

Owner



Agent

Patrick M. Lewis, P.E.,  
Director of Engineering and Public Services

Project

## ***SOUTH CUSTER BOOSTER PUMP STATION EXPANSION***

Location:

South Custer Booster Station  
3561 South Custer Road, Monroe, MI 48161

Bid Due Date

**Monday, June 26, 2023 at 10:00 A.M.**

City Officials

Mayor: Robert E. Clark  
Council Member: Paula L. Whitman  
Council Member: Debra J. Staelgraeve  
Council Member: Kellie M. Vining  
Council Member: Michelle Germani  
Council Member: Brian Lamour  
Council Member: Andrew B. Felder

## TABLE OF CONTENTS

Advertisement for Bid

Division A	Instructions to Bidders.....	A-1 to A-6
Division B	Proposal.....	B-1 to B-10
Division C	Bonds and Forms.....	C-1 to C-11
Division D	General Conditions and Specifications.....	D-1 to D-38
Division E	General Material Specifications.....	E-1 to E-17
Division F	Sanitary & Storm Sewer Specifications.....	F-1 to F-28
Division G	Water Main Construction Specifications.....	G-1 to G-21
Division H	NOT A PART OF THIS CONTRACT.....	H-1 to H-29
Division I	NOT A PART OF THIS CONTRACT.....	I-1
Division J	Labor Standards.....	J-1
Division K	Supplemental Specifications.....	K-1 to K-3
Appendix	(See one page title sheet for contents)	

## ADVERTISEMENT FOR BIDS

Sealed proposals for the construction of:

### SOUTH CUSTER BOOSTER PUMP STATION EXPANSION

will be received, through electronic submission, to the Michigan Intergovernmental Trade Network (MITN) until 10:00 A.M., LOCAL TIME, Monday the 26th day of June, 2023. The bids will be publicly unlocked from the MITN web site with bid total and other pertinent information read aloud at 11:00 A.M. the same day via Zoom teleconference. Bidders desiring to attend this opening should email [edward.sell@monroemi.gov](mailto:edward.sell@monroemi.gov) no later than Wednesday, June 21, 2023 to obtain the meeting link. This project consists of expanding the capacity of the South Custer Booster Station. The Work includes, but is not limited to, temporary relocation and wiring of the existing generator, demolition, saw cutting and coring; exterior underground and interior plumbing / piping modifications and expansion; pump installation; building expansion consisting of concrete and masonry construction, roofing system, electrical additions and modifications including generator installation, coordination with the electrical utility; HVAC improvements; SCADA improvements including installation and commissioning of a SCADA panel; and other related work as specified for the capacity expansion of the South Custer Booster Station.

The Proposal and Contract Documents, including plans and specifications, may be obtained from the Michigan Intergovernmental Trade Network (MITN) / Bid Net Direct at <https://www.bidnetdirect.com/mitn>. **Contact person for questions on this contract is Patrick M. Lewis, P.E., Director of Engineering and Public Services at [patrick.lewis@monroemi.gov](mailto:patrick.lewis@monroemi.gov).** There will be an **OPTIONAL** pre-bid meeting beginning on Tuesday, June 13, 2023 at 2:00 P.M. in the First Floor Conference Room of Monroe City Hall, 120 East First Street, Monroe, MI 48161. Any questions on this contract / bid documents should be asked in writing (email) no later than Friday, June 16, 2023 at 4:30 P.M., to provide adequate time for preparation of an Addendum, if necessary. Should an addendum be necessary, this is intended for publication by the close of business on Wednesday, June 21, 2023. Bidders shall note that **Prevailing Wage** provisions apply to this contract, and are contained within Division J of the contract.

Bidders for any Construction Project whose bid is valued at greater than \$175,000 in total, and subcontractors of any tier that intend to perform work valued at over \$50,000.00 shall be determined to be a "Responsible Bidder" in accordance with the City's Purchasing and Contracts ordinance prior to award, and must submit a Responsible Bidder Prequalification Package with their bid. Details on the entirety of this process are contained in Division D of the contract, and required forms are included in the Appendix to the contract. For this contract, the 10-day advance requirement will be waived and information may be submitted any time prior to, or with, the bid submission. Should the prime bidder identify any trades / subcontracts where they have been unable to identify a potentially responsible bidder at the time of bid submission, this should be clearly noted on the bid form, so this may be evaluated for exception if possible.

The City of Monroe reserves the right to accept any proposal, to reject any proposal or to waive defects in proposals. A bid bond or certified check made payable to the City of Monroe in the amount of not less than five percent (5%) of the bid must be posted by each bidder with his / her bid. No bidder may withdraw his bid within SIXTY (60) days after the actual date of the opening thereof, but may withdraw it at any time prior to the scheduled closing time for receipts of bids.

ROBERT E. CLARK  
Mayor

MICHELLE J. LAVOY  
City Clerk-Treasurer

PATRICK M. LEWIS, P.E.  
City Engineer

# INDEX

## DIVISION A

### INSTRUCTIONS TO BIDDERS

<u>PARA.</u>	<u>DESCRIPTION</u>	<u>PAGE</u>
1.	Proposals	A-1
2.	Basis on Which Proposals are Solicited	A-1
3.	Obligation of Bidder	A-2
4.	Qualifications of Bidder	A-2
5.	Subcontracts	A-2,3
6.	Interpretation of Plans	A-3
7.	Preparation of Bid	A-3
8.	Unsolicited Alternates	A-4
9.	Laws and Regulations	A-4
10.	Bid Security	A-4
11.	Power of Attorney	A-4
12.	Awarding of Contract	A-4,5
13.	Obligation to Enter into Contract	A-5
14.	Performance Security	A-5
15.	Insurance	A-5
16.	Signing of Proposals	A-5
17.	Signing of Agreement	A-5,6
18.	Substitute Material and Equipment	A-6
19.	Truck & Oversize Load Regulations	A-6



**DIVISION A**  
**INSTRUCTION TO BIDDERS**

1. PROPOSALS:

Sealed proposal, on the forms attached hereto, for the construction of:

**SOUTH CUSTER BOOSTER PUMP STATION EXPANSION**

will be received, through electronic submission to the Michigan Intergovernmental Trade Network (MITN) until 10:00 A.M., LOCAL TIME, Monday the **26th** day of **June, 2023**. The bids will be publicly unlocked from the MITN web site with bid total and other pertinent information read aloud at 11:00 A.M. the same day via Zoom teleconference. Bidders desiring to attend this opening should email [edward.sell@monroemi.gov](mailto:edward.sell@monroemi.gov) no later than Wednesday, June 21, 2023 to obtain the meeting link.

The Proposal and Contract Documents, including plans and specifications, may be obtained from the Michigan Intergovernmental Trade Network (MITN) / Bid Net Direct at <https://www.bidnetdirect.com/mitn>. Proposals shall be submitted directly through MITN / Bid Net Direct, including, in their entirety, Division B (Proposal), Bid Bond or evidence of certified check, Bid Form and / or spreadsheet, Bidder Information Questionnaire, any addenda, and any other relevant attachments necessary to properly evaluate the bid.

Complete sets of Bidding Documents shall be used in preparing bids. The City does not assume any responsibility for errors or misinterpretations resulting from the use of incomplete sets of bids.

The City in making copies of Bidding Documents available on the above terms does so only for the purpose of obtaining bids on the work and does not confer a license or grant for any other use.

2. BASIS ON WHICH PROPOSALS ARE SOLICITED:

The unit prices when applied to the several construction quantities are to make up the total price for the entire work finished and complete in every particular, according to the Plans and Specifications appertaining to such work, or as modified by the City Engineer, within the specifications, to meet new conditions disclosed during the progress of the work. All extra work that may be required of the Contractor will be estimated and paid for under the provisions of the Contract which govern such work.

The plans attached and made a part of the Contract Documents are as prepared by **Jones & Henry Engineers Ltd. And PAC Engineering** Plans are entitled "**South Custer Booster Pump Station Expansion**" **(36 total pages of project drawings, plus 14 total pages of control panel drawings)**.

No Proposal shall be withdrawn for a period of **SIXTY (60)** days from the date of opening of bids thereof.

3. OBLIGATION OF BIDDER:

It is assumed that each bidder will inspect the site of the proposed work, will obtain first-hand information concerning any probable interference transporting, handling and storing construction equipment and materials. It is also assumed that each bidder will have read and be thoroughly familiar with the plans, specifications and Contract Documents.

On request, the City will provide each bidder access to the site to conduct such investigations and tests as each bidder deems necessary for submission of his bid.

The lands upon which the work is to be performed, right-of-ways for access thereto and other lands designated for use by the Contractor in performing the work are identified in the Supplemental Specifications, General Conditions or Drawings.

The submission of a bid will constitute an incontrovertible representation by the bidder that he has complied with every requirement of Section 3 and that the Contract Documents are sufficient in scope and detail to indicate and convey understanding of all terms and conditions for performance of the work.

Reference is made to the Supplemental Specifications for the identification of those reports of investigations and tests of subsurface and latent physical conditions at the site or otherwise affecting cost, progress or performance of the work which have been relied upon by the City Engineer in preparing the Drawings and Specifications. The City will make copies of such reports available to any bidder requesting them. These reports are not guaranteed as to accuracy or completeness, nor are they part of the Contract Documents. Before submitting his bid, each bidder will, at his own expense, make such additional investigations and tests as the bidder may deem necessary to determine his bid for performance of the work in accordance with the time, price and other terms and conditions of the Contract Documents.

4. QUALIFICATIONS OF BIDDER:

The City may make such investigations as it deems necessary to determine the construction capabilities and the financial resources of the bidder. The bidder shall furnish to the City all such information and data for this purpose as the City may request. The City reserves the right to reject any bid if the evidence submitted by, or investigation of, the bidder fails to satisfy the Owner that such bidder is properly qualified to carry out the obligations of the Contract and to complete the work contemplated therein. Bidder must provide necessary information to the Engineer to be qualified as a "responsible bidder" as defined by Division D of the contract, no later than ten (10) days prior to the opening of bids unless timeline is modified by the project advertisement.

5. SUBCONTRACTS:

The bidder is specifically advised that he must perform a majority of the contracted work and further that any person, firm, or other party to whom it is proposed to award

a subcontract under this Contract:

- a. Must be approved in writing by the City Engineer and be able to fulfill the qualification requirements of the bidder for that portion of the work to be performed, including qualification as a "responsible bidder" for subcontracts greater than \$50,000 in value.
- b. Must procure and maintain during the life of the subcontract, Subcontractor's Public Liability and Property Damage Insurance and Vehicle Liability Insurance of the type and in the amounts specified in the General Conditions.

Prior to the award of the Contract, the apparent successful bidder, and any other bidder so requested, will within seven days after the day of the bid opening submit to the City a list of all subcontractors and other persons and organizations (including those who are to furnish the principal items of material and equipment) to the City. Such list shall be accompanied by an experience statement with pertinent information as to similar projects and other evidence of qualification for each subcontractor, person and organization if requested by the City. If the City after due investigation has reasonable objection to any proposed subcontractor, other person or organization, it may before awarding the Contract request the apparent successful bidder to submit an acceptable substitute without an increase in bid price. If the apparent successful bidder declines to make any such substitution, the Contract shall not be awarded to such bidder, but his declining to make any such substitution will constitute grounds for sacrificing his bid security.

6. INTERPRETATION OF PLANS:

If any bidder is in doubt as to the true meaning of any part of the Plans, Specifications or other Contract Documents, he may submit to the City Engineer a written request for a clarification thereof; that the person submitting the request will be responsible for its prompt delivery, and that any interpretation of the Plans, Specifications or other Contract Documents will be made by Addendum, duly issued to each person receiving a set of documents. The City Engineer will not be responsible for any other explanations or interpretations of the proposed documents.

7. PREPARATION OF BID:

Each bid must be submitted on the prescribed form with all sections of the proposal completed. All blank spaces for bid prices must be filled in, in ink or typewritten, in both words and figures. Where a discrepancy exists between words and figures, the amount stated in words shall govern. For electronic submissions, either digital signatures or scanned versions of hand signatures are acceptable.

Any line item listed within a bid section which is omitted will be considered a part of other bid item amounts and incidental to the Contract. This is not meant to exclude a contractor from omitting an entire bid section or sections or from submitting an alternate bid when solicited by the City.

8. UNSOLICITED ALTERNATES:

No unsolicited alternates will be considered in awarding the Contract, and inclusion by the bidder of such alternates will be considered informal and the bid subject to rejection. Conditional bids will not be accepted.

9. LAWS AND REGULATIONS:

Bidders are notified that they should acquaint themselves with all applicable laws of the State of Michigan, and with the ordinances and regulations of the City of Monroe and of Monroe County where these authorities have jurisdiction over construction of the project. Such rules and regulations shall apply to the Contract throughout and will be deemed to be included in the Contract the same as though herein written out in full.

10. BID SECURITY:

Each bid must be accompanied by a certified check or bid bond in the amount of five percent (5%) of the total bid, payable to the City of Monroe, Michigan.

A single certified check or bid bond may serve to cover two or more alternate bids if submitted in an amount equal to five percent (5%) of the maximum alternate bid.

All bid deposits will be returned to bidders within ten days after execution of the Contract or, when all bids are rejected, within ten days after rejection.

11. POWER OF ATTORNEY:

Attorneys-in-fact who sign bid bonds or contract bonds must file with each bond a certified and effectively dated copy of their power of attorney.

12. AWARDING OF CONTRACT:

The Contract shall be awarded to the lowest qualified bidder based on the combination of unit prices and lump sum amounts as stated in the proposal. Where the City solicits bids by section, the right to award the Contract(s) by section to the low section bidder is reserved.

