not require supplemental cooling over the entire range of specified operating conditions. Pump shall be of submersible construction and shall be capable of normal, continuous operation when flooded in water to a depth of 65 feet or greater.

2.02 PUMP SIZING AND PERFORMANCE

A. Wastewater Pumps (P-1, P-2, P-3)

1. Suction Nominal Pipe Size, Maximum: 10 inches

2. Discharge Nominal Pipe Size, Maximum: 10 inches

3. Solids Passing Size, Minimum: 3 inches

4. Motor Horsepower, Maximum: 85

5. Motor Speed, Maximum at 60 Hz: 1800 rpm

6. Maximum Height of Removable Equipment (motor and volute, not including suction elbow and stand): 60”

7. Maximum Weight of Removable Equipment (motor and volute, not including suction elbow and stand): 2,000 pounds.

8. Operating Conditions

a. The pump must meet all of the following operating conditions:

Condition	Flow (gpm)	Head (feet of water)	NPSH available (feet of water)	Overall Efficiency (Minimum Percent)	Speed
Nameplate	1530	111	27.7	66	Maximum
Maximum Head	1200	133	29.3	64	Maximum
Maximum Flow (Runout)	1900	92	25.5	64	Maximum

Minimum Flow	620	65	29.9	56	Reduced

b. Each operating point must fall within the allowable operating region as defined by the Manufacturer and the Hydraulic Institute Standards.

c. The "Nameplate" condition matches the nameplate of existing pumps and should be printed on the nameplate of the new pumps. This condition will occur with two pumps in operation at full speed and with the force main in good condition.

d. The "Maximum Head" condition is the maximum anticipated head with two pumps in operation at full speed and the existing force main in its current dirty condition.

e. It is anticipated that the force main will be cleaned as part of this project. The actual operating point with two pumps in operation at full speed is anticipated to be between the "Nameplate" and "Maximum Head" conditions.

f. The "Maximum Flow (Runout) Condition" is specified to insure that when one pump is in operation at full speed: motor horsepower is sufficient, NPSH margin is sufficient, and there is sufficient overlap in capacity between 1 and 2 pump operation.

g. The "Minimum Flow" condition is specified to insure that there is sufficient turndown to meet typical station flows without excessive pump cycling and without excessive power consumption.

h. **The Manufacture's NPSH required shall maintain a factor of safety of five feet or 35%, whichever is greater, over the NPSH available at all specified conditions**.

i. In the unlikely event that primary level control should fail, the pumps will run at full, constant speed between high-high and low-low floats. In this case, the "Maximum Flow (Runout) Condition" NPSH available will be as low as 23.8 feet. **Manufacturer shall submit a statement that operation at this point for up to a total of 48 hours over the life of the pump will not significantly shorten the pump life or significantly reduce performance.**

j. "Overall Efficiency" includes pump and motor losses.

2.03 ACCEPTABLE MANUFACTURERS

A. Xylem Flygt

B. Sulzer (ABS) PUMP

2.04 PUMP EQUIPMENT

A. Inlet Elbow: Single piece gray cast iron, ASTM A-48, class 30, 35, or 40. ANSI B16.1 Class 125 flange connection. Hand hole: large enough for inspection and cleanout of the impeller, with watertight cover.

B. Base: Single piece gray cast iron, ASTM A-48, class 30, 35, or 40, designed to support all static and dynamic forces and prevent excessive vibration.

C. Volute: Single piece gray cast iron, ASTM A-48, Class 30, 35 or 40, non-concentric design with smooth passages of sufficient size to pass any solids that may enter the impeller. Minimum inlet and discharge size shall be as specified. Discharge connection shall conform to ANSI B16.1 Class 125.

D. Impellers: Single piece ASTM A-532 (Alloy III A) 25% chrome cast iron or ASTM A-48 Class 30 gray cast iron, statically and dynamically balanced. Semi-open design optimized for solids handling and maximum efficiency. Impellers shall have a minimal number of vanes and be specially designed to handle raw wastewater containing rags and debris. Keyed and held in place with a single stainless steel bolt.

E. Wear Rings: Volute and impeller shall be equipped with replaceable stainless steel wear rings. Volute wear ring shall be adjustable with the pump in service to maintain tolerance between volute and impeller.

F. Shaft: Single piece motor/pump shaft. Material of construction: 416 stainless steel, Deflection at the Shaft Seal within allowable operating range shall not be more than 0.002 inch.

G. Mechanical Shaft Seals: Two independent seal sets, each with stationary and positively-driven parts. Contacting sliding surfaces shall be single-piece tungsten, silicon carbide, or carbon. Other parts shall be stainless steel. Seal springs shall not contact pumped fluid. Seals shall not require maintenance or adjustment.

H. Leak Detection: Provide intermediate chamber between shaft seals with conductive leak sensor which indicates need for seal inspection.

I. Upper and lower bearings: Ball and/or roller bearings. Sealed and factory pre-lubricated for life of equipment. Designed to withstand radial and thrust forces and provide 100,000 hours Ll0 life over allowable operating range.

J. Cable Entry Seal: Provide entry seal to insure a watertight, submersible seal up to the depth specified above, consisting of threaded gland, compressible grommet(s), and positive stop. Glands shall provide strain relief independent of sealing function.

K. Cable: Provide single cable for power and instrument conductors. Jacket: neoprene. Rating: NEC severe service "S," type "SJTO." Length: sufficient to reach termination point as shown on the Drawings.

L. Other Seals: Stationary parts shall be sealed with Buna-N O-rings.

M. Lifting Handle: Stainless steel, rated for maximum weight of pump and motor.

N. Hardware: 316 stainless steel

2.05 MOTORS

A. Motor shall be NEMA B, squirrel-cage induction motor.

B. NEMA premium or equivalent efficiency.

C. Horsepower Rating: Not be less than maximum brake horsepower requirements of pumps over the entire range of the pump performance curve.

D. Service Factor: 1.15 over 40°C ambient.

E. Rated for at least 10 starts per hour.

F. Overload Protection: Provide thermal overload protection with automatic reset.

G. Insulation: Class H

H. Agency Listing: Underwriters Laboratories or Factory Mutual

I. Duty: Continuous or intermittent, inverter-duty NEMA MG1 Part 31.

J. Provide shaft grounding ring.

K. Housing: Air filled, watertight design.

L. Integral closed-loop cooling system: Stator housing shall be enclosed by a motor cooling jacket. An impeller, integral to the cooling system and driven by the pump shaft, shall provide the necessary circulation of the cooling liquid through the jacket. Jacket shall have one fill port and one drain port. System shall be designed to maximize heat transfer from the motor to the cooling fluid and from the cooling fluid to the pumped fluid. The cooling system shall provide for continuous pump operation in liquid or ambient temperatures of up to 104°F without operational restrictions over the entire range of operating conditions including near-zero speed. Pumps cooled by process fluid (sewage), fans, blowers or auxiliary cooling systems mounted external to the pump motor are not acceptable.