The City reserves the right to accept any proposal, to reject any or all proposals, and to waive any defect or irregularity in any proposal if it appears advantageous for the City to do so.

In particular, any alteration, erasure, interlineation, or omission in the Form of Contract or in the specifications which are attached hereto and made a part, specifically, of these instructions or of the Form of Proposal, shall render the accompanying proposal irregular and subject to rejection by the City. In case any explanations, additions or alterations are to be offered, they shall be indicated on separate sheets attached to

the proposal form and referred to therein. Proposals which are clearly unbalanced will be considered as irregular and will be subject to rejection by the City.

13. OBLIGATION TO ENTER INTO CONTRACT:

The successful bidder shall execute three conformed copies of the Contract and deliver required bonds to the Engineering Department of the City of Monroe within fifteen (15) days of receiving written notice of the acceptance of his bid and conditional award per the terms of Section 17 of the Instruction to Bidders. Failure or refusal by the Contractor to execute said Contract will result in his forfeiture to the City as liquidated damages, the security deposited with his bid.

14. PERFORMANCE SECURITY:

The Contractor shall furnish with the executed Contract two surety bonds on the forms attached hereto in Division C of this Contract. The surety on such bonds shall be a duly authorized surety company incorporated in the United States of America, acceptable to the City. One bond shall be executed to the City of Monroe for the faithful performance of the Contract and the protection of the City from all liens and damages arising out of the work; one bond shall be executed to the City of Monroe for the payment of all labor, materials, and supplies used in the work. The penal sum of each bond shall be equal to an amount not less than the total contract price.

15. INSURANCE:

Workmen's Compensation Insurance, Comprehensive General Liability Insurance, and Motor Vehicle Liability acceptable to the City must be carried by the Contractor, and/or his subcontractor, in the amounts specified in the General Conditions and Specifications (Division D).

16. SIGNING OF PROPOSALS:

If the bidder is a corporation, the legal name of the corporation shall be set forth together with the signature of the officers authorized to sign contracts on behalf of the corporation; if bidder is a co-partnership, the true name of the firm shall be set forth together with the signatures of all the partners; and if bidder is an individual, his signature shall be inscribed. If signature is by an agent, other than an officer of a corporation or a member of a partnership, a power of attorney must be on file with the City prior to opening bids or submitted with the bid; otherwise, the bid may be disregarded as irregular and unauthorized.

17. SIGNING OF AGREEMENT:

When the City gives a Notice of Award to the successful bidder, it will be accompanied by three unsigned counterparts of the Agreement and all other Contract Documents except the drawings. Within fifteen (15) days thereafter, the Contractor shall sign and deliver all three sets of documents to the City Engineer. Within ten (10) days thereafter the City Engineer will deliver one completely executed set of documents to the

Contractor, one set to the Clerk-Treasurer of the City of Monroe and retain one set. Thereafter, the Contract and all of the Contract Documents are binding on all parties.

18. SUBSTITUTE MATERIAL AND EQUIPMENT:

The Contract, if awarded, will be on the basis of material or equipment described in the drawings or specified in the Specifications without consideration of possible substitute of "or equal" items. Whenever it is indicated in the drawings or specified in the specifications that a substitute or "or equal" item of material or equipment may be furnished or used by the Contractor if acceptable to the City Engineer, application for such acceptance will not be considered by the City Engineer until after the "effective date of the Agreement".

19. TRUCK AND OVERSIZE LOAD REGULATIONS:

All contractors are advised that the City of Monroe has ordinances and regulations affecting operations of trucks and overweight loads on City Streets. All contractors shall be responsible to become aware of the specifics of the regulations.

Contractors and their suppliers are required to utilize the shortest route from designated truck routes to the job site to transport materials and equipment. The City Engineer may designate specific routes to be utilized. Other routes as well as overweight loads anywhere in the City will be subject to appropriate enforcement action and will be the responsibility of the contractor, owner, or operators of the equipment.

**I N D E X**  
**DIVISION B**  
**PROPOSAL**

<u>PARA.</u>	<u>DESCRIPTION</u>	<u>PAGE</u>
1.	Proposal	B-1
2.	Certified Check	B-1
3.	Time of Completion & Liquidated Damages	B-1,2
4.	Approximate Quantities & Unit Price	B-2
5.	Bid Units	B-2-1
6.	Bid Rejections	B-3
7.	Proposal Signatures	B-3,4
	Bid Bond	B-5
	Statement of Experience Bidder	B-6
	Affidavit of Non-Collusion	B-7
	Contract Signatures	B-8
	Affidavit of Responsible Bidder	B-9
	Subcontractor Listing	B-10

REVISED: February 1, 2022

DIVISION B  
PROPOSAL

FOR

**SOUTH CUSTER BOOSTER PUMP STATION EXPANSION**

Honorable Mayor and City Council  
City of Monroe  
Monroe, Michigan

Dear Mayor and Council:

1. The undersigned, having familiarized (themselves, herself, himself) with the local conditions affecting the cost of the work and with the Contract Documents including Advertisement for Bids, Instruction to Bidders, General Conditions and Specifications, Proposal, Contract, Bonds, Plans and Specifications, etc., hereby propose(s) to perform everything required and to provide and furnish all labor, materials, necessary tools, equipment and all utility and transportation services necessary to perform and complete in a workmanlike manner all of the work required for the

**SOUTH CUSTER BOOSTER PUMP STATION EXPANSION**

according to the Plans and Specifications.

2. CERTIFIED CHECK: Accompanying this proposal is a certified check or bid bond in the amount of five percent (5%) of the total bid, which amounts to \$\_\_\_\_\_, payable to the City of Monroe, Michigan, which it is agreed will be forfeited to said City of Monroe if the undersigned fails to enter into a contract in conformity with the Form of Contract incorporated herein, and furnish bonds and certificates of insurance as specified, within fifteen days after receiving written notice that the Contract is awarded to the undersigned.
3. TIME OF COMPLETION AND LIQUIDATED DAMAGES:
  - 3.1 Time of Completion: The Contractor shall commence work under this Contract on or before a date to be specified in a written "Notice to Proceed" of the City Engineer or his authorized representative and shall fully complete all work by **June 30, 2024**. However, as it is recognized that material / equipment lead times are highly uncertain, for each calendar day beyond March 31, 2024 that delivery of one or more major material / equipment items is delayed, this completion date will be extended by one additional calendar day, provided bidder makes timely order following contract award.
  - 3.2 Deductions for not completing on time: If the contract work is not fully completed according to the terms of the Contract within the time limit herein



stipulated, the Contractor shall pay the City, not as penalty, but as liquidated damages, a sum equal to TWO HUNDRED (\$200.00) dollars per calendar day for each day elapsing between expiration of such time limit and date of all completion; provided, however, that the time limit herein stated is subject to extension without payment of damages as provided in Division D. Where any deductions from or forfeiture of payment in connection with the work of the Contract are duly and properly declared or imposed against the Contractor, in accordance with the terms of this Contract, State Laws or ordinances of the City, the total amount thereof may be withheld from any money whatsoever due or to become due the Contractor under the Contract, and when deducted shall be deemed and taken as payment in such amount.

4. APPROXIMATE QUANTITIES AND UNIT PRICES:

The City shall pay the Contractor for all work included in and completed according to this Contract, the prices shown in the following schedule of quantities, but it is understood that the quantities indicated are only approximate and may not represent the actual amount of work to be performed.

5. BID UNITS:

The following is an example of how this section should be completed:

ITEM NO.	UNITS	NO. OF UNITS	ITEM DESCRIPTION WITH UNIT BID PRICE WRITTEN IN WORDS	UNIT PRICE FIGURES	AMOUNT
1.	LFT	200	12" DIA. REINFORCED CONCRETE C-76-IV STORM SEWER.		
			<u>ten</u> DOLLARS <u>no</u> CENTS	\$ <u>10.00</u>	\$ <u>2000.00</u>
2.	EACH	7	4 FT. DIA. MANHOLE.		
			<u>two hundred fifty-two</u> DOLLARS <u>ten</u> CENTS	\$ <u>252.10</u>	\$ <u>1764.70</u>
TOTAL BID					\$ <u>3764.70</u>

# SOUTH CUSTER BOOSTER PUMP STATION EXPANSION - BID FORM

Note: Provide Lump Sum for full scope of work as described on plans and in specifications.

Base Bid \$ \_\_\_\_\_

-----  
Bidder's Signature

-----  
Company Name (Please Print)

-----  
Bidder's Name (Please Print)

-----  
Company Street Address

-----  
Telephone Number Fax Number

-----  
City, State ZIP

-----  
Email Address

List of Subcontractors

-----  
Subcontractor

-----  
Subcontractor

-----  
Subcontractor

-----  
Subcontractor

-----  
Subcontractor

-----  
Subcontractor

6. In submitting this bid it is understood that the right is reserved by the City of Monroe, Michigan to reject any or all bids. It is agreed that this bid may not be withdrawn for SIXTY (60) DAYS from the opening of bids thereof. I/We hereby declare that

\_\_\_\_\_  
(Name and Address of Bidding Company)  
will execute a contract with the City of Monroe, Michigan according to the forms attached hereto and furnish the required bonds, all within fifteen (15) days after notification of award of Contract.

7. PROPOSAL SIGNATURES:

State of \_\_\_\_\_)

County of \_\_\_\_\_)

\_\_\_\_\_, being  
(Officers)

first duly sworn on oath deposes and says that the bidder on the above proposal is organized as indicated below and that all statements herein made are made on behalf of such bidder and that this deponent is authorized to make them.

\_\_\_\_\_  
(Officers)  
deposes and says that he has examined and carefully prepared his bid proposal from the Contract Drawings and Specifications and has checked the same in detail before submitting this Proposal or bid; that the statements contained herein are true and correct.

(Fill out Applicable Paragraph Below)

A. Corporation

The bidder is a corporation organized and existing under the laws of the State of \_\_\_\_\_, which operates under the legal name of \_\_\_\_\_, and the full name of its officers are as follows:

President \_\_\_\_\_

Vice President \_\_\_\_\_

Secretary \_\_\_\_\_

Treasurer \_\_\_\_\_

Other \_\_\_\_\_

and it does \_\_\_\_ have a corporate seal. The \_\_\_\_\_ (officer) is authorized to sign construction proposals and contracts for the company by action of its Board of Directors taken \_\_\_\_\_, a certified copy of which is hereto attached.

B. Co-Partnership

The Bidder is a co-partnership consisting of individual partners whose full names are as follows:

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C. Individual

The Bidder is an individual whose full name is \_\_\_\_\_, and if operating under a trade name, said trade is as follows:

---

---

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ALL BIDDERS COMPLETE THE FOLLOWING SECTION:

Date: \_\_\_\_\_, 20\_\_.

\_\_\_\_\_  
Title

(Sign Here)

By: \_\_\_\_\_

(Seal) If Corporation

Telephone No: \_\_\_\_\_

Subscribed and sworn to me this \_\_\_\_ day of \_\_\_\_\_, 20\_\_.

\_\_\_\_\_  
Notary Public

My Commission Expires: \_\_\_\_\_

BID BOND

(To be executed by Bidder and Surety before submitting bid, unless certified check is submitted.)

KNOW ALL MEN BY THESE PRESENTS:

That we, the undersigned \_\_\_\_\_  
(Name & Address of Contractor)

as principal (Bidder) and \_\_\_\_\_  
(Name & Address of Bonding Company)

\_\_\_\_\_ as surety are held and firmly bound unto the  
Owner, the City of Monroe, in the sum of \_\_\_\_\_

\_\_\_\_\_ Dollars (\$\_\_\_\_\_).

for the payment of which will and truly to be made, we hereby jointly and severally bind ourselves, our heirs, our successors and assigns, executors and administrators, jointly and severally, firmly by these presents.

THE CONDITION OF THIS OBLIGATION is such that if the attached Proposal for

\_\_\_\_\_ is accepted,

and the Contract awarded to the above Bidder for construction of all work entitled as

\_\_\_\_\_ and the said Bidder shall, within fifteen (15) days after notice of such award, enter into a contract in writing and give bond as required for the faithful performance of said Contract, then this obligation shall be null and void; otherwise it shall remain in full force and virtue in law.

Signed and sealed at

this \_\_\_\_\_ day of \_\_\_\_\_, A.D., 20 \_\_\_\_.

\_\_\_\_\_  
Principal

\_\_\_\_\_  
Surety

STATEMENT OF EXPERIENCE BIDDER

The bidder is requested to state below what work of similar magnitude and character he has done, and to give references that will enable the City to judge their experience, skill and business standing and his ability to conduct the work as completely and as rapidly as required under the terms of the Contract. This form should also be provided for all subcontractors whose work has a proposed value of greater than \$50,000.

<u>Project Location</u>	<u>Reference &amp; Telephone Number</u>
1. _____	_____
2. _____	_____
3. _____	_____
4. _____	_____
5. _____	_____
6. _____	_____
7. _____	_____
8. _____	_____
9. _____	_____
10. _____	_____

\_\_\_\_\_   
 Date

\_\_\_\_\_   
 Bidder

By \_\_\_\_\_

AFFIDAVIT OF NON-COLLUSION

State of \_\_\_\_\_ )  
\_\_\_\_\_ County)

\_\_\_\_\_ being duly sworn upon oath, deposes and says  
Bidder's Agent/Officer  
that \_\_\_\_\_ has filed a bid with the Clerk-Treasurer  
Bidding Company

of the City of Monroe, Michigan, this \_\_\_\_\_ day of \_\_\_\_\_, 20 \_\_\_\_ for the  
construction of \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_.

Affiant further says that in making such bid that neither he nor any company that he may represent nor anyone in behalf of him or company directly or indirectly has entered into any combination, collusion, undertaking or agreement with any other bidder or bidders in bidding on said Contract or work and further says that such bids are made without regards or references to any other bidder or bids and without any agreement, understanding or combination either directly or indirectly with any other person or persons with reference to such bidding in any way or manner whatsoever.

\_\_\_\_\_  
Agent/Officer's Signature

Subscribed and sworn to me this \_\_\_\_\_ day of \_\_\_\_\_, 20 \_\_\_\_.

Notary Public \_\_\_\_\_

My Commission Expires: \_\_\_\_\_

CITY OF MONROE, MICHIGAN  
C O N T R A C T

ARTICLES OF AGREEMENT, made and entered into this \_\_\_\_\_ day of \_\_\_\_\_, 20\_\_ by and between the City of Monroe, Monroe County, Michigan, a Michigan Municipal Corporation, Party of the First Part, and \_\_\_\_\_  
\_\_\_\_\_, party of the Second Part of the City of \_\_\_\_\_, County of \_\_\_\_\_, State of \_\_\_\_\_.

- a. That all proposals, specifications, plans, bonds, etc., hereto attached or herein referred to, shall be and are hereby made a part of this Agreement and Contract.
- b. That the Party of the Second Part, under penalty of the bonds attached, shall furnish all labor, materials, and appliances necessary, and do all the work asset forth in the proposal, and in accordance with the plans titled **South Custer Booster Pump Station Expansion** and in accordance with the specifications which have been made a part of this Contract, in a manner, time and place, all and singular, as therein set forth.

IN CONSIDERATION WHEREOF, said Party of the First Part, for it and its successors, promises and agrees to pay to said Party of the Second Part, the sum provided in the attached proposal, specifications, etc., namely for the work performed at the unit prices in Division B all in the time and manner therein provided.

For the faithful performances of all and singular of the stipulations, terms, and conditions of this agreement, said parties respectfully bind themselves, their successors, heirs, executors, administrators and assigns.

IN WITNESS WHEREOF, said parties have hereunto set their hands and seals, in duplicate, the day and year first above written.

CITY OF MONROE (Party of the First Part)

CITY OF MONROE WITNESS

\_\_\_\_\_  
Robert E. Clark, Mayor

\_\_\_\_\_  
City of Monroe Witness

\_\_\_\_\_  
Michelle J. LaVoy, Clerk-Treasurer

\_\_\_\_\_  
City of Monroe Witness

CONTRACTOR (Party of the Second Part)

CONTRACTOR WITNESS

\_\_\_\_\_  
Contractor Principal

\_\_\_\_\_  
Contractor Witness

\_\_\_\_\_  
Contractor Principal

\_\_\_\_\_  
Contractor Witness



AFFIDAVIT OF RESPONSIBLE BIDDER

Required only for those contracts greater than \$175,000 in overall value based on submitted bid. For applicable contracts, this form must be submitted by bidder and any proposed subcontractors intending to perform work valued at greater than \$50,000.

State of \_\_\_\_\_ )

\_\_\_\_\_ County)

\_\_\_\_\_ being duly sworn upon oath, deposes and says  
Bidder's Agent/Officer

that \_\_\_\_\_ has filed a bid with the Clerk-Treasurer  
Bidding Company

of the City of Monroe, Michigan, this \_\_\_\_\_ day of \_\_\_\_\_, 20 \_\_\_\_ for the contract entitled: \_\_\_\_\_.

Affiant further says that in making such bid that they recognize the City's acceptance and / or award of said bid is conditioned upon the determination that the bidder and any subcontractors intending to perform work valued at over \$50,000 are deemed to be a "Responsible Bidder" in accordance with the City's Purchasing and Contract ordinance, which requires submission of a Pre-Qualification packet to the Engineer no later than ten (10) days prior to the opening of bids, and the bidder and subcontractor(s) to receive a minimum score of 80 points. Affiant further acknowledges, under penalty of perjury, that the required Bidder Information Questionnaire provided with the bid is truthful and accurate to the best of their knowledge at the time submitted, and that if any information contained therein materially changes during the course of the contract, they shall promptly inform the Engineer of same.

\_\_\_\_\_  
Agent/Officer's Signature

Subscribed and sworn to me this \_\_\_\_\_ day of \_\_\_\_\_, 20\_\_\_\_.

Notary Public \_\_\_\_\_

My Commission Expires: \_\_\_\_\_

SUBCONTRACTOR LISTING

Required only for those contracts greater than \$175,000 in overall value based on submitted bid. For applicable contracts, this form must be submitted by bidder detailing proposed subcontractors intending to perform work valued at greater than \$50,000. Subcontractors listed below are in turn themselves required to be designated as Responsible Bidders by the City, and bidder shall submit Bidder Information Questionnaire on their behalf as a part of the bid. Attach additional sheets if necessary.

<u>Subcontractor Name</u>	<u>Proposed Work and Approximate Value</u>
1. _____	_____
2. _____	_____
3. _____	_____
4. _____	_____
5. _____	_____
6. _____	_____
7. _____	_____
8. _____	_____
9. _____	_____
10. _____	_____

\_\_\_\_\_

Date

\_\_\_\_\_

Bidder

By \_\_\_\_\_

I N D E X  
DIVISION C  
BONDS AND FORMS

<u>DESCRIPTION</u>	<u>PAGE</u>
Notice of Award	C-1
Performance Bond	C-2,3
Labor and Material Bond	C-4,5
Notice to Proceed	C-6
Change Order	C-7
Maintenance and Guarantee Bond	C-8,9
Contractor's Affidavit	C-10
Waiver of Lien	C-11

REVISED: 3/16/18

NOTICE OF AWARD

TO: \_\_\_\_\_ Dated \_\_\_\_\_, 20\_\_\_\_  
(Bidder)

PROJECT: \_\_\_\_\_

CONTRACT FOR: \_\_\_\_\_

You are notified that your Bid dated \_\_\_\_\_, 20\_\_\_\_ for the above Contract has been considered. You are the apparent successful bidder and have been awarded a contract for \_\_\_\_\_.

The Contract Price of your Contract is \_\_\_\_\_ Dollars (\$\_\_\_\_\_).

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

You must comply with the following conditions precedent within fifteen days of the date of this Notice of Award, that is by \_\_\_\_\_, 20\_\_\_\_.

1. You must deliver to the City Engineer three fully executed counterparts of the Agreement including all the Contract Documents. Each of the Contract Documents must bear your signature where indicated.
2. You must deliver with the executed Agreement the Contract Performance Bond and the Labor and Material Bond as specified in the Instructions to Bidders.

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 you comply with those conditions, OWNER will return to you one fully signed counterpart of the Agreement with the Contract Documents attached.

\_\_\_\_\_  
CITY OF MONROE  
(Owner)

BY: \_\_\_\_\_  
(Authorized signature)

\_\_\_\_\_  
(Title)

PERFORMANCE BOND

KNOW ALL MEN BY THESE PRESENTS, that \_\_\_\_\_

Name & Address of Contractor

\_\_\_\_\_, Contractor, as Principal, and

\_\_\_\_\_, as Surety,

Name & Address of Bonding Company

are held and firmly bound unto the CITY OF MONROE, a Michigan Municipal Corporation,  
hereinafter called the Owner, in the penal sum of

\_\_\_\_\_ Dollars

(\$\_\_\_\_\_), good and lawful money of the United States of America, to be paid to said Owner, its legal representatives and assigns, for which payment well and truly to be made, we bind ourselves, our heirs, executors, administrators, successors and assigns, and each and every one of them jointly and severally, firmly by these presents.

WHEREAS, the above named Principal has entered into a certain written Contract with the Owner, dated the \_\_\_\_\_ day of \_\_\_\_\_ A.D. 20\_\_\_\_, for construction of work entitled \_\_\_\_\_

\_\_\_\_\_ (hereinafter called the Contract) which

Contract and Specifications for said work shall be deemed a part hereof fully

as is set out herein.

NOW THEREFORE, if the said Principal shall save and hold harmless the said Owner from all public liability and damages of every description in connection therewith, shall well and faithfully in all things fulfill the said Contract according to all the conditions and stipulations therein contained in all respects, and shall save and hold harmless the said Owner from and against all liens and claims of every description in connection therewith, then this obligation shall be void and of no effect; but otherwise it shall remain in full force and virtue, and said Surety, for value received, hereby stipulates and agrees that no change, extension of time, alterations or addition to the terms of the Contract or to the work to be performed thereunder or to the Specifications accompanying the same shall in any way affect its obligations 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.

WITNESS our hands and seals this \_\_\_\_\_ day of \_\_\_\_\_ A.D.,

20\_\_\_\_.

WITNESSES:

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_  
Principal (CONTRACTOR) (Seal)

\_\_\_\_\_  
Surety (BONDING COMPANY) (Seal)

I hereby approve the form and correctness of the foregoing Bond.

\_\_\_\_\_  
Owner's Legal Officer

Date: \_\_\_\_\_

LABOR AND MATERIAL BOND

KNOW ALL MEN BY THESE PRESENTS, that we \_\_\_\_\_  
(Contractor)

of \_\_\_\_\_  
(Address)

hereinafter called the Principal and \_\_\_\_\_  
Name & Address of Bonding Co.

\_\_\_\_\_ hereinafter called the Surety, are held and firmly bound

unto the City of Monroe in the sum of \_\_\_\_\_  
\_\_\_\_\_ Dollars (\$\_\_\_\_\_),  
to the payment whereof, well and truly to be made, we bind ourselves, our heirs, executors,  
administrators, successors, and assigns, jointly and severally, firmly by these presents.

Sealed with our seals, and dated this \_\_\_\_ day of \_\_\_\_\_ A.D., 20\_\_.

WHEREAS, the above named Principal has entered into a certain Contract  
with the CITY OF MONROE, A Michigan Municipal Corporation, hereinafter  
called the Owner, dated the \_\_\_\_\_ day of \_\_\_\_\_, 20\_\_,  
(hereinafter called the Contract) for construction of work entitled \_\_\_\_\_

\_\_\_\_\_ which Contract and Specifications for said work shall be deemed a part hereof as fully as if set out herein.

AND WHEREAS, this Bond is given in compliance with and subject to all the provisions and conditions of Act. No. 213 of Public Acts of Michigan, for the year 1963, as amended.

NOW, THEREFORE, THE CONDITION OF THIS OBLIGATION IS SUCH that if the above named Principal, legal representatives, or successors shall pay or cause to be paid to all subcontractors, persons, firms and corporations, as the same may become due and payable all indebtedness which may arise from said Principal to a subcontractor or party performing labor or furnishing materials, or any subcontractor to any person, firm, or corporation on account of any labor performed or materials furnished in connection with the contract, construction, and work herein referred to, then this obligation shall be void; otherwise to remain in full force and effect.

AND PROVIDED, that any changes, alterations, or modifications in the terms of said Contract, or in the work to be done under it, or the giving by the Owner of any extension of time for the performance of said Contract, or any other forbearance on the part of either party to the other, or the placing of an inspector or superintendent on the work by the Owner shall not in any way release the Principal and the Surety of either of them, their heirs, exe-

cutors, administrators, successors or assigns from any liability hereunder, notice to the Surety of any such alterations, extensions of time or any forbearance being hereby waived.

IN WITNESS THEREOF, the parties hereto have caused this instrument to be executed by their respective authorized officers this \_ day of \_\_\_\_\_  
\_\_\_\_\_ A.D., 20\_\_\_\_.

\_\_\_\_\_  
Principal (CONTRACTOR) (Seal)

\_\_\_\_\_  
Surety (BONDING COMPANY) (Seal)

Signed, Sealed and Delivered  
in the Presence of:

I hereby approve the form and correctness of the foregoing bond.

Owner's Legal Officer

Attest:

Bond and Surety Approved:

\_\_\_\_\_  
Title



NOTICE TO PROCEED

Dated \_\_\_\_\_, 20

TO: \_\_\_\_\_  
Contractor

PROJECT: \_\_\_\_\_

CONTRACT FOR: \_\_\_\_\_

\_\_\_\_\_

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 the work and your other obligations under the Contract Documents. The date of Final Completion as set forth in the Agreement is \_\_\_\_\_, 20\_\_.

Before you may start any work at the site, you must deliver to the City a certificate of insurance in accordance with the Contract Documents.

\_\_\_\_\_  
Owner

BY: \_\_\_\_\_

\_\_\_\_\_  
Title

# CHANGE ORDER

Date:	No.:
Project:	
Contractor:	
Contract for:	Contract Date:

TO: \_\_\_\_\_  
(Contractor)

You are directed to make the changes noted below in the subject Contract:

CITY OF MONROE \_\_\_\_\_ By \_\_\_\_\_ Owner

Nature of Changes:

These changes result in the following adjustment of Contract Price & Contract Time:

Contract price prior to this change order	\$
Net (increase)(decrease) resulting from this change order	\$
Current contract price including this change order	\$
Contract time prior to this change order	Days or Date:
Net (increase)(decrease) resulting from this change order	Days:
Current contract time including this change order	Days or Date:

Above Changes are Approved:

Above Changes are Accepted:

\_\_\_\_\_  
 City Engineer

\_\_\_\_\_  
 Contractor

By: \_\_\_\_\_

By: \_\_\_\_\_

Date \_\_\_\_\_, 20\_\_\_\_

Date \_\_\_\_\_, 20\_\_\_\_

MAINTENANCE AND GUARANTEE BOND

KNOW ALL MEN BY THESE PRESENTS, that \_\_\_\_\_  
Contractors Name & Address

\_\_\_\_\_, Contractor, as Principal, and  
\_\_\_\_\_  
Name & Address of Bonding Company

firmly bound unto the CITY OF MONROE, a Michigan Municipal Corporation, hereinafter called the Owner, in the sum of \_\_\_\_\_ Dollars (\$\_\_\_\_\_) good and lawful money of the United States of America, to be paid to said Owner, its legal representatives and assigns, for which payment well and truly to be made, we bind ourselves, our heirs, executors, administrators, successors and assigns, and each and every one of them jointly and severally, firmly be these presents.