M. Thermal switches: Provide one thermal switch for each stator phase winding to detect motor over-temperature.

N. The motor and cable shall be capable of continuous submergence underwater without loss of watertight integrity to a depth of 65 ft. or greater.

O. Shop Test: Use NEMA report of test form to report tests conducted in accordance with AIEE Test Code as specified in the ANSI Standard C50 for Rotating Electrical Machinery.

2.06 CONTROLS

A. Furnish relays for each pump to detect seal failure and motor over-temperature. Provide separate dry contacts for seal failure and motor over temperature, Contact rating: 240VAC 3A max. Indicators lights: power, seal failure, and motor over-temperature. Power: 24VDC.

B. Relays will be installed in control panel by others. Contractor shall coordinate panel fabrication to accept relays provided by pump Manufacturer.

2.07 RAIL SYSTEM

A. Not applicable.

2.08 LUBRICATION

A. All lubrication fittings shall be readily accessible from the outside without the necessity of removing covers, plates, housings, or guards.

2.09 SURFACE PREPARATION AND PAINTING

A. Factory coat all external ferrous metal surfaces as follow. Factory surface preparation in accordance with SPCC SP-10. Factory prime and finish with a total of two coats of Tnemec Series 66HS (or Engineer approved equal), 6 to 8 mills thickness each coat.

B. Stainless steel, brass, bronze, galvanized, plastic, and copper components shall not be painted. All nameplates shall be properly protected during painting.

2.10 NAMEPLATES

A. 304 stainless steel, embossed data.

B. Equipment nameplate data: Manufacturer's name, address, type or style, model or serial number, catalog number, rated capacity, gear ratio, speed, and any other pertinent data.

C. Motor nameplate data: At least the minimum information required by NEMA MG 1 standards.

2.11 SPARE PARTS AND SPECIAL TOOLS

A. Provide spare parts and special tools prior to startup and in clearly labeled packaging, in a location determined by the Owner.

B. Provide one set of the following spare parts:

1. Complete set of seals including cable entry seals.

2. Wearing ring(s)

3. Spares of any additional parts subject to wear and/or as recommended by the Manufacturer.

C. Provide one set of all special tools required for the normal operation and maintenance of the pumps.

PART 3 – EXECUTION

3.01 FACTORY TESTS

A. All pump tests shall be in accordance with the Hydraulic Institute's Standards. All tests shall be performed at the manufacturer's facility prior to shipment. All test results shall be certified by a registered professional Engineer, and shall be submitted to Engineer for approval prior to shipment.

B. Each Pump shall be performance tested at a minimum of five operating points spanning the full range of allowable operating conditions and including all specified operating points. Pump test curves shall be developed to illustrate conformance with the Contract Documents. Capacity, head, motor speed, pump speed, efficiency, input horsepower, and vibration shall be recorded for each test point. For variable speed units, each pump shall be tested at full speed plus 3 equally spaced speeds between maximum and minimum design conditions.

C. Each pump shall be hydrostatically tested to 1.5 times shutoff head.

D. All motors shall be tested in accordance with IEEE standards. All test results shall be submitted to the Engineer for approval prior to shipment. Each motor shall be tested at no load running current, high potential, and winding resistance.

E. Pump units shall not be shipped to Site until factory test reports are submitted and approved by Engineer.

F. Engineer and Owner shall be allowed the option of witnessing the test at their expense.

3.02 INSTALLATION

A. Each pump and motor shall be installed in accordance with the written instructions of the manufacturer and under the direct supervision of the manufacturer's representative. Correct installation and assembly of the pumps and other equipment shall be the Contractor's responsibility and shall be in accordance with the Drawings and with the manufacturers' installation instruction manual. The Contractor shall furnish all bolts, shims, tools, and other devices necessary for installing the pumping units. The manufacturer's representative(s) familiar with the equipment being installed shall supervise the handling, installation, start-up, and testing of the equipment.

B. A certificate from the pump manufacturer shall be provided stating that the installation of the pumping equipment is satisfactory, that the equipment is ready for operation, and that the operating personnel have been suitably instructed in the operation, lubrication and care of each type unit provided.

C. Installation shall include furnishing of all required lubricants for initial operation, including startup and six (6) months of operation. The grades and quantities of oil supplied following acceptance shall be as recommended by the pump manufacturer.

3.03 FIELD TESTS

A. After installation of each pumping unit and appurtenances is complete, test for proper operation. The Contractor shall make arrangements to have the Manufacturer's representatives present during each test. Notify Engineer one week prior to test, and confirm with Engineer 24 hours prior to test. Each pumping unit shall be given a running field test in the presence of the Engineer and Manufacturer’s Representative for a minimum of 2 hours. Each pumping unit shall be operated at its rated capacity and the design points specified herein. Throttle discharge valves or run multiple pumps simultaneously to achieve specified heads. The Contractor shall provide an accurate and acceptable method of measuring the discharge flow and suction and discharge heads. **Use of new, calibrated, and tested station flow meter and discharge pressure gauges is acceptable. Contractor shall provide suction pressure/vacuum gauge.** Tests shall assure that the units and appurtenances have been installed correctly, that the assembly is free from undue stress imposed by the piping or mounting bolts, that there is no objectionable heating, vibration, or noise from any parts, and that all manual and automatic controls function properly. If any deficiencies are revealed during any tests, such deficiencies shall be corrected and the tests shall be re-conducted.

B. The Contractor shall provide vibration testing by a qualified and independent testing company. Test each complete system (base, pump, and motor) at each specified condition. The vibration testing shall be conducted in the presence of the Manufacturer’s Representatives in accordance with procedures outlined in the applicable sections of the Hydraulic Institute Standards and these Specifications.

C. In the event vibration exceeds the specified limits and the cause of the vibration is attributable to the pumping equipment, the Manufacturer shall make the necessary balancing or alignment adjustments to bring the equipment to within the specified limits.

D. Provide Field Test Booklets for each unit showing all field tests performed to adjust each component and all field tests performed to prove compliance with the specified performance criteria, upon completion and testing of the installed system. Each test report shall indicate the final position of controls, and all data gathered during testing and shall be signed by the Manufacturer's representative, Contractor, and Engineer.

3.04 FIELD PAINTING

A. Touch-Up Painting: Prior to final acceptance, touch up paint in accordance with Section 09 90 00 PAINTING AND COATING.