WHEREAS, the above named Principal has entered into a certain written Contract with the Owner, dated the \_\_\_\_ day of \_\_\_\_\_ A.D., 20\_\_, for construction of work \_\_\_\_\_ entitled (hereinafter called the Contract) which Contract and Specifications for said work shall be deemed a part hereof as fully as if set out herein.

NOW, THEREFORE, THE CONDITIONS OF THIS OBLIGATION ARE SUCH, that by and under said Contract, the above named Principal has agreed with the Owner that for a period of one year from the date of payment of Final Estimate, to keep in good order and repair any defect in all the work done under said Contract either by the Principal or his subcontractor, or his material suppliers, that may develop during said period due to improper materials, defective equipment, workmanship or arrangements, and any other work affected in making good such imperfections, shall also be made good all without expense to the Owner, excepting only such part or parts of said work as may have been disturbed without the consent or approval of the Principal after the final acceptance of the work, and that whenever directed to do so by the Owner by notice served in writing, either personally or by mail, \_\_\_\_\_ on \_\_\_\_\_ the \_\_\_\_\_ Principal \_\_\_\_\_ at

\_\_\_\_\_  
Name & Address  
\_\_\_\_\_  
OR  
\_\_\_\_\_  
legal  
representatives, or successors, or \_\_\_\_\_ on the Surety at  
\_\_\_\_\_  
Name & Address

WILL PROCEED at once to make such repairs as directed by said Owner; and in case of failure

to do so within one week from the date of service of such notice, or within reasonable time not less than one week, as shall be fixed in said notice, then the Owner shall have the right to purchase such materials and employ such labor and equipment as may be necessary for the purpose, and to undertake, do and make such repairs, and charge the expense thereof to, and receive same from said Principal or Surety. If any repair is necessary to be made at once to protect life and property, then and in that case, the Owner may take immediate steps to repair or barricade such defects without notice to the Contractor. In such accounting, the Owner shall not be held to obtain the lowest figures for the doing of the work, or any part thereof, but all sums actually paid therefor shall be charged to the Principal or Surety. In this connection the judgment of the Owner is final and conclusive. If the said Principal for a period of one (1) year from the date of payment of Final Estimate, shall keep said work so constructed under said Contract in good order and repair, excepting only such part or parts of said work which may have been disturbed without the consent or approval of said Principal after the final acceptance of the same, and shall whenever notice is given as hereinbefore specified, at once proceed to make repair as in said notice directed, or shall reimburse said Owner for any expense incurred by making such repairs, should the Principal or Surety fail to do as hereinbefore specified, and shall fully indemnify, defend and save harmless the Owner from all suits and actions for damages of every name and description brought or claimed against it for or on account of any injury or damage to person or property received or sustained by any party or parties, by or from any of the acts or omissions or through the negligence of said Principal, servants, agents, or employees, in the prosecution of the work included in said Contract, then the above obligation shall be void, otherwise to remain in full force and effect.

IN WITNESS WHEREOF, the parties hereto have caused this instrument to be executed by their respective authorized officers this \_\_\_\_\_ day of \_\_\_\_\_ A.D., 20\_\_.

\_\_\_\_\_  
(Seal)  
Principal (CONTRACTOR)

\_\_\_\_\_  
(Seal)  
Surety (BONDING COMPANY)

Signed, Sealed and Delivered  
in the Presence of:

I hereby approve the form and correctness of the foregoing bond.

\_\_\_\_\_  
Owner's Legal Officer



WAIVER OF LIEN

---

FOR A VALUABLE CONSIDERATION, paid to the undersigned, the receipt whereof is hereby confessed and acknowledged, the undersigned hereby waive, release and relinquish any and all claims or right of lien which the undersigned now have or may have hereafter upon the premises known and described as \_\_\_\_\_  
\_\_\_\_\_ for (material)(labor), give description,  
\_\_\_\_\_ to  
\_\_\_\_\_ for the construction,  
of \_\_\_\_\_ on the premises described, same  
being owned by \_\_\_\_\_.

The following is for information purposes only:

Total amount of material: \_\_\_\_\_

SIGNED, SEALED AND DELIVERED this \_\_\_\_ day of \_\_\_\_\_ A.D. 20\_\_.

------(L.S.)

BY: \_\_\_\_\_  
(Title)

**DIVISION D**  
**GENERAL CONDITIONS & SPECIFICATIONS**

<u>PARA.</u>	<u>DESCRIPTION</u>	<u>PAGE</u>
1.	Definition and Terms	D-1-4
2.	Intent of Plans & Specifications	D-4,5
3.	Contract	D-5
4.	Contractor's Responsibility for the Work	D-5,6
5.	Protection of Persons and Property	D-6,7
6.	Use of Explosives	D-7
7.	Liability of Contractor and Indemnification	D-8
8.	Insurance Requirements	D-8-11
9.	Assignment of Contract	D-12
10.	Laws and Regulations	D-12,13
11.	Patented Devices, Materials and Processes	D-13
12.	The Engineer	D-13
13.	Authority	D-13,14
14.	Employment of Labor	D-14
15.	Working Conditions	D-14,15
16.	Progress of the Work	D-15,16
17.	Cooperation of Contractor	D-16,17
18.	Work Included	D-17
19.	Order of Completion	D-17
20.	Changes	D-17,18
21.	Extra Work	D-18,19
22.	Work Adjacent to Railways	D-19
23.	Preservation & Restoration of Property, Trees, Monuments, Etc.	D-20
24.	Public Service Structures	D-20,21
25.	Utilities	D-21,22
26.	Rights of Various Interests	D-22
27.	Report of Error & Discrepancies	D-22
28.	Salvaged Materials or Second-Hand Materials	D-22
29.	Inspection and Rejection of Work	D-22-25
30.	Interpretation	D-25
31.	Suspension of Work	D-25,26
32.	Clean-up Work	D-26
33.	Time of Completion	D-26
34.	Time of Completion and Liquidated Damages	D-27
35.	Injunctions	D-27
36.	Forfeiture of Contract	D-27,28
37.	Waiver of Contract	D-28
38.	Payment to Contractor	D-28-30
39.	Coordination of Specifications and Plans	D-30,31
40.	Gratuities; Sanctions	D-31
41.	Additional Safety Requirements	D-31
42.	Confined Space Entry	D-31
43.	Responsible Bidder Certification Requirements	D-31-38

DIVISION D  
GENERAL CONDITIONS & SPECIFICATIONS

1. DEFINITION AND TERMS:

1.1 Abbreviations:

AASHTO: American Association of State Highway and Transportation  
Officials  
ASTM: American Society for Testing and Materials  
AWWA: American Water Works Association  
AISC: American Institute of Steel Construction  
CRSI: Concrete Reinforcing Steel Institute  
ANSI: American National Standards Institute, Inc. (ASA)  
MDOT: Michigan Department of Transportation

1.2 Addendum: Written or graphic instruments issued prior to the opening of bids which clarify, correct or change the bidding documents or the contract documents.

1.3 Advertisement: The public announcement, as required by law, inviting bids for work to be performed or materials to be furnished.

1.4 Attorney: The City Attorney of the City of Monroe.

1.5 Award: The written acceptance of the proposal by the City of Monroe.

1.6 Bid Bond: The security furnished with a bid to guarantee that the bidder will enter into Contract if his bid is accepted.

1.7 Bidder: The individual, partnership or corporation, or combination thereof, formally submitting a proposal for the work contemplated, acting directly or through an authorized representative.

1.8 Calendar Day: Every day shown on the calendar beginning and ending at midnight.

1.9 Change Order: A written order to the contractor signed by the City Engineer authorizing an addition, deletion or revision in the work, or an adjustment in the contract price or the contract time issued after the effective date of the contract.

1.10 City: City of Monroe.

1.11 Clerk: City Clerk of the City of Monroe.

1.12 Contract: Written agreement between the City and the Contractor setting forth the obligations of the parties thereunder. The Contract includes Advertisement for Bids, Instructions to Bidders, Proposal, General Conditions and Specifications, Bonds and Forms, General Material Specifications, Addendum, Detailed Specifications as applicable, Drawings, Supplemental



Specifications and Contract Forms.

- 1.13 Contractor: The individual, partnership or corporation, or any combination thereof undertaking the execution of the work under the terms of the Contract and acting directly or through agents or employees.
- 1.14 Contract Item (Pay Item): A specifically described item of work for which a unit price is provided in the contract.
- 1.15 Contract Time: The number of days or the date stated in the Agreement for the completion of the work.
- 1.16 Contract Unit Price: The price provided in the contract for a specifically described item of work.
- 1.17 Department: The Engineering Department of the City of Monroe.
- 1.18 Engineer: The City Engineer of the City of Monroe.
- 1.19 Estimate:
  - a. Final Estimate: A compilation of final quantities showing work performed, upon which basis final payment is made.
  - b. Progress Estimate: An estimate made monthly as the work progresses showing estimated work performed and materials furnished and upon which monthly payment is made.
- 1.20 Extension of Time: The additional contract time authorized by the Department beyond the original calendar date, or number of working days, specified in the contract.
- 1.21 Extra Work: An item of work not provided for in the Contract as awarded but found essential to the satisfactory completion of the Contract within its intended scope.
- 1.22 Inspector: The authorized representative of the Engineer, assigned to make detailed inspections of contract performance.
- 1.23 Labor and Material Bond: The security furnished by the contractor and his surety to guarantee payment of debts covered by the bond.
- 1.24 Notice of Award: The written notice by the City to the apparent successful bidder stating that upon compliance by the apparent successful bidder with conditions precedent enumerated therein, within the time specified, the City will sign and deliver the Contract.
- 1.25 Notice to Proceed: Written notice to the Contractor to proceed with the Contract work including, when applicable, the date of beginning of Contract time.

- 1.26 Performance Bond: The securities furnished by the Contractor and his surety to guarantee performance of the work in accordance with the Contract and to guarantee payment of all debts incurred by the Contractor in performing the Contract.
- 1.27 Plans: The approved plans, profile, typical cross sections, applicable standard plans, working drawings, and supplemental drawings, or exact reproductions thereof, which show the location, character, dimensions, and details of the work to be done.
- 1.28 Project Engineer: The staff engineer designated by the City Engineer who is responsible for engineering supervision of the construction.
- 1.29 Responsible Bidder: A bidder Responsible Bidder: A bidder that has satisfied the pre-qualifying criteria; designated in the bid and as provided in the City's Purchasing and Contracts Ordinance, Section 114-13 of the Codified Ordinances of the City of Monroe, as amended. All bidders engaged in contracts covered by this ordinance shall be qualified, responsible contractors or subcontractors that have sufficient capabilities in all respects to successfully perform contracts on which they are engaged, including the necessary experience, equipment, technical skills and qualifications and organizational, financial and personnel resources. Bidders bidding on Construction Contracts shall also be required to have a satisfactory past performance record and a satisfactory record of law compliance, integrity and business ethics
- 1.30 Specifications: Those portions of the contract documents consisting of written, technical description of materials, equipment, construction systems, standards and workmanship as applied to the work and certain administrative details applicable thereto.
- a. Standard Specifications: Those specifications which apply generally to all City projects of a specific nature.
- b. Supplemental Specifications: Those specifications which apply only to a specific project.
- 1.31 Standard Plans: Those plans which contain standard details, of contract items and materials which are in general use in the City.
- 1.32 Subcontractor: The individual, partnership or corporation, or a combination thereof, undertaking the execution of a part of the work under the terms of the Contract, by virtue of an agreement with Contractor approved by the Engineer.
- 1.33 Surety: The legal entity incorporated in the United States of America and licensed to operate in the State of Michigan, which is bound with and for the Contractor for the performance of the contract and for the payment of all

lawful indebtedness pertaining thereto.

1.34 Work: Work shall mean the furnishing of all labor, materials, equipment, and other incidentals necessary or convenient to the successful completion of the project and carrying out of all the duties and obligations imposed by the contract.

2. INTENT OF PLANS AND SPECIFICATIONS: General and detailed drawings showing the scope of the work are hereby made a part of these specifications, it being mutually understood and agreed that when taken together, plans and specifications shall be cooperative and shall provide for a complete and finished piece of work. Should any work or material be required which is necessary for the proper carrying out of the intent thereof, the Contractor shall perform such work and furnish such material as fully as if they were completely described.

2.1 The work shall be executed in strict compliance with the Plans and Specifications, and the Contractor shall do no work without proper drawings and instructions. Unless otherwise noted, all work is to be inspected by the Engineer and/or his representative.

2.2 Unless otherwise provided in the Contract Documents, the Engineer will furnish the Contractor free of charge, all copies of the Plans and Specifications reasonably necessary to carry out the work.

2.3 The Contractor will keep one record copy of all Specifications, Drawings, Addenda, Modifications, and Shop Drawings at the site in good order and annotated to show all changes made during the construction process.