B. Stainless steel, galvanized steel, and nonferrous surfaces shall not be painted

3.05 MANUFACTURER'S FIELD SERVICES

A. Provide the services of a factory trained service representative to assist in the installation, start-up, and testing of each piece of equipment, and to perform training to Owner personnel in the operation and maintenance of the equipment. A minimum of eight hours on site shall be provided for instruction and training. Instruction time shall be in addition to startup, checkout, testing and travel time.

END OF SECTION

SECTION 43 21 41

CHANNEL GRINDERS

PART 1 – GENERAL

1.01 SUMMARY

A. Furnish, install, test and place into satisfactory operating condition; wastewater open channel grinding equipment by JWC Environmental, as shown on the Drawings and specified herein. Provide all related appurtenances, including but not limited to, motors, valves, piping, pipe supports, wiring, attachments, conduit, control relays, foundations, anchors, guide rails, support brackets, and all related accessories to provide a complete operational grinding system as specified herein and as shown on the Drawings.

B. All channel grinder equipment shall be a product of JWC Environmental without substitution. The Owner has standardized on JWC throughout the City and utilizes their cutter exchange program.

1.02 PRICE AND PAYMENT PROCEDURES

A. Measurement and payment requirements: per Division 01 General Requirements.

1.03 REFERENCES

A. Reference Standards

1. AMERICAN BEARING MANUFACTURERS ASSOCIATION (ABMA)

   a. ABMA 9 Load Ratings and Fatigue Life for Ball Bearings

2. ASME INTERNATIONAL (ASME)

   a. ASME B16.1 Standard for Gray Iron Threaded Fittings; Classes 125 and 250

   b. ASME B16.5 Standard for Pipe Flanges and Flanged Fittings: NPS 1/2 Through NPS 24

   c. ASME B40.100 Pressure Gauges and Gauge Attachments

3. ASTM INTERNATIONAL (ASTM)

   a. ASTM 4130 Enhanced Hardenability and Tempering Resistance of Steel by Ni Addition

   b. ASTM A743 Standard Specification for Castings, Iron-Chromium, Iron-Chromium-Nickle, Corrosion Resistant, for General Application

c. ASTM A36 Standard Specification for Carbon Structural Steel

d. ASTM A536 Standard Specification for Ductile Iron Castings

e. ASTM F593 Stainless Steel Bolts, Hex Cap Screws, and Studs

f. ASTM F594 Standard Specification for Stainless Steel Nuts

4. NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

a. NEMA ICS 1 Industrial Control and Systems: General Requirements

b. NEMA MG 1 Standard for Motors and Generators

5. AMERICAN IRON AND STEEL INSTITUTE (AISI)

a. AISI 4140 Alloy steel

6. SOCIETY OF AUTOMOTIVE ENGINEERS (SAE)

a. SAE 600 Bearing Bronze

7. NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

a. NFPA 70 National Electrical Code

8. THE SOCIETY OF PROTECTIVE COATINGS (SSPC) SURFACE PREPARATION STANDARDS

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination, Sequencing, and Scheduling: per Division 01 General Requirements.

1.05 SUBMITTALS

A. Submit in accordance with Division 01 General Requirements.

B. Product Data

1. Product data shall include but is not limited to a complete list of equipment and materials; including descriptive data, technical literature, performance charts, curves, catalog cuts, and installation instructions shall also be included. Include warrantee language for the grinding equipment and all related appurtenances.

2. Complete list of all items to be provided including Supplier and delivery schedule.

3. Specifications and product data required to demonstrate compliance with requirements which shall include complete parts listing showing materials of construction with applicable HI, ANSI, ASTM and other standards.

4. Certified dimension prints showing all details of fabrication, assembly, installation including anchorage details.

5. The weight of each major component and the total weight of the equipment.

6. A list of the manufacturer's recommended spare parts including gaskets, bearings, and seals.

7. Complete data on motors including complete performance characteristics.

8. Complete wiring diagrams and control schematics.

C. Shop Drawings

1. Shop drawings shall show layout and dimensions of equipment, major components, key alignment locations and locations of bolt holes. Drawings shall also indicate where access points for maintenance and operations are located on the equipment. Drawings shall show critical field dimensions identified by the Manufacturer and obtained by the Contractor. Shop drawings shall include electrical and control wiring diagrams for the equipment including motor wiring diagrams, control wiring diagrams, and grounding requirements.

2. Provide sufficient product data to verify compliance with the specifications and to illustrate the construction and assembly of the products. Include compliance of materials and components with applicable CEAM, ASTM, AGMA and other standards. List the manufacture, model and weights of major components. Include catalog cuts, illustrations, schedules, diagrams, performance charts, instructions and brochures illustrating size, physical appearance and other characteristics of materials, systems or equipment.

D. Certificates

1. Submit warranty statement.

E. Manufacturer's Instructions

1. Manufacturer's recommended shipping, unloading, storage, installation, testing, operation and maintenance procedures including a list of special tools and equipment required to maintain the units.

F. Source and Field Quality Control Submittals

G. Manufacturer's Field Reports

1. The manufacturer's field reports shall include all requirements of Division 01, General Requirements, including but not limited to written certification

of proper installation, initial adjustments, and satisfactory operations, dated and signed by a manufacturer's field representative.

H. Qualification Statements: Manufacturer's field representative.

I. Manufacturer's Field Reports: Startup reports.

J. Closeout and Maintenance Material Submittals per Division 01 General Requirements.

1.06 QUALITY ASSURANCE

A. The grinding unit required under this section shall be complete. All parts shall be so designed and proportioned as to have liberal strength, stability, and stiffness and to be especially adapted for the service to be performed.

B. Mechanical equipment, including drives and electric motors shall be supplied and installed in accordance with applicable OSHA Regulations. The noise level of motors, unless otherwise noted, shall not exceed 85 dBA measured 3 meters from the unit under free field conditions while operating on utility power.

1.07 DELIVERY, STORAGE AND HANDLING

A. Provide in accordance with Division 01 General Requirements and manufacturer instructions.

1.08 SITE CONDITIONS

A. In accordance with Division 01 General Requirements and as shown on the Drawings.

B. Pay particular attention to tight clearances in existing influent channel. Field verify dimensions and notify Engineer of any conflicts prior to placing order for equipment.

1.09 MAINTENANCE

A. Submit operation and maintenance data in accordance with Division 01, General Requirements. In addition to the requirements of Division 01, the manual shall include but is not limited to the following:

1. Startup, normal, shut down, and emergency operating instructions

2. Test data and performance curves

3. Installation instructions

4. A written warrantee statement

5. All required drawings, equipment lists, descriptions, etc., which are required to instruct operation and maintenance personnel unfamiliar with such equipment.