2.4 Figured dimensions and elevations on the Plans are intended to be correct, but shall be checked by the Contractor before starting construction. Any errors, omissions or discrepancies shall be brought to the attention of the Engineer and his decision thereon shall be final. All notes on the Plans shall be followed.

2.5 Where underground and surface structures are shown on the Plans, the locations, depth, and dimension of such structures are believed to be reasonably correct, but are not guaranteed. Such structures are shown for the information of the Contractor, but information so given is not to be construed as a representation that such structures will in all cases be bound or encountered just where shown, or that they represent all the structures which may be encountered.

2.6 The approved Plans will be supplemented by such standard and working drawings as are necessary to control the work. It is mutually agreed that all authorized alterations affecting the requirements and information given on the approved Plans shall be in writing. No changes shall be made on any plan or

drawing after the same has been approved by the Engineer except by direction of the Engineer, in writing.

Working drawings for any structure shall consist of such detailed plans as may be required for the prosecution of the work and which are not included in the Plans furnished by the Engineer. They shall include shop details, erection plans, masonry layout, diagrams, equipment details and bending diagrams for reinforcing steel, which must be approved by the Engineer before any work involving these plans shall be performed.

It is expressly understood, however, that approval by the Engineer of the Contractor's working drawing does not relieve the Contractor of any responsibility for accuracy of dimensions and details, or of mutual agreement of dimensions and details. It is mutually agreed that the Contractor shall be responsible for agreement and conformity of his working drawings with the approved Plans and Specifications.

3. CONTRACT:

3.1 A copy of these specifications and the accompanying Proposal shall be attached to the Contract and made a part thereof.

3.2 No Other Interested Parties: The Contractor declares that only persons interested in this contract as principals are therein named as such; that no official of the municipality is directly or indirectly interested in this bid, or in any Contract which may be made under it, or in any expected emolument of profit to arise therefrom; that his bid and his Contract are made in good faith, without fraud, collusion or connection with any other person bidding for the same work.

3.3 Penalty For Collusion: If at any time it shall be found that the person, firm, or corporation to whom the Contract has been awarded has, in presenting any bid or bids, colluded with any other party or parties, then the Contract so awarded shall be null and void, and the Contractor and his sureties shall be liable to the Owner for all loss or damage which the Owner may suffer thereby and the Owner may advertise anew for bids for said work.

4. CONTRACTORS RESPONSIBILITY FOR THE WORK:

4.1 Except as provided otherwise, until the final acceptance of the work by the City, including any periods of suspension of work for any cause whatever, the work shall be under the charge and care of the Contractor. Except as otherwise provided, the Contractor shall rebuild and make good at Contractor's own expense, all injuries and damages to the work occurring before its completion and acceptance.

4.2 The Contractor shall furnish all transportation ways, works, machinery and plants, and all suitable appliances requisite for the execution of this Contract and shall be solely answerable for the safe, proper and lawful construction, maintenance and use thereof. The Contractor shall cover and protect its work from damage, until completion and acceptance of this Contract, and shall be solely answerable for all damage to persons or property due to the improper, illegal, or negligent conduct by the Contractor or its agents, employees and/or subcontractors in and about said works.

5. PROTECTION OF PERSONS AND PROPERTY:

5.1 The Contractor shall protect its Work, equipment, and materials by standard industry methods. The City will not in any manner be answerable or accountable for any loss or damage that shall or may happen to the Work or any part or parts thereof respectively or for any of the materials or other things used and employed in finishing and completing the Work, or for injury to any person or persons, either workers or the public, or for damage to property.

5.2 Contractor further agrees that it will, during the performance of the Work, take proper precautions to prevent injury or damages to persons or property, including without limitation providing, erecting, and maintaining all reasonable, necessary, or required safety devices for its employees and flagmen, erecting proper barricades and other safeguards around its Work, and posting danger signs and other warning devices where warranted by the nature of the existing condition of the Work. In any event, the Contractor shall promptly and properly replace any safety devices provided by others or the Contractor and which are disturbed by the Contractor's operations or forces hereunder.

5.3 Contractor shall take all necessary steps to protect and secure its Work, materials, tools, scaffolding, equipment, buildings, trailers, and work shacks from vandalism, theft, and fire damage and the City shall not be responsible for losses or damages to such items.

5.4 Contractor shall be responsible for compliance with all federal, state and local safety, traffic, highway, fire, health, environmental protection, hazardous materials, and other laws, rules, and regulations and all standards, rules, and regulations which have been or shall be promulgated by the parties or agencies which administer the aforesaid laws.

5.5 Contractor shall be responsible for initiating, maintaining, and supervising safety precautions and programs in connection with the performance of its Work hereunder. The Contractor shall take all reasonable precautions for the safety of and shall provide all reasonable protection to prevent damage,

injury or loss to: (i) all Contractor's employees on the Project and all other persons on or near the Project Site who may be affected by the Contractor's operations; (ii) all the Work and all materials and equipment used in connection with the performance of the Work, whether on or off-site, under the care, custody, or control of the Contractor or any of the Contractor's subcontractors; (iii) other property at the Site or adjacent thereto; and (iv) the Work of the City or other separate contractors. When the use or storage of explosives or other hazardous materials or equipment is necessary for the execution of the Work, Contractor shall exercise the utmost care and shall carry on such activities under the supervision of properly qualified personnel and in accordance with all applicable Legal Requirements. Contractor shall properly remedy all damage or loss to any property referred to herein caused in whole or in part by the Contractor, any of its subcontractors, or anyone directly or indirectly employed by any of them or anyone for whose acts any of them may be liable and for which the Contractor is responsible hereunder. The foregoing obligation is in addition to the Contractor's indemnification set forth elsewhere herein.

- 5.6 The Contractor shall designate a responsible member of the Contractor's organization at the Site whose duty shall be the prevention of accidents. This person, unless notified otherwise by the Contractor, shall be the Contractor's foreman at the Site.
- 5.7 The Contractor shall not load or permit any part of the Work or the Project to be loaded so as to endanger its safety.
- 5.8 In an emergency affecting the safety or persons or property the Contractor shall act, at the Contractor's discretion, to prevent threatened damage, injury, or loss.

6. USE OF EXPLOSIVES:

- 6.1 No explosives shall be used except at locations authorized in writing by the Engineer. When the use of explosives is approved in writing by the Engineer for the prosecution of the work, the Contractor shall use the highest degree of care so as not to endanger life or property and, whenever directed, the number and size of the charges shall be reduced. The Contractor shall be responsible for any and all damage resulting from use of explosives.
- 6.2 The Contractor agrees and warrants that it will observe State Laws and Local Ordinances and Regulations relative to the use and storing of such explosives as may be kept on the job and all such storage places shall be marked clearly, "DANGER EXPLOSIVES".

7. LIABILITY OF CONTRACTOR AND INDEMNIFICATION:

- 7.1 The Contractor shall be liable and take responsibility for the work and for all of its undertakings under this Contract and shall bear all losses resulting from or relating to the work.
- 7.2 The mention of any specific duty of liability of the Contractor in any part of the specifications shall not be construed as a limitation or restriction upon any general liability or duty imposed upon the Contractor by the specifications.
- 7.3 The Contractor shall, to the fullest extent permitted by law indemnify and defend the City and its agents, officials and employees and save them harmless from and against any and all claims, damages, losses, liabilities, suits, judgments, actions, and all expenses (including attorney's fees and disbursements in the event Contractor fails to defend as required hereunder) arising out of or claimed to have arisen out of or resulting from any negligent or wrongful act, error, or omission or breach of contract or infringement of any patent right by the Contractor or any of its subcontractors or suppliers of any tier in connection with the performance of the Work hereunder, and such indemnity shall apply regardless of the active or passive negligence or wrong-doing of any Indemnitee and will not be released or excused by reason of any approval by any Indemnitee of any methods of performing the Work or any other approval. The foregoing indemnity shall not be construed to negate, abridge, or otherwise reduce any other right or obligation of indemnity which would otherwise exist as to any indemnitee hereunder. The foregoing indemnity shall include but is not limited to bodily injury and death of any employee of the Contractor and shall not be limited in any way by any limitation on the amount or type of damages, compensation, or benefits payable under any applicable workers' compensation, disability benefits, or other similar employee benefits acts.

8. INSURANCE REQUIREMENTS

- 8.1 Contractor agrees to carry insurance for its own account of sufficient amount to cover any loss or damage that may arise on account of injuries happening to its employees, or to any other person, caused by or in connection with the operations of the Contractor under this Contract, but in any event with the minimum limits of liability set forth in Section 5.1(e) hereinafter. Contractor shall provide copies of the policies therefore to the City whenever requested.
- 8.2 Contractor shall not commence Work under this Contract until it has obtained all of the insurance referred to herein and such insurance has been approved by the City, nor shall the Contractor allow any subcontractor to

commence Work on its subcontract until the insurance required of the subcontractor herein has been so obtained and approved.

- 8.3 Contractor further agrees to deliver to the City no less than three (3) days prior to commencing Work hereunder a certificate of insurance, in a form satisfactory to the City, showing the name of the insurance company, the date of expiration of the policies, the various endorsements and coverages required herein, the additional insureds required herein, and the limits of liability thereunder, and which certificate shall recite that thirty (30) days' prior written notice will be given to the City should such policies be canceled or changed during the term.
- 8.4 All insurance required to be maintained must be procured from insurance companies authorized to do business in Michigan and approved by the City.
- 8.5 The kinds of insurance and limits of liability required of the Contractor and each subcontractor shall be:

<u>Kind</u>	<u>Limits</u>
Michigan Workers' Disability Compensation and Insurance and Employer's Liability	Statutory - \$100,000
Comprehensive General Liability Insurance, written on an occurrence Liability basis, with Contractual Liability, Limit Independent Owners, Products Liability, Personal Injury, Broad Form Property and Completed Operations endorsements and XCU endorsements.	\$1,000,000/ <b>\$2,000,000</b> Bodily Injury Liability/Property Damage OR <b>\$2,000,000</b> Combined Single Limits (through underlying and umbrella layers)
Comprehensive Automobile Liability, each written on an occurrence basis, Liability including all owned, non-owned and hired automobiles.	<b>\$2,000,000</b> Combined Single Limit occurrence, Bodily Injury and Property Damage Liability



- 8.6 Compliance with the foregoing requirements with respect to insurance shall not relieve the Contractor from any liability under the indemnity provisions of this Contract.
- 8.7 The Contractor shall list the City as an additional insured under the Contractor's liability policy.
- 8.8 Each subcontractor shall be required to maintain the same forms of liability insurance referred to above and all subcontracts shall contain the same complete indemnification provisions as set forth in this Contract, indemnifying the City, its agents, officials and employees.
- 8.9 Worker's Compensation:  
The Contractor shall notify the City of Monroe Engineering Department of any employee, owner, individual, subcontractor, or sole proprietor which or who is not covered by Workers' Compensation prior to their working on the project. Any employee, owner, individual, subcontractor, or sole proprietor not covered by Workers' Compensation shall either be added to the Contractor's insurance or shall certify they are a sole proprietor or otherwise exempt from coverage and will be responsible for any injuries/illnesses they may sustain while performing work for the City of Monroe either directly or indirectly."

All employees, owners, individuals, subcontractors, or sole proprietors not covered by Worker's Compensation shall fill out and submit to the City of Monroe the Sole Proprietor form on the next page. (D-11)

SOLE PROPRIETOR FORM  
For Sole Proprietor's with No Employees

For workers' compensation purposes we are required to maintain verification regarding workers' compensation coverage for all of our independent contractors.

You must provide the following information if you:

- a) Are a sole proprietor with no employees, and
- b) Do not carry workers' compensation insurance.

- 1) Name of Sole Proprietor: \_\_\_\_\_
- 2) Social Security Number or Federal Tax Identification Number: \_\_\_\_\_
- 3) I am doing business as: \_\_\_\_\_

Please attach one of the following:

- A copy of the assumed name certificate you filed with the county; or
- Your business card; or
- A copy of your advertisement (Yellow Pages, Newspaper, etc.); or
- List one other business or private homeowner that you have worked for during the period of July 1, through current date, including the name and address: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Please complete the following statement:

I, \_\_\_\_\_, a Sole Proprietor with no employees will provide \_\_\_\_\_ services to \_\_\_\_\_ on a periodic basis. I do understand that I am not entitled to workers' compensation benefits under Michigan's Law, therefore, I am personally responsible for any injuries/illnesses I may sustain while performing any services to said entity.

Dated at: \_\_\_\_\_, on this \_\_\_\_\_ day of \_\_\_\_\_, \_\_\_\_\_.

Signed: \_\_\_\_\_  
Sole Proprietor

STATE OF MICHIGAN, COUNTY OF \_\_\_\_\_

On this \_\_\_\_\_ day of \_\_\_\_\_, \_\_\_\_\_ before me personally appeared \_\_\_\_\_, who being duly sworn did state the s/he is not entitled to workers' compensation benefits as indicated under Michigan's Law, and will not hold responsible the above named entity s/he may provide services to for any injury(ies) illness(es) s/he may sustain while performing such indicated services.

Seal/Stamp \_\_\_\_\_

Notary Public, \_\_\_\_\_ County

My Commission expires \_\_\_\_\_

9. ASSIGNMENT OF CONTRACT:

- 9.1 Assignment: The Contractor shall not assign this Contract or any part hereof without the written consent of the City. No assignment shall be valid unless it shall contain a provision that the funds to be paid to the assignee under the assignment are subject to a prior lien for services rendered or materials supplied for the performance of the work in favor of all persons, firms or corporations rendering such services or materials.
- 9.2 Subcontracting: The Contractor shall not subcontract any work to be performed under this Contract without the written consent of the City. If the Contractor shall sub-let any part hereof, the Contractor shall be fully responsible to the City for acts and omissions of his subcontractor and of persons either directly or indirectly employed by himself. Subcontractors shall be subject to qualification as a "responsible bidder" for any subcontracts greater than \$50,000 in value that are a part of an overall contract greater than \$175,000 in value.

10. LAWS AND REGULATIONS:

- 10.1 The Contractor shall keep himself fully informed of all laws and municipal ordinances and regulations in any manner affecting those engaged or employed in the work, and all orders and decrees of bodies or tribunals having any jurisdiction or authority over the same. He shall, at all times, observe and comply with all such existing and future laws, ordinances, regulations, orders and decrees which become effective during the progress of the work; and shall protect and indemnify the City and its officers and agents against any claim or liability arising from or based on the violations of any such law, ordinances, regulation, order or decree, whether by himself, his subcontractors or his employees.
- 10.2 Income and Sales Taxes, Social Security, Etc.: All such items of payment required by Federal, State and Local laws must be paid by the Contractor.
- 10.3 Permits and Licenses: The Contractor shall procure all permits and licenses, pay all charges and fees, and give all notices necessary and incidental to the due and lawful prosecution of work, unless otherwise specified.
- 10.4 Control of Noise: The Contractor shall eliminate noise to as great an extent as possible at all times. Air compressors shall be equipped with silencers and the exhaust of all gasoline motors and other power equipment shall be provided with mufflers. In the vicinity of hospitals, libraries, and schools precautions shall be taken to avoid noise and other nuisance, and the Contractor shall require strict observances of all pertinent ordinances and regulations. Any blasting permitted in such locations shall be done with reduced charges. The Contractor shall comply with provisions of Ord. No. 83-017 regulating noise within the Corporation limits of the City of Monroe.

10.5 Smoke Prevention: Strict compliance with all ordinances regulating the production and emission of smoke will be required and the Contractor shall accept full responsibility for all damage that may occur to property as a result of negligence in providing required control.

10.6 Dust Control: The Contractor shall apply water or dust palliative, or both, for the alleviation or prevention of dust nuisance caused by his operations. Dust control operations shall be performed by the Contractor at the time ordered by the City, but failure of the City to issue such order will not relieve the Contractor of this responsibility. Unless otherwise specified, no direct payment will be made for any such work performed or material used to control dust under this Contract.

10.7 Open Burning: No open burning is allowed in the City of Monroe.

11. PATENTED DEVICES, MATERIALS AND PROCESSES:

The Contractor shall assume the responsibility of defending any and all suits brought for the infringement of any patent claimed to be infringed in any process which he may use in the execution of his work.

12. THE ENGINEER:

The Engineer shall have the authority to control the Contractor's work to the extent necessary for proper execution of the contract and to protect the public welfare and safety. He has the authority to stop the work whenever it may be necessary to insure the proper execution of the Contract. He shall also have the authority to reject all work and materials which do not conform to the specifications, to direct the application of forces to any part of the work, as in his judgement is required, to order the forces increased or diminished and to decide questions which arise in the execution of the work. Any refusal on the part of the Contractor or his authorized representative to carry out any of the aforementioned orders of the Engineer or his authorized agent shall be deemed a violation of this Contract.

13. AUTHORITY:

13.1 Authority to Change Contract: No agent of the City shall have power to revoke, alter, or relax the stipulations or requirements of these plans and specifications except insofar as such authority may be specifically conferred by the specifications themselves, without the formal authorization to do so, conferred by the Contract of which the specifications are a part or by ordinance, resolution or other official action by the City. Inspectors may be appointed and directed to inspect all materials used and all work done. The inspection may extend to all or any part of the work and to the preparation or manufacture of the materials for use in the work. Inspectors will not be authorized to revoke, alter, enlarge or relax any of the provisions of these specifications nor to change the plans in any particular, nor will they be authorized to approve or accept any portion of the completed work. The Inspector on the work will

inform the Engineer as to the progress of the work, the manner in which it is being done and the quality of the materials being used.

He will also call to the attention of the Contractor any failure to follow the plans and specifications that he may observe. He shall have authority to prevent any material being used and to stop any work being done which he believes does not conform to the plans and specifications until the Engineer shall have had an opportunity to inspect the material or work.

- 13.2 Supervision and Superintendence: The Contractor will supervise and direct the work efficiently and with his best skill and attention. He will be solely responsible for the means, methods, techniques, sequences, and procedures of construction. The Contractor will be responsible to see that the finished work complies accurately with the Contract Documents.

The Contractor will keep on the work at all times during its progress a competent resident superintendent, who shall not be replaced without written notice to the Owner and Engineer except under extraordinary circumstances. The superintendent will be the Contractor's representative at the site and shall have authority to act on behalf of the Contractor. All communications given to the superintendent shall be as binding as if given to the Contractor.

The Contractor will provide competent, suitably qualified personnel to survey and layout the work and perform construction as required by the Contract Documents. He will at all times maintain good discipline and order at the site.

14. EMPLOYMENT OF LABOR:

- 14.1 Equal Employment Opportunity: The Contractor agrees that he will not discriminate against any employee or applicant for employment because of race, creed, sex, color or national origin. The Contractor will take affirmative action to ensure the applicants are employed, and that employees are treated during employment, without regard to their race, creed, color or national origin. Such action shall include, but not be limited to the following:

Employment, upgrading, demotion, or transfer; recruitment or recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship.

- 14.2 Behavior of Employees: Any person employed by the Contractor refusing or neglecting to obey the directions or orders of the Engineer in anything relating to the work or appearing to be incompetent, disorderly, or unfaithful shall be discharged and shall not be re-employed on the work and such discharge shall not be used as a basis of any claim for damages against the City.

15. WORKING CONDITIONS:

- 15.1 Site: The Contractor shall confine his operations to the site of the work and on

public property and any infringement on private property shall be at the Contractor's expense and he shall accept all liability for same.

- 15.2 Boundaries of Work: The City will furnish, not later than the date when needed by the Contractor, lands upon which the work is to be done, rights-of-way for access thereto, and such other lands which are designated for the use of the Contractor.

Other Contractors of the City may for all purposes required by their Contracts, enter upon the work and premises used by the Contractor, and the Contractor shall give to the other Contractors of the City all reasonable facilities and assistance for the completion of adjoining work.

The Contractor will provide for all additional lands and access thereto that may be required for temporary construction facilities or storage of materials and equipment; but the Contractor shall not enter or occupy with men, tools or materials any private ground outside the property of the Owner without the consent of the owner thereof.

- 15.3 Sanitary Provision: The Contractor shall provide sanitary facilities adjacent to the work for his employees acceptable to the Engineer. The location of the facility shall be approved by the Engineer and must be marked with the Contractor's name.

- 15.4 Drinking Water: The Contractor shall furnish a convenient supply of drinking water for his employees from a safe and wholesome source.

- 15.5 Maintaining Traffic: Where contract work is carried on in streets or other public thoroughfares, the Contractor shall so plan and schedule his work as to cause as little interference as possible with general public traffic, both vehicular and pedestrian. Street surfaces shall be maintained and kept clean where construction work under this Contract has been performed until inspection and acceptance of all such work. Access of Fire, Police, and Ambulance vehicles to property abutting and adjacent to such thoroughfares shall be maintained whether or not permission has been granted to restrict other traffic. All signing and barricades shall be in accordance with the current issue of the Michigan Manual of Uniform Traffic Control Devices.

16. PROGRESS OF THE WORK:

- 16.1 Starting: Materials shall be offered and work shall begin on the ground on or before a date specified in a written "Notice to Proceed" of the City Engineer. Work shall be prosecuted diligently thereafter and at such a rate as to insure its completion within the time specified.

- 16.2 Locating: Principal location points and bench marks shall be given by the Engineer at such times as he may deem necessary, or if the Contractor shall be in need of the Engineer's service, he shall notify the Engineer twenty-four (24)

hours in advance of such need.

- 16.3 Lines, Grades, and Markers: All work under this Contract shall be built in accordance with the lines and grades shown on the Plans or as altered or modified by authority of the Engineer.

The City will establish such general reference points as in his judgement will enable the Contractor to proceed with the work. The Contractor will be responsible for the layout of the work and will protect and preserve the established reference points and will make no changes or relocations without the prior written approval of the City. He will report to the Engineer whenever any reference point is lost or destroyed or requires relocation because of necessary changes in grades or locations. The Contractor will replace and accurately relocate all reference points so lost, destroyed or moved.

The Contractor shall mark all points given by the Engineer by stakes or other suitable means and shall protect and maintain the same and locate all work accurately therefrom. Stakes or other points damaged or removed by the Contractor shall be replaced at the expense of the Contractor if needed for the work at \$20.00 per stake.

- 16.4 Hours of Work & Overtime: The Contractor is required to prosecute the work done under this Contract during the hours of daylight starting no earlier than 7:30 a.m., local time, and not exceeding ten working hours per day. In no case will work continue past 5:30 p.m., local time, each day. No work will be permitted in excess of ten hours per day, past 5:30 p.m., local time, or Sunday except to save property, life or to perform an operation which cannot be carried out in the minimum hours permitted and only upon written authorization by the Engineer. The contractor shall request and receive written authorization for Saturday work prior to Thursday, 12 noon local time, proceeding the weekend to be worked.

17. COOPERATION OF CONTRACTOR:

- 17.1 The Contractor shall conduct his operations so as to interfere as little with those of other Contractors, utilities or any public authority on or near the work as shown on the Plans or in the Contract Documents. The City reserves the right to perform other work by Contract or otherwise, and to permit other public bodies and public utility companies and others to do work on or near the project during progress of the work. The Contractor shall conduct his work and cooperate with such other parties so as to cause as little interference as possible with their operations and as the Engineer may direct. Claims for delay or inconvenience due to operations of such other parties, on work indicated or shown on the Plans or which can be reasonably expected to be encountered by the nature and location of the work, will not be considered.
- 17.2 If any part of the Contractor's work depends for proper execution or results upon the work of any such other contractor (or the City), the Contractor will

inspect and promptly report to the Engineer in writing any defects or deficiencies in such work that render it unsuitable for such proper execution and results. His failure to so report shall constitute an acceptance of the other work as fit and proper for the relationship of his work except as to defects and deficiencies which may appear in the other work after the execution of his work.

- 17.3 The Contractor will do all cutting, fitting, and patching of his work that may be required to make its several parts come together properly and fit it to receive or be received by such other work. The Contractor will not endanger any work of others by cutting, excavating or otherwise altering their work and will only cut or alter their work with the written consent of the Engineer.

18. WORK INCLUDED:

- 18.1 The unit prices or lump sums set forth in the proposal shall cover everything, including all labor and materials necessary for performing and completing all work required as contemplated by the plans and specifications.

- 18.2 Indeterminate Estimate of Quantities: When the location and quantity of an item cannot be definitely determined until after construction has started, an indeterminate estimate of quantity will be included on the plans. If the item involves the purchase of materials, the Contractor shall not order the materials until the quantities have been determined by the Engineer.

19. ORDER OF COMPLETION:

The Contractor shall complete any portion or portions of the work in such order of time as the Engineer may direct. The City shall have the right to use any completed or partially completed portions of the work prior to the date for final completion but such use shall not be deemed as an acceptance of the work so taken or used or any part thereof, nor shall it release the Contractor or any of his sureties of any liability defined elsewhere herein. If such prior use increases the cost or delays the work, the Contractor will be entitled to such extra compensation or extension of time or both as the Engineer may determine to be just and equitable.

20. CHANGES:

- 20.1 The City shall have the right to make any changes, that may be hereafter determined upon in the nature of dimensions of the work whether before or after its commencement and such changes shall in no way effect or void the obligations of this Contract. If such changes make any change in the cost of performing the work, an equitable adjustment shall be made by the Engineer to cover the same.

- 20.2 Changes in Quantities: The Engineer shall have the right under the contract to make increases and decreases in quantities as may be necessary to ensure the completion of the contemplated work subject to the following requirements.



- a. Where the amount of the final estimate, prior to consideration of adjustment, is within 10 percent of the original total contract price, no adjustment in contract unit prices will be considered for any increased or decreased quantities.
- b. Where the amount of the final estimate, prior to consideration of adjustment, has increased or decreased more than 10 percent of the original total contract price, requests for adjustments will be considered, on the following basis, for items whose original total cost is equal to or greater than 5 percent of the original total contract price. Lesser items are not subject to adjustment.
  - 1) Where the quantity of an item of work required to complete the project is not increased or decreased from the original estimate by more than 25 percent the payment for the quantity of said item will be made at the contract unit price.
  - 2) Where the quantity of any item of work is increased by more than 25 percent, then the unit price for the quantity of that item of work over 125 percent of the original contract quantity, will be decreased by 10 percent of the unit price bid.
  - 3) Where the quantity of any item of work is decreased by more than 25 percent, then the adjusted unit price will be obtained by multiplying the contract unit price for that item of work by the factor obtained as follows:
 
$$\text{Factor} = 1 + (.10 (P-C)/C)$$
 Where P = Contract Quantity and C = Constructed Quantity.
- c. Where the quantity of any item of work is eliminated entirely, an amount representing all direct material costs incurred on such items prior to such elimination shall be paid to the contractor upon delivery of the materials to a location directed by the Engineer. The Contractor shall have the option of retaining such materials in which case no payment will be made to the contractor for eliminated items.