1.10 WARRANTY

A. Provide one-year warranty in accordance with Division 01 General Requirements.

PART 2 – PRODUCTS

2.01 GENERAL

A. Manufacturer: JWC Environmental, no substitution allowed.

B. The grinder shall be capable of handling solids, fibrous materials, heavy sludge, grit, trash, debris, and other matter typical to wastewater applications. The grinder shall reduce or shred influent solids for protection of downstream equipment. Grinder shall have a single motor and speed reducer to drive both the cutters and the screen drum.

C. Grinder shall be two shafted design consisting of individual cutters and spacers. The grinder shall have two rotating screen drums that shall collect solids too large to pass through the screen drum and direct them to the cutters for solids reduction.

D. All grinder materials and equipment shall be as specified and as shown on the Drawings. All grinding equipment shall be suitable for continuous or intermittent operation under the specified design conditions. Materials and equipment shall be new and unused, except for testing. Where two or more pieces of equipment performing the same function are required, they shall be duplicate products of the same Manufacturer. Under no circumstances, under the specified range of operation, shall the grinder(s) be subjected to factors including but not limited to: overheating, excessive vibration, and excessive strain.

E. There shall be no significant change in vibration and/or noise level over the entire specified range of operating conditions for each grinding system. The motor sizing shall provide a minimum of 25% reserve motor horsepower as evidenced by specific requirements at the maximum design conditions on a certified performance curve.

2.02 GRINDER

A. Design Criteria

OPEN CHANNEL GRINDER DESIGN CRITERIA	
Number of Grinders	One
Maximum Flow Capacity	4.4 mgd
Channel Width	3 Feet

OPEN CHANNEL GRINDER DESIGN CRITERIA	
Channel Depth (Frame Height)	4 Feet
Motor Horsepower (Maximum)	5 hp
Maximum Speed	1770 rpm
Total Weight – Removable Assembly	1620 lbs (Maximum)

B. Cutters & Spacers

1. Cutter shall be an individual disk constructed of ASTM 4130 alloy steel surface ground to thickness of .438-inches +.000/-.001 (11.1 mm +.000/-.003).

2. Cutters shall be heat treated to produce a hardness of 45-53 Rockwell C.

3. Cutters shall have seventeen (17) cam shaped teeth. Tooth height shall not be greater than 1/2-inch above the root diameter of the cutter. OD shall be 4.73-inches (120 mm).

4. Spacers shall be an individual disk constructed of ASTM 4130 alloy steel surface ground to a thickness of .446-inches +.001/-.000 (11.3mm +.003/-.000).

5. Spacers shall have a hardness of 34-53 Rockwell C.

6. Spacers shall have a smooth outside diameter with no tooth profiles.

C. Shafts

1. Shafts shall be constructed from AISI 4140 alloy steel with a minimum tensile strength of 170,000 PSI (1,172 kPA).

2. Shafts shall be measure a nominal 2-inches (51 mm) across flats of hex.

3. Shafts shall be hardened to 38-42 Rockwell C.

4. Intermediate Shaft Collars with Vertical Support Structure

5. Intermediate shaft collars shall be constructed of ASTM A743 stainless steel, AISI 17-4 stainless steel and SAE 660 bearing bronze.

6. Shaft collars shall be lubricated with high temperature marine grade grease at the factory.

7. Grease fittings on the shaft collars shall be provided for periodic maintenance.

8. Intermediate shaft collars shall provide radial support to the shafts during severe grinding demands.

9. Vertical support structure shall be constructed of stainless steel.

10. Vertical support structure shall have brackets to locate and secure intermediate shaft collars within the cutter stack.

11. Vertical support structure shall have a shape that coincides with the radial profile of the cutters to allow for a close interface.

12. Vertical support structure shall have adjustable brackets for mounting to the top and bottom end housings.

13. Intermediate shaft collars and vertical support structures shall only be supplied on cutter stacks of 32-inches (813mm) and taller.

D. Seal Cartridges

1. Seal cartridges shall be rated to a maximum of 90 PSI (620 kPA).

2. Seal cartridges shall not require flushing.

3. Dynamic and rotating seal faces shall be constructed of tungsten carbide with 6% nickel binder.

4. O-rings shall be constructed of Buna-N (Nitrile).

5. Radial and axial loads shall be borne by sealed, oversized, deep-groove ball bearings. Load Ratings and Fatigue Life for Ball Bearings shall be in accordance with ABMA 9.

E. Housing & Cover

1. End housings and top cover shall be constructed of ASTM A536-84 ductile iron.

2. End housings shall have integral bushing deflector to guide solids from seal cartridges.

3. Bottom cover shall be constructed of ASTM A-36 rolled steel.

F. Side Rails

1. Side rails shall be constructed of ASTM A536-84 ductile iron.

2. Drum side rail shall have a UHMW sealing strip for creating an adjustable interface between the side rail and the rotating drum.

3. Cutter side rail shall have evenly-spaced horizontal slots to increase flow and decrease water head loss through the grinder. Slots shall only be located on the upstream or influent side of the rail and the effluent side of the rail shall be void of slots to allow for unobstructed flow.

4. Inside profile of the cutter side rail shall be concave and follow the radial arc of the cutters.

5. Clearance between the outside diameter of cutters and concave arc of the cutter side rail shall not exceed 5/16-inch (7.9 mm).

6. Side rails shall have integral guide slot for installing into framework.

G. Perforated Steel Drum

1. Drum shall 10" nominal diameter and ½" perforation size.

2. Drum shall be of 304 stainless steel.

3. Nominal clearance between the drum and adjacent cutters shall not exceed 0.100" (2.54 mm).

H. Speed Reducer

1. Reducer shall be manufactured by Sumitomo Machinery Corporation of America or approved equal.

2. Reducer shall be internal planetary mechanism with trochoidal curved tooth profile.

3. Reducer shall be a vertically mounted with 29:1 single reduction.

4. Reducer shall be grease lubricated.

I. Motor

1. Motor shall be U.L. rated NEMA 6P, Class I, Div. I Groups C&D, Class II Div. II, Groups F&G, Class III Div. I

2. Motor shall be 480 volts, 3 phase, 60 Hz.

3. Rated for 7 consecutive days of submergence at a maximum depth of 30 feet (9 m).

4. Motor shall not utilize fan cooling at any time during operation.

5. Motor shall utilize ceramic shaft seal requiring no oil lubrication.

6. Motor shall have a minimum service factor of 1.15, 91% minimum efficiency factor at full load, minimum 76% power factor at full load.