21. EXTRA WORK:

- 21.1 No bill or claim for extra work done beyond the lines shown in the Plans or material shall be allowed or paid unless such extra work or material shall have been ordered by the Engineer in writing on the change order form attached hereto in Division C, of this Contract. No consideration will be given for claims made after the work has been completed. When the Contractor is directed to perform the work and furnish materials which are neither shown upon the plans, nor reasonably implied in the specifications and for which no price has been

named in the agreement for work or materials of like character, such work and materials shall be considered as extra work, and the Contractor shall perform the same to the satisfaction of the Engineer. The value of any such work or change shall be determined in one or more of the following ways:

- a. By unit prices named in the Contract or subsequently agreed upon.
- b. By estimate and acceptance in a lump sum.
- c. By cost and percentage or by cost and a fixed fee.

If none of the above methods is agreed upon, the Contractor, provided he received an order as above, shall proceed with the work. Such work will be considered force account and will be paid for as provided in the current MDOT Standard Specifications for force account payments. In such case and also under case (c), he shall keep and present in such form as the Engineer may direct, a correct amount of the net cost of labor and materials, together with vouchers. In any case, the Engineer shall certify to the amount, including reasonable allowance for overhead and profit, as provided in the current MDOT Standard Specifications, due to the Contractor. No extras of any kind will be allowed unless ordered in writing by the Engineer.

21.2 No verbal order or suggestion given by any employee of the City shall be construed as authorizing or laying the basis for any claim on the part of the Contractor for extra compensation, either for extra work or materials. Such verbal orders and suggestions as to the performance of the work may be freely given, but in case they appear to the Contractor to involve extra work, for which he should receive extra compensation, he must make written demand for a written order for such extra work prior to performing such work. In case of dispute as to what does or does not constitute extra work, a decision will be made by the Engineer.

21.3 If the Contractor shall decline or fail to perform such or furnish extra materials as authorized in writing by the Engineer, the City may then arrange for the performance of the work in any manner it may see fit, and the Contractor shall not interfere with the performance of the work.

All extra work or change order items whether requested by the Contractor and approved by the Engineer or directly ordered by the Engineer shall be made on the City of Monroe Change Order Form as presented in Division C of this contract.

## 22. WORK ADJACENT TO RAILWAYS:

Whenever the work embraced in the Contract is near railways or within railroad rights-of-way the Contractor shall use proper care to avoid injury to persons and property. The work must be performed so as to avoid interference with the movement of traffic and the Contractor shall not proceed until necessary permits have been obtained and specific authority and direction from the Railway Company has been given.

23. PRESERVATION AND RESTORATION OF PROPERTY, TREES, MONUMENTS, ETC.

- 23.1 The Contractor shall be responsible for the preservation of all public and private property, affected by operations within his control. He shall use the precautions necessary to prevent damage or injury thereto. All such protective and corrective work shall be in accordance with the Contract Documents.
- 23.2 The Contractor shall protect and preserve all land survey monuments or property corners along the line of his work. Where monuments, irons, or property corners are unavoidably disturbed or removed due to operations under this Contract, the Contractor, at his own expense, shall employ the services of a registered land surveyor to establish, reset or replace such monuments, irons, or property corners.
- 23.3 The Contractor shall be responsible for the damage or destruction of property of any character resulting from neglect, misconduct or non-execution of the work, or caused by defective work or the use of unsatisfactory materials.
- 23.4 The Contractor shall not injure or destroy trees or shrubs nor remove or cut them without authorization by the City. All trees and shrubs except those ordered to be removed shall be adequately protected by boxes or otherwise by the Contractor. No excavated material shall be placed so as to injure such trees and shrubs. Trees and shrubs destroyed by negligence of the Contractor or his employees shall be replaced by him with new stock of similar size and age, or with other stock size and age satisfactory to the City, at the proper season, and at the sole expense of the Contractor.
- 23.5 Parkways shall be left in as good condition as before the commencement of the work. Where sod is removed, it shall be carefully preserved and later replaced, or the area where sod has been removed shall be covered with a 2 inch layer of good top soil and seeded with a specified grass seed mixture.
- 23.6 When or where any direct or indirect damage or injury is done to public or private property resulting from the Contractor's operations, such property shall be restored by the Contractor, at his expense, to a condition similar or equal to that existing before such damage or injury was done by repairing, rebuilding or otherwise restoring same, or he shall make good such damage or injury in an acceptable manner.

24. PUBLIC SERVICE STRUCTURES:

- 24.1 Public Service Structures shall be understood to include all poles, tracks, pipes, wires, conduit, house-service connections, vaults, manholes, and other appurtenances, whether owned or controlled by the City or other public bodies or by privately-owned corporations, used to supply the public with transportation, heating, electric, telephone, water, sewer, or other services.

24.2 At least 72 hours in advance of breaking ground, the Contractor shall notify the Miss Dig Construction Communication System and adhere to the provisions of State Act 53 by calling 1-800-482-7171.

24.3 Three (3) conditions, which may be encountered, will be dealt with as follows:

- a. Structures which are adjacent to but not included within the limits of excavation required for performance of the work shall be acceptably protected, supported, and maintained in service by the contractor at his expense.
- b. Structures within the limits of the work which can be satisfactorily supported and maintained in service and which do not require removal and rebuilding in the judgement of the Engineer shall be thus supported by the Contractor at his expense, including cost of repair of damage incidental to his operations.

Supports for water and gas mains, sewers, conduits, and similar structures shall be constructed of timber or other acceptable material; shall be supported from undisturbed foundations and shall be sufficiently substantial to insure against settlement when pipe trenches or other excavations are backfilled. In all cases where permits or inspection fees are required by utilities in connection with changes to or temporary support of their conduits, the Contractor shall secure such permits and pay all inspection fees.

The Contractor shall assume full responsibility for maintaining all public service structures in service and shall support and protect, or remove and rebuild them at his own expense. Such services shall not be interrupted for more than two (2) hours without special permission.

- c. In case relocation of pipelines or other utility structures is required because of direct interference with the installation of the work, the Contractor shall notify the Owners of the utility structure involved. Unless such interference is shown on the Plans or described in the Specifications, and is specifically included in the work to be performed by the Contractor, the Contractor will not be charged for the cost of necessary relocation nor will the Contractor be paid for time lost because of such direct interference. Where it is the policy of any utility owner to perform such work with his own forces, the Contractor shall cooperate to the fullest extent with such utility owner.

All work shall be done in a manner to protect the public and the work.

## 25. UTILITIES:

25.1 Private Utilities: The Contractor shall comply with the provisions of State Act 53 of Public Acts of 1974.

25.2 Public Utilities: For the location of water mains, sanitary sewers, and (within the Monroe City limits) storm sewers contact:

City of Monroe  
Engineering Department  
120 East First Street  
Monroe, Michigan 48161  
Telephone: (734) 384-9126

For the location of water services contact:

Monroe Water Department  
120 East First Street  
Monroe, Michigan 48161  
Telephone: (734) 384-9150  
Water Emergency Calls: (734) 241-5947

26. RIGHTS OF VARIOUS INTERESTS:

Whenever work is being done by the City or by other Contractors, contiguous to work covered by this Contract, the rights of the various interests involved shall be established by the Engineer.

27. REPORT OF ERROR AND DISCREPANCIES:

If, in the course of the work, the Contractor finds any discrepancies between the plans and the physical conditions encountered in the work or any error or omissions in the plans or in the layout, it shall be his duty to immediately inform the Engineer in writing. Any work done after such discovery, until authorized by the Engineer, will be done at the Contractor's risk.

28. SALVAGED MATERIALS OR SECOND-HAND MATERIALS:

All materials salvaged during the work shall be the property of the City. Any such salvaged material, which in the judgement of the Engineer can be used in the work, shall be paid for by the Contractor at a price agreed upon in writing between the Contractor and the Engineer.

Any material, structures, pipe, castings, etc. to be removed which the City has no use for becomes the property of the Contractor and he is responsible for its disposal.

29. INSPECTION AND REJECTION OF WORK:

29.1 Material and Work: Only materials conforming to the requirements of the Specifications and approved by the Engineer prior to use shall be used in the work. Unless otherwise stipulated in the Specifications, all workmanship, equipment, materials and articles incorporated in the work covered by this Contract are to be new and of the best grade of their respective kinds for the

purpose. The Contractor shall furnish to the Engineer for his approval, the name of the manufacturer of machinery, mechanical and other equipment, and the source of supply of each of the materials which he contemplates installing or incorporating in the work. Samples of materials shall be submitted for approval when so directed. Machinery, equipment, materials, and articles installed or used without such approval shall be at the risk of subsequent rejection.

All materials proposed to be used may be inspected or tested at any time during their preparation and use. If after trial, it is found that sources of supply which have been approved do not furnish a uniform product, or if the product from any source does not meet the Specifications, at any time, the Contractor shall furnish material from other approved sources. No material which, after approval, has in any way become unfit for use shall be used in the work.

The Contractor shall guarantee that all materials used, and all work done under this Contract, will fully comply with the requirements of the Plans and Specifications. The Contractor shall supply all material certifications as required in Paragraph 1 of Division E.

- 29.2 Samples and Tests: In order to assure the use of suitable materials, the City may require any or all materials to be subjected to test by means of samples or otherwise as he may determine. The Contractor shall afford such facilities as the City may require for collecting and forwarding samples and shall not make use of nor incorporate in the work any material represented by the samples until the tests have been made and the materials found acceptable and in accordance with the requirements of the Specifications. The Contractor in all cases, shall furnish the required samples without charge.
- 29.3 Defective Materials: All materials, equipment, and articles to be incorporated into the work not conforming to the requirements of these Specifications shall be considered as defective, and whether in place or not, shall be rejected and shall be removed immediately from the site of the work and not again offered for inspection.
- 29.4 Storage of Materials and Equipment:
- 29.41 Materials, equipment, and articles to be incorporated into the work shall be stored so as to facilitate inspection and in such manner as to insure the preservation of their quality and fitness for the work. Stocked materials, even though approved before storage, shall be subject to test and shall meet requirements of the Specifications at the time they are to be used in the work.
- 29.42 Where construction is in roads, streets, etc., that portion of the right-of-way not required for public travel may be used for storage purposes, unless otherwise prohibited, and for placing of the Contractor's plant and equipment; any other additional space required shall be provided

by the Contractor at his expense.

29.43 The City will furnish not later than the date when needed by the Contractor, the lands upon which the work is to be done, rights-of-way for access thereto, and such other lands which are designated for the use of the Contractor. The Contractor will provide for all additional lands and access thereto that may be required for temporary construction facilities or storage of materials and equipment.

29.44 The Contractor will confine his equipment, the storage of materials and equipment and the operations of his workmen to areas permitted by law, ordinances, permits, or the requirements of the Contract Documents, and shall not unreasonably encumber the premises with materials or equipment.

29.5 Inspection of Work: The Engineer and his representatives shall at all times have access to the work wherever it is in preparation or progress and the Contractor shall provide proper facilities for such access and for inspection.

The work is to be done under the supervision of an inspector or inspectors, whose duties will be to see that the requirements of the specifications are carried out, but their presence or absence is in no manner to be presumed to relieve in any degree the responsibility or obligations of the Contractor.

If the specifications, the Engineer's instructions, law, ordinances, or any public authority require any work to be inspected, tested or approved, the Contractor should give the Engineer timely notice of its readiness for inspection, and if the inspection is by another authority than the Engineer, of the date fixed for such inspection. Inspections by the Engineer shall be promptly made, and where practicable at the source of supply. If any work should be covered up without inspection, approval or consent of the Engineer it must, if required by the Engineer, be uncovered for examination at the Contractor's expense.

29.51 Soil and/or Aggregate Compaction Testing: The compaction tests shall be provided by a private consulting firm which will be under contract with the City of Monroe. The Contractor shall be required to contact the City Engineering Department at least 24 hours in advance of needing the tests. Failure of the Contractor to be ready for the tests when scheduled will result in the cost for the consultant service to be borne by the Contractor. This amount shall be directly deducted from the Contractor's pay estimate. In the event that a scheduled test is to be canceled, the Contractor shall contact the Engineering Department no later than two (2) hours prior to the scheduled test.

29.6 Correction and Removal of Defective Work: The Contractor shall remove, rebuild and make good at his own cost any work which is found to be defectively executed. Any failure to condemn work at the time of its construction shall not be construed as an acceptance of defective work. If any doubt exists as to the character of inspected or previously approved work, it

must on order of the Engineer be taken up. If found to be imperfect it must be made good without additional compensation, if satisfactory, the actual cost, plus fifteen (15%) percent, of removing and replacing, shall be paid to the Contractor. Any work which during its progress and before final acceptance may become damaged from any cause shall be removed and replaced by satisfactory work at the Contractor's expense. Improper work shall not be accepted and the Contractor shall not be entitled compensation for such.

If the Contractor does not correct the work within a reasonable time, all as specified in a written notice from the Engineer, the City may have the deficiency corrected or the rejected work removed and replaced. All direct or indirect costs of such correction or removal and replacement, including compensation for additional professional services, shall be paid by the Contractor, and an appropriate deductive change order shall be issued. The Contractor will also bear the expenses of making good all work of others destroyed or damaged by his correction, removal or replacement of his defective work.

If, instead of requiring correction or removal and replacement of defective work the Owner (and, prior to approval of final payment, also the Engineer) prefers to accept it, he may do so. In such case, if acceptance occurs prior to approval of final payment, a change order shall be issued incorporating the necessary revisions in the Contract Documents, including appropriate reduction in the Contract price; or if the acceptance occurs after approval of final payment, an appropriate amount shall be paid by the Contractor to the City.