J. Performance

1. Minimum peak shaft torque: 3,981 lb-in/hp (603 Nm/kW).

2. Minimum peak force at cutter tip: 1,717 lb_f/hp (10,240 N/ kW).

2.03 FRAME AND SUPPORTS

A. Frame and/or supports shall provide a method for properly securing the grinder in an open channel or wet well. The frame shall allow installation or removal without any disassembly of the frame or grinder.

B. Frame and/or supports shall be constructed of AISI 304 stainless steel.

C. Frame shall provide proper support and interface to prevent unwanted bypass.

D. Frame shall utilize guides that insert into the grinders side rail slots to properly position and locate the grinder.

2.04 CONTROLLER

A. General

1. Controller shall provide control of the grinder and house components as described below.

2. Enclosure shall be fiberglass reinforced polyester.

3. Enclosure and all face-mounted devices shall be NEMA 12.

B. Grinder On-Off/Reset-Remote Selector Switch:

1. Three-Position, 22mm.

2. In the OFF/RESET position, the grinder shall not run.

3. In the ON position, the grinder shall run continuously.

4. In the REMOTE position, the grinder shall start and stop as controlled by an external device.

5. Selector switch shall be the only method for resetting the controller after a failure.

C. Pilot Lights: LED, 22 mm, indicating POWER ON, RUN, and FAIL.

D. Programmable Logic Controller (PLC): Industrial PLC manufactured by Allen-Bradley or Engineer approved equal, minimum of 16K of memory.

E. Motor Starter: Full-voltage reversing type with 120 volt operating coil. Adjustable overload relays sized to full load amperes (FLA) of the motor.

F. Emergency Stop (E-STOP): Easily accessible on the front of the grinder. Coordinate with Drawings to ensure location is accessible. Rated for a class 1 division 1 environment per NFPA and NEC.

G. Control Transfer: Minimum 130 VA, primary and secondary shall be fused for over current protection.

H. Current Transducer: Veris Industries, adjustable set point from 1-135A with 200ms or less response time.

I. Performance

1. When a grinder jam condition occurs, the controller shall stop the grinder and reverse the grinder rotation to clear the obstruction. If the jam is cleared, the controller shall return the grinder to normal operation. If three (3) reverses occur within a 30 second interval, the controller shall stop the grinder motor and activate the grinder FAIL indicator and relay.

2. When a power failure occurs while the grinder is operating, the grinder will resume operation once power is restored.

3. When a power failure occurs while the grinder is in a fail condition, once power is restored the fail indicator shall reactivate and remain until reset.

4. Reset of the grinder and shall be accomplished from the controller only.

2.05 LIFTING BALE

A. Grinder shall be equipped with a 316 stainless steel lifting bale to attach cable/chain for removal from the tank/vessel.

2.06 HARDWARE

A. All Bolts, nuts, anchors, washers, appurtenances and related fastening hardware shall be type 316 stainless steel. Electro-polished or pacified to obtain maximum corrosion resistance. Bolts: ASTM F 593. Nuts: ASTM F 594 standards.

2.07 FINISHING

A. Factory coat all ferrous metal surfaces as follows. Factory surface preparation in accordance with SPCC SP-10. Factory prime and finish with a total of two coats of Tnemec Series 66HS (or Engineer approved equal), 6 to 8 mills thickness each coat.

B. Stainless steel, brass, bronze, galvanized, plastic, and copper components shall not be painted. All nameplates shall be properly protected during painting.

2.08 NAMEPLATES

A. 304 stainless steel, embossed data, secured to each major component including equipment and motor.

B. Equipment nameplate data: Manufacturer's name, address, type or style, model or serial number, catalog number, rated capacity, gear ratio, speed, and any other pertinent data.

C. Motor nameplate data: At least the minimum information required by NEMA MG 1 standards.

2.09 SPARE PARTS

A. Manufacturer to have an established exchange program for replacement of worn part of the grinder unit. Exchange program must have an established shipping center on the East Coast capable of next day arrival of replacement parts.

B. No special tools or spare parts are required.

2.10 OILS & LUBRICANTS

A. The Manufacturer shall state in the operating and maintenance manual the amount of and specification for any lubricants required. All lubricants for the grinder equipment shall be non-proprietary and easily obtainable from a local source for operations staff convenience. Designs which utilize proprietary and/or special lubricants shall not be acceptable.

2.11 MANUFACTURER'S FIELD SERVICES –

A. The manufacturer shall furnish a competent installation technician fluent in the English language who is knowledgeable and experienced with the installation and start-up procedures for equipment.

PART 3 – EXECUTION

3.01 FACTORY TESTING

A. Perform tests at Manufacturer's facility prior to shipment. Document and submit results to Engineer. Equipment shall pass all tests prior to shipment.

B. Test rotation, smooth operation without excessive noise or vibration, all manual and automatic controls.

3.02 INSTALLATION

A. Correct installation and assembly of the grinder and other equipment shall be the Contractor's responsibility. Install grinder and appurtenances in accordance with the Drawings and the Manufacturer's installation instruction manual.

B. Provide the required oil and grease for initial operation. The grades of oil and grease shall be in accordance with the Manufacturer's recommendations.

3.03 FIELD TESTING

A. Test, startup, and demonstrate performance in accordance with Division 01, Manufacturer procedures, and the following:

B. Provide all the requirements to conduct a proper field test which include but are not limited to: power, water (not wastewater), facilities, labor, materials, supplies and test instruments.

C. Provide necessary set points in writing prior to field test as outlined in the submittals.

D. Startup testing of the grinder shall be with water or in the dry. Provide all water for testing. Wastewater shall not be used for initial testing.

E. Test all grinder system components and control systems to determine if the installed equipment meets the purpose and intent of the specifications. Tests shall demonstrate that the equipment is not electrically, mechanically, structurally, or otherwise defective; is in safe and satisfactory operating condition; and conforms to the specified operating characteristics. Tests shall include checks for excessive vibration, leaks, correct operation of all manual and automatic control systems, proper alignment, excessive noise levels, and power consumption.

F. After successful startup test, grinder system shall be put into service and successfully operated on influent wastewater for a period of seven days before final acceptance of the equipment.

3.04 FIELD PAINTING

A. Touch-Up Painting: Prior to final acceptance, touch of paint in accordance with Section 09 90 00 PAINTING AND COATING.

B. Stainless steel, galvanized steel, and nonferrous surfaces shall not be painted

3.05 MANUFACTURER'S FIELD SERVICES

A. The on-site man days listed below are exclusive of travel time and do not relieve the Contractor of the obligation to provide sufficient service to place the equipment into satisfactory operation.

B. The manufacturer’s field representation shall supervise the installation, adjustment, and testing of the equipment. The manufacturer's field representative shall be present for a period of not less than 2 days, to inspect the installed equipment, supervise the initial test run, and to provide instruction to the plant personnel.

C. The manufacturer's field representative shall provide a signed and dated certification of proper installation and satisfactory operation to the Owner and Engineer.

D. The manufacturer's representative shall make all necessary adjustments and settings to the controls, in particular, verify the control set points for grinder as well as proper rotational direction.

3.06 FIELD TRAINING

A. A field training course shall be provided for designated operating and maintenance staff members. Training shall be provided in conjunction with the visit of the manufacturer’s field representative. The field training shall start after the system is functionally complete but prior to final acceptance tests. Field training shall cover all of the items contained in the operating and maintenance manuals, including normal operations, trouble-shooting, maintenance, lubrication, and other related work.

END OF SECTION

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SECTION 44 31 19

PACKAGED ODOR CONTROL SYSTEMS

PART 1 – GENERAL

1.01 DESCRIPTION OF WORK

A. The Contractor shall furnish all materials, equipment and incidentals required for activated carbon odor control equipment, appurtenances and coordinated systems as hereinafter specified. The Contractor shall also provide all related appurtenances, including but not limited to, motors, fans, valves, piping, wiring, attachments, control relays, foundations, anchors, supports, and all related accessories to provide a complete operational odor control system as specified herein and as shown on the Drawings. All appurtenances, accessory equipment, and auxiliaries for a complete odor control system shall be provided whether specifically mentioned or not.

1.02 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.

B. AIR MOVEMENT AND CONTROL ASSOCIATION INTERNATIONAL (AMCA)

C. AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

1. Laboratory Methods of Testing Fans for Aerodynamic Performance Rating

D. ASTM INTERNATIONAL (ASTM)

E. NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

F. THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)

1.03 SUBMITTALS

A. The following shall be submitted in accordance with Division 01 General Requirements. The submittals shall include but are not limited to the following in addition to Division 01 General Requirements.

B. Shop Drawings

1. Layout and dimensions of equipment: major components including blower, fan, motor, prefilter, and pressure gauges as specified. Indicate sample piping connection points and sizes including sample and drain. Indicate key alignment locations, locations of bolt holes, and access points for maintenance and operations.

2. Layout drawings shall show actual arrangement of all components within the available space as field-measured by the Contractor.

3. Electrical and control wiring diagrams for the equipment including motor wiring diagrams, and grounding requirements.

4. Demonstrate compliance with the Specifications and applicable standards including CEAM, ASTM, AGMA and other standards.

5. Vessel fabrication details and materials of construction.

6. Vessel design calculations shall be stamped by a professional engineer.

7. Shop drawing shall indicate total weight of all components as shipped and as installed.

C. Carbon Specifications

1. Furnish with 60 days after contract execution, a certificate from the carbon manufacturer certifying that the proposed activated carbon will meet the carbon media specifications.

D. Product Data

1. Performance data for carbon and vessel including capacity in CFM.

2. Fan motor data including size, hp, service factor, insulation rating, efficiency full load/locked rotor current, dimensions and power factor.

3. Descriptive data and technical literature, performance charts and curves, catalog cuts, and installation instructions for all components.

4. Warrantee language for the equipment and all related appurtenances.

5. List of all parts including materials of construction.

6. A list of at least twenty (20) installations of similar equipment, including contact names and phone numbers.

7. Shipping, storage, and installation instructions.

E. Manufacturer's Field Reports

1. Submit in accordance with Division 01 including written certification of proper installation, initial adjustments, and satisfactory operations, dated and signed by a Manufacturer's representative.

F. Operation and Maintenance Data

1. Submit in accordance with Division 01.

1.04 QUALIFICATIONS OF MANUFACTURER

A. Materials and equipment shall be the standard products of a Manufacturer regularly engaged in the production of such products and shall essentially duplicate items that have been in satisfactory use in identical applications in other wastewater pumping facilities. The Manufacturer shall have a minimum of ten (10) years of documented experience in the design and production of carbon odor control equipment for municipal wastewater applications, and not less than five (5) years of experience in the production of equal or larger sized models of the exact equipment as specified herein.

B. Manufacturer shall be CE and ISO 9001 certified. Provide proof of certification for review by the Engineer as part of the submittals.

1.05 DELIVERY, STORAGE AND HANDLING

A. In accordance with Division 01.

1.06 WARRANTY

A. Provide one-year warranty in accordance with Division 01 General Requirements.

PART 2 – PRODUCTS

2.01 GENERAL

A. The Contractor shall one self-contained, up-flow activated carbon odor control equipment and all related appurtenances as outlined in the Contract Documents. The system shall be specifically designed to treat odorous air from raw untreated municipal wastewater containing sewer gasses including but not limited to hydrogen sulfide, ammonia, amines, and mercaptains. The system shall be designed to achieve removal of odorous compounds from the feed air stream to the minimum levels as specified herein. The system shall include but is not limited to; a carbon absorption vessel, fan, in line pre-filter, carbon media, interconnecting ductwork, flexible connectors, fan outlet damper, differential pressure gauge, and discharge stack.

B. All components of the odor control equipment shall be designed for installation and continues, operation located indoors as shown on the Drawings.

C. All components of the odor control equipment shall be designed to handle corrosive gas and be rated for a Class 1 Division 1 environment.

D. Contractor shall field verify all dimensions and communicate them to the Manufacturer before ordering equipment.

E. Under no circumstances, under the specified range of operation, shall the system be subjected to factors including but not limited to: overheating, excessive vibration, and excessive strain.

2.02 PROCESS DESIGN CONDITIONS

A. The process air stream is odorous air from raw unscreened municipal wastewater.

B. All odor control equipment shall meet the following criteria:

ODOR CONTROL EQUIPMENT DESIGN CRITERIA	
Number of Units	One (1)
Location	Odor Control Room (Indoors)
Airflow	300 CFM
Inlet Hydrogen Sulfide	40 ppmv (Peak Instantaneous)
Inlet Hydrogen Sulfide	7 ppmv (Average)
Hydrogen Sulfide Removal	99% (Minimum)
Carbon Capacity	As specified below
Media Volume	3 ft. minimum bed depth
Fan Motor Power Rating	3 hp Maximum
Power Supply	480 Volts, 3 Phase, 60 Hertz
Motor Type	Constant Speed
Fan Pressure Losses	Manufacturer shall size fan to overcome all anticipated losses in their equipment and media plus suction losses from ductwork as shown in Drawings, plus -0.1 inch static head in room.
Inlet Air Connection	Provide flexible coupling and transition fitting to duct of size shown on drawing.
Discharge Stack	8-inch nominal diameter
Wash Water Connection	None.
Drain & Overflow Connections	2 inch NPT
Sample Port Connections	1-1/2 inch (Minimum)
Vessel Pressure Rating	As required to withstand maximum pressure of fan against completely plugged media.

ODOR CONTROL EQUIPMENT DESIGN CRITERIA	
Vessel Diameter	44.5 in. maximum
Skid Length & Width	No Skid. Components to be mounted directly to the floor.
Maximum Bearing Pressure	550 lb/ft^2 when flooded
Elastomers & Seals	Buna-N

2.03 CARBON VESSEL

A. The carbon adsorption vessel shall be constructed of UV resistant Fiber Reinforced Plastic (FRP) or polypropylene (PPL). The resin used shall be Dow 510, AOC K022, or approved equal suitable for continuous exposure to saturated water vapor, hydrogen sulfide gas, and their associated acidic products. A certificate from the resin manufacturer listing the nomenclature, composition, and characteristics of the resin shall be furnished with the vessel. The vessel shall not have any moving parts and shall be specifically designed to allow replacement of the internal carbon media without disassembly. The vessel shall be reusable. The vessel shall have a maximum diameter and height as previously specified and as shown on the Drawings. At a minimum, the carbon vessel shall be designed to contain the previously specified amount of carbon media. The vessel shall include a carbon bed support system consisting of FRP grating with a (PPL) carbon retaining ring. The vessel shall be designed such that odorous air enters though an air inlet in the vessel sidewall, is processed up through the carbon bed and exits through a center top outlet.

B. Connections: Inlet and Outlet shall be ANSI, standard 150 lb flange or nozzle, sizes previously specified. Provide all interconnecting piping, ductwork, fittings, between the fan, carbon vessel, and discharge stack as required and as shown on the Drawings.

C. Discharge Stack: Size as previously specified. Provide 316 stainless steel bird screen and rain cap or tee. Rain cap or tee shall be manufactured of the same material as the vessel.

D. Grounding rod: provided for the vessel if located outside. The grounding rod shall be manufactured of 316 stainless steel and shall be connected to an external grounding lug on the tank at shown on the Drawings.

E. Pressure differential gauge: Magnehelic or Engineer approved equal, indicating pressure loss in inches of water column across the carbon. Range: 0-10 inches of water. Tubing bonded to a solid acrylic plastic block that contains safety traps.

F. Vessel and all accessories shall be securely mounted to the concrete floor or pad as indicated on Drawings.

2.04 CARBON MEDIA

A. The activated carbon shall be a virgin, non-impregnated, re-agglomerated, granular, pelleted product. Direct activated, broken pellet and mixed media carbon shall not be acceptable. Sufficient activated carbon shall be provided to completely fill the reactor vessel. The activated carbon shall be virgin pelleted activated carbon, suitable for the vapor phase adsorption of sewage treatment odors at the concentrations previously specified. Caustic impregnation of the activated carbon shall not be permitted under any circumstances. The activated carbon shall have the following physical and chemical properties:

1. Iodine No., mg/g: 800 min
2. Butane Activity, weight %: 15.6 min
3. Ash, weight %:7 max
4. Moisture, weight % as packed: 4 max
5. Hardness No.: 95 min
6. Apparent Density, g/ml: 0.44 min
7. Mean Particle Diameter, mm: 3.6 min
8. Initial H2S Breakthrough Capacity, g H2S removed/cc Carbon[1]: 0.30 min
9. Ultimate H2S Breakthrough Capacity, g H2S removed/cc Carbon[2]: 0.69 min
10. Peroxide Number (by CCC TM-25)[3]: 19 max

B. The determination of H2S breakthrough capacity shall be made by passing a moist (85% R.H.) air stream containing 1% H2S at a rate of 1,450 cc/minute through a minimum one (1) inch diameter by nine (9) inch deep bed of uniformly packed activated carbon. The carbon shall be monitored to 50 ppm breakthrough. Results shall be expressed in grams H2S removed per cc of carbon. All testing shall be performed per ASTM Test Method D-6646 standards, without modification or addition. The Manufacturer shall submit certified test results of the activated carbon per ASTM D-6646 standards for review by the Engineer. Test results shall demonstrate the carbon to be provided meets and/or exceeds the minimum breakthrough capacity previously specified.

C. The carbon bed shall be designed to last a minimum of 1000 days at the average H2S load and flow previously specified. The Manufacturer shall include a written performance guarantee of carbon bed life for review and approval by the Engineer as outlined in the submittals.

D. Under no circumstances shall the carbon media produce a filtrate with an acidic (0-6) and/or basic (8-14) pH.

2.05 FAN

A. Provide a constant speed centrifugal fan designed to provide the air flows previously specified.

B. Construction: non-sparking, constructed of graphite-impregnated FRP. The fan shall have a 12-blade, backwardly inclined, non-overloading type wheel. Wheel shall be keyed to the shaft and shall be statically and dynamically balanced prior to delivery.

C. Bearing: heavy-duty, grease-lubricated, self-aligning, precision, anti-friction pillow-block bearings with a minimum average life of 40,000 hours.

D. Tested and rated according to AMCA 210-74 and ASHRAE 51-75 standards. Each fan shall be certified by the Air Movement and Control Association (AMCA) and shall be licensed to bear the AMCA seal.

E. Drive: V-belt drive with a minimum service factor of 1.15. Belts: minimum size "B", high-capacity type, provided in matched sets.

F. Base: 304L stainless steel base with OSHA approved 304L stainless steel belt guard and a PVC coupling drain.

2.06 FAN MOTOR

A. 480 volts, 3 phase, 60 hertz service. All motors shall be NEMA Premium Efficiency, NEMA B rating, minimum Class F insulation rating.

B. Electrical Hazard Area Classification: Class 1, Division 1, Groups C&D, and Explosion Proof).

C. Housing: ASTM A 48/A 48M, Class 30 cast iron.

D. Duty: continuous and/or intermittent duty, capable of handling a minimum of 15 equally spaced starts per hour.

E. Service factor: 1.15. The motor horsepower shall be selected such that the unit is non-overloading over the entire specified performance range. All motors shall conform to NEMA MG 1 standards.

2.07 EXPANSION JOINTS

A. Provide flexible boot type expansion joints on the inlet and discharge connections of the fan to prevent transmission of vibration from the fan to the inlet connecting piping.

B. Material: minimum of 1/8 inches thick EPDM or silicone rubber. 316 stainless steel clamps.

C. Provide all fittings/adaptors as required for connection of the odor control piping to the fan and inlet flexible connector.

2.10 FLOW CONTROL VALVE

A. Provide sealing butterfly valve for flow control during operation. PVC body and disk, stainless steel shaft, EPDM seat, and hand quadrant lever.

2.11 PRE-FILTER

A. Provide FRP prefilter to collect airflow, remove moisture / particulate and direct it into a fan.

B. Drain: 2" NPT at the base, with ball valve.

C. Legs: (2) 8" diameter, FRP. Length of legs shall be coordinated with the Contactor. Housing shall be supported by these legs independent of the connecting ductwork, anchored with stainless steel HILTI bolts.

D. Particle removal efficiency: 99% of particles 10 microns or larger.

2.12 CARBON SAMPLING AND MONITORING

A. Each odor control system shall include one (1) monitoring device containing media which changes colors to indicate breakthrough of organics and H2S, thus providing a visual indication of carbon degradation.

B. Each odor control system shall have three 2-inch diameter sample ports which extend into the carbon bed 1 foot minimum, suitable for extracting carbon samples. Provide one grain thief that is capable of extracting a core sample of the in-place carbon through the sample ports. Ports shall be adequate to provide suitable extraction of air samples from the carbon bed and be nonbinding. Each port nozzle shall extend outside the vessel wall and be blocked off with a 2-inch ball valve. One additional air sampling port shall be provided above the carbon bed.

2.13 HARDWARE

A. All Bolts, nuts, anchors, washers, appurtenances and related fastening hardware shall be type 316 stainless steel. All stainless steel components shall be electro-polished or pacified to obtain maximum corrosion resistance. All necessary hardware, attachments, and related appurtenances for installation of all equipment shall be furnished. All stainless steel bolts shall comply with ASTM F 593 standards. Stainless steel nuts shall comply with ASTM F 594 standards.

2.14 FINISHING

A. Factory coat all ferrous metal surfaces as follow. Factory surface preparation in accordance with SPCC SP-10. Factory prime and finish with a total of two coats of Tnemec Series 66HS (or Engineer approved equal), 6 to 8 mills thickness each coat.

B. Stainless steel, brass, bronze, galvanized, plastic, and copper components shall not be painted. All nameplates shall be properly protected during painting.

2.15 NAMEPLATES

A. 304 stainless steel, embossed data, secured to each major component including equipment and motor.

B. Equipment nameplate data: Manufacturer's name, address, type or style, model or serial number, catalog number, rated capacity, gear ratio, speed, and any other pertinent data.

C. Motor nameplate data: At least the minimum information required by NEMA MG 1 standards.

2.16 SPARE PARTS

A. The Manufacturer shall furnish a total of one (1) set of the following spare parts for each of the odor control systems specified in this section. At a minimum, a set of spare parts shall include the following:

1. One (1) set of fan V-Belts

2. One complete filter for use in the pre-filter unit.

B. The spare parts shall be individually boxed with the Project name and part number clearly identified on each individual box. All spare parts shall be shipped in a separate crate and clearly labeled. Spare parts shall be stored indoors by the Contractor in a temperature-controlled environment.

2.17 OILS AND LUBRICANTS

A. The Manufacturer shall state in the operating and maintenance manual the amount of and specification for any lubricants required. All lubricants for the equipment shall be non-proprietary and easily obtainable from a local source for operations staff convenience. Designs which utilize proprietary and/or special lubricants shall not be acceptable.

2.18 SPECIAL TOOLS

B. Furnish one set of all special tools required to completely assemble, disassemble, or maintain the odor control equipment.

2.19 DESIGN BASIS MANUFACTURER

A. The Drawings are based upon ECS Environmental Solutions V1-36-300. Modifications to piping, wiring, controls, other services, foundations and structures to accommodate other vendors, whether specifically named in this specification or not, shall be the responsibility of the Contractor with no additional cost to the Owner or extension to the Contract time permitted. Coordinate any such modifications with the Manufacturer and the Engineer.

B. All activated carbon odor control equipment of the same type, style, and duty shall be supplied by a single Manufacturer. All Manufacturers named or otherwise shall comply completely with the Contract Documents.

2.20 MANUFACTURER'S SERVICES

A. Services of a Manufacturer's representative who is experienced in the installation, adjustment, and operation of the equipment specified shall be provided. The Manufacturer shall submit qualifications of the representative for approval by the Engineer. The on-Site man days listed below are exclusive of travel time and do not relieve the obligation to provide sufficient service to place the equipment into satisfactory operation.

B. The service technician shall supervise the installation, adjustment, and testing of the equipment. The Manufacturer's service technician shall be present for a period of not less than two (2) days, to inspect the installed equipment, supervise the initial test run, and to provide instruction to the plant personnel.

C. The Manufacturer's representative shall provide a certification of proper installation and satisfactory operation to the Owner and Engineer. Certification shall be signed and dated by Manufacturer's representative.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Per Manufacturer instructions.

B. All appurtenances required for a complete and operating odor control system shall be provided, including but not limited to such items as piping, conduit, valves, wall sleeves, wall pipes, concrete foundations, anchors, grouting, pumps, drivers, power supply, and controls.

C. Installation shall include the Contractor furnishing the required oil and grease for initial operation. The grades of oil and grease shall be in accordance with the Manufacturer's recommendations.

3.02 STARTUP & TESTING

A. Per Division 01 General Requirements

B. If any deficiencies are revealed during any test, such deficiencies shall be corrected and the tests shall be re-conducted at no additional cost to the Owner.

3.03 FIELD PERFORMANCE DEMONSTRATION

A. Test odor control system under actual operating conditions in order to demonstrate that it meets the minimum performance criteria previously specified within the Manufacturer's Warranty Period. The Manufacturer shall submit a detailed field testing procedure to the Engineer for review prior to conducting any testing. The Manufacturer shall furnish all labor, technicians, instruments, equipment, and appurtenances as necessary for testing. All testing shall be coordinated at least two (2) weeks in advance with the Engineer and Owner.

B. Performance testing shall last for a minimum of six (6) consecutive hours. Engineer shall provide start time for test to coincide with high-odor time of day. Manufacturer shall test air samples taken from the inlet and outlet of the odor control system at one-hour intervals and analyze for hydrogen sulfide concentration using a portable, solid state analyzer. Analyzer shall have a current calibration certificate from a third party company specializing in instrument calibration. Manufacturer shall submit a written report of the testing and results to the Contractor, Engineer, and Owner. The Manufacturer shall modify or replace, at no additional cost to the Owner, any/all equipment that fails to meet the performance criteria previously specified.

3.04 FIELD TRAINING

A. A field training course shall be provided for designated operating and maintenance staff members. Training shall be provided in conjunction with the visit of the Manufacturer’s representative. The training shall start after the system is functionally complete but prior to final acceptance tests. Field training shall cover all of the items contained in the operating and maintenance manuals, including normal operations, trouble-shooting, maintenance, lubrication, and other related Work.

END OF SECTION

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