30. INTERPRETATION:

Should any questions arise as to the intent of any parts of the plans and specifications, the interpretation of the Engineer shall be final. However, it is not intended to deprive the Contractor of his legal rights or of recourse to the Courts.

31. SUSPENSION OF WORK:

31.1 The City may at any time suspend the work, or any part thereof, by giving three (3) days notice to the Contractor in writing. The work shall be resumed by the Contractor within ten (10) days after the date fixed in the written notice from the City to the Contractor to do so. The City shall reimburse the Contractor for expense incurred by the Contractor in connection with the work under this Contract as a result of such suspension, unless such suspension is ordered to secure compliance with the terms of this Contract.

But, if the work or any part thereof, shall be stopped by the notice in writing aforesaid, and if the City does not give notice in writing to the Contractor to resume work at a date within six (6) months of the date fixed in the written notice to suspend, then the Contractor may abandon that portion of the work so suspended.



31.2 Seasonal Suspension of Work: The City may suspend the work due to seasonal limitations, by giving three days notice to the Contractor. The Contractor shall complete such work as is deemed necessary by the Engineer to secure the work for the duration of the suspension. The work shall be resumed by the Contractor at the earliest allowable date or within ten (10) days after the date fixed in the written notice from the City suspending the work. Should the contract time period extend beyond a seasonal shut down approved by the City Engineer no additional compensation will be allowed due to increased costs incurred as a result of the suspension.

32. CLEAN-UP WORK:

On or before the completion of the work, the Contractor shall without charge, unless there is a specific item in the proposal, tear down and remove all buildings and other temporary structures and plant built by him, and shall remove all rubbish and left-over materials accumulated during construction, from any grounds which he has occupied and shall leave the line of work in a neat and clean condition. Furthermore, all structures and appurtenances included in this Contract shall be cleared of all scaffolding, rubbish and dirt. The Contractor shall restore in an acceptable manner all property, both public and private, which may have been used or damaged during the prosecution of the work.

33. TIME OF COMPLETION:

33.1 The time allowed for the completion of the work contemplated in this Contract shall be as stated in the proposal and is the time allowed for all construction and clean-up and any other pertinent operation required before final and formal acceptance by the City.

33.2 All days on which work is suspended by order of the Engineer or in accordance with these specifications shall automatically extend the time for completion an equal number of days. No other extension of time shall be allowed except under formal consent of the Engineer.

33.3 It is distinctly understood and agreed to by the parties hereto that the time specified for the completion is the essence of this Contract and the Contractor shall not be entitled to claim performance of this contract unless the work is satisfactorily completed in every respect within the time specified.

33.4 Extension of Time: If the Contractor should be delayed in the performance of the work from any cause for which the City is responsible he shall, upon written application upon the required change order form to the Engineer at the time of such delay, be granted a reasonable extension of time as the Engineer may deem equitable and just.

The Contractor may also be granted extension of time for other unavoidable delays if application in writing on the change order form for extension is made to the Engineer at the time of delay and approved by the Engineer.

34. TIME OF COMPLETION AND LIQUIDATION DAMAGES:

It is hereby understood and mutually agreed, by and between the Contractor and the owner, that the date of completion, as specified in the Proposal, is an essential condition of this Contract; and that the time for the completion of the work described herein is a reasonable time for the completion of the same, taking into consideration the average climatic range and prevailing industrial conditions.

If the Contractor shall neglect, fail or refuse to complete the work within the time herein specified, or within 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 Proposal, not as a penalty but as liquidated damages, for each and every calendar day that the Contractor shall be in default, after the time stipulated for completion of the work. The amount of liquidation damages shall be deducted from the estimated amounts coming due and payable to the Contractor.

The Contractor shall not be charged with liquidated damages or any excess cost when the owner determines that the Contractor is without fault due to 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.

35. INJUNCTIONS:

Should the City of Monroe be prohibited or enjoined from proceeding with the work, or from authorizing the prosecution, either before or after its commencement, by the reason of any litigation or otherwise, the Contractor shall not be entitled to any damages by reason of the delays caused thereby, except for the actual cost of protecting such work as he may have under way, or for the cost of removal and replacement of such tools, plant and materials as he may have delivered upon the work, such as to be determined by the Engineer. Nor shall the Contractor be permitted to withdraw from this agreement until such delays, as aforesaid, aggregate one year, but the time of completion shall be extended for such time, as in the judgement of the Engineer, shall be equal to the aggregate delay.

36. FORFEITURE OF CONTRACT:

36.1 Failure to Abide by Contract: If the work to be done under this Contract shall be abandoned by the Contractor, or if at anytime, in the judgement of the City, the Contractor shall fail to prosecute the work at a reasonable rate of progress, or to comply with all or any of the terms and requirements herein set forth, such action shall not affect terms and requirements herein set forth, and such action shall not affect the right of the City to recover damages resulting from such failure, then the City has a right to take possession of the work, including the Contractor's plant, supplies, tools, and materials at any time after having noti-

fied the Contractor in writing to discontinue the work under this Contract for said cause or causes. Upon receiving such notice, the Contractor shall, upon demand, immediately give the party of the first part, safe and peaceful possession of the work including the plant and shall then cease to have any control over any portion of the men employed thereon.

36.2 City's Rights to Finish Work: The party of the first part, the City, may then proceed to complete the work herein specified by Contract or otherwise and the entire cost of the same shall be charged to the Contractor and deducted from any sum or sums due or to become due under this Contract, the excess cost, if any, shall be paid by the Contractor or his sureties to said party of the first part.

36.3 Annulment Without Fault of Contractor: The City shall have the right to annul, at any time, this Contract upon giving ten (10) days notice in writing to the Contractor, in which event the Contractor shall be entitled to the full amount of the estimate for the work done by him under the terms and conditions of this Contract up to the time of such annulment, including the retained percentage. The Contractor shall be reimbursed by the City for such expenditures as in the judgement of the Engineer are not otherwise compensated for in preparing for and moving to and from the work; the intent being that an equitable and just settlement be made.

In case of an annulment of this Contract before completion, the Contractor, if notified to do so by the City, shall promptly remove any part or all of his equipment and supplies from the property of the City as instructed by the Engineer and, should he refuse or neglect to do this, the City shall have the right to remove such equipment and supplies at the expense of the Contractor.

37. WAIVER OF CONTRACT:

Neither the acceptance by the City or its Engineer or other agents, nor any order, measurements or certificate by the Engineer, nor any order of the City for the payment of money, nor any payment for or acceptance of the whole or any part of the work by the Engineer, or by the City, nor any extension of time, nor any possession taken by the City or its agents, shall operate as a waiver for any portion of the Contract and any power therein reserved to the City or any right to damages therein provided, nor shall any waiver of any breach of Contract be held to be a waiver of any subsequent breach.

38. PAYMENT TO CONTRACTOR:

38.1 Progress Payments: The Owner shall make a progress payment to the estimate of the work performed the preceding calendar month under this Contract and shall submit progress payment to the City Council for their approval on the third Monday of the month. To insure proper performance of this Contract, the Owner shall retain ten percent (10%) of the first 50 percent of the contract amount until final completion and acceptance of all work covered by this

Contract.

- 38.2 Unincorporated Materials: No payment will be made for materials furnished unless incorporated in the finished work.
- 38.3 Payment Withheld: The City may withhold the payments of any estimate or portion of estimate as may be necessary to protect itself from loss because of the following:
- a. Defective work not remedied.
  - b. Claims filed against the Contractor or reasonable evidence indicating probable filing of claims.
  - c. Failure of the Contractor to make payments properly.
  - d. A reasonable doubt that the Contract can be completed for the balance then unpaid.
  - e. Damage to another contractor.
  - f. Labor Standards Violations.

When the contractor can furnish satisfactory evidence that the above grounds for withholding payments have been removed, payments shall be made for the amounts withheld because of them.

- 38.4 Deductions for Uncorrected Work: If the Engineer deems it inexpedient to correct work injured or done, not in accordance with the Contract, an equitable deduction from the Contract price shall be made therefore.
- 38.5 Measurement of Quantities: Quantities of work completed under the contract will be measured by the Engineer according to United States standard measures.

The method of measurement and computations to be used in determination of quantities of material furnished and of work performed under the contract will be those methods generally recognized as conforming to good Engineering practice.

Unless more stringently controlled by tolerances in cited specifications, manufacturing tolerances established by the industries involved will be accepted.

When required by the Engineer, the Contractor shall file original copies of paid freight bills, trucking slips, bills of lading, and paid invoices for any or all materials used in the work.

- 38.6 Final Payment: Within thirty (30) days after the completion of the work under

this Contract to the satisfaction of the City and its Engineer in accordance with all and singular terms and stipulations, herein contained, the City shall make final payment from a final estimate. Before final payment is made, the Contractor shall furnish to the City the following:

- a. An Affidavit that he has paid all claims of every nature.
- b. A maintenance bond, for a period of one year, covering the repair of any defect in all the work done under said Contract, either by the Contractor, his subcontractors, or his material suppliers, that may develop during said period due to improper materials, defective equipment, or poor workmanship. Said bond shall be in an amount equal to five percent (5%) of the final Contract amount on the forms attached hereto in Division C, of this Contract.
- c. A waiver of lien from all major material and equipment suppliers.

The acceptance by the Contractor of the final payment aforesaid shall operate as, and shall be, a release to the City and its agents, from all claims and liability to the Contractor for anything done or furnished in relation to the work, or for any act or neglect of the City or of any person relating to or affecting the work.

38.7 No Estoppel: The party of the first part shall not, nor shall any office thereof, be precluded or estopped by any return or certificate made or given by the Engineer or other officer, agent, or appointee under the provisions of this agreement, at any time (either before or after the final completion and acceptance of the work and payment made thereof pursuant to any such return or certificates showing the true and correct amount of any money due therefore, notwithstanding any such return or certificate, or any payment made in accordance therewith) from demanding and receiving from the Contractor or his Sureties, separately or collectively, such sums as may have been improperly paid said Contractor by reason of any such return or certificate which has been untruly or incorrectly compiled.

38.8 P.A. 524 of 1980: The provision of P.A. 524 of 1980 will apply to all contracts in amounts greater than \$30,000.00 and with contract time greater than 60 days.

39. COORDINATION OF SPECIFICATIONS AND PLANS:

In case of discrepancy, figured dimensions shall govern over scaled dimensions and the parts of the contract will prevail over all other parts in the following order:

1. Addendum
2. Supplemental Specifications
3. Project Plans and Drawings
4. General Conditions & Specifications
5. Detailed Specifications (sanitary sewer, water, etc.)
6. Proposal

7. Instruction to Bidders
8. Advertisement for Bids
9. Bonds and Forms

40. GRATUITIES; SANCTIONS:

It shall be unethical for any person to offer, give, or agree to give any City employee, officer or former City employee or officer, or for any City employee, officer or former City employee or officer to solicit, demand, accept or agree to accept from another person, a gratuity or an offer of employment in connection with any decision, approval, disapproval, recommendation, or preparation of any part of a program requirement or a purchase request, influencing the content of any specification or procurement standard, rendering of advice, investigation, auditing, or in any other advisory capacity in any proceeding or application, request for ruling determination, claim or controversy, or other particular matter, pertaining to any program requirement or a contract or subcontract, or to any solicitation or proposal thereof.

41. ADDITIONAL SAFETY REQUIREMENTS:

The contractor shall comply with Part 1910.146 of the Occupational Safety and Health Act concerning entry into confined spaces. Prior to commencing work on the project, the contractor shall provide a copy of his confined space entry program and permit forms that will apply to his employees as well as subcontractor's employees.

42. CONFINED SPACE ENTRY:

Wherever required, by these plans and specifications, for personnel of the contractor or his subcontractors to enter existing facilities of the Owner that are defined as confined entry spaces, the contractor shall follow the Owners procedures and secure the required permits prior to entering said facilities. Confined space areas to be constructed or installed under these plans and specifications shall be subject to the contractors confined space entry procedures until such time that the facility has been tested, approved, and accepted by the Owner.

43. RESPONSIBLE BIDDER CERTIFICATION REQUIREMENTS:

The bidding and award process for Construction Projects shall include two parts. The first part is the submission of a Responsible Contractor Pre-Qualification. The second part shall be a Contractor Information Questionnaire. All contractors bidding on a Construction Project valued at over \$175,000 and subcontractors of any tier that intend to perform work on any Construction Project valued at over \$50,000.00 shall submit the information described in this Section which information shall be considered as part of the determination of any contract to be awarded by the City of Monroe.

43.1 Responsible Contractor Pre-Qualification: Prior to, but at least ten (10) days before a submission of a formal bid proposal, the bidder shall submit a Responsible Contractor Pre-Qualification packet to the City Engineering Department. The packet shall include the formation requested below. In order

for a bidder to be considered for a possible bid award the Responsible Contractor Pre-Qualification packet must score a rating of 80% or greater based on the point structure outlined in the Responsible Contractor Pre-Qualification form.

<b><u>Provided</u></b>	<b><u>Not Provided</u></b>	<b><u>Corporate Accountability</u></b>
5	0	References from individuals or entities the bidder has worked for within the last five (5) years including information regarding records of performance and job site cooperation.
5	0	Evidence of any quality assurance program used by the bidder and the results of any such program on the bidder's previous projects.
<b><u>Provided</u></b>	<b><u>Not Provided</u></b>	<b><u>Workplace Safety</u></b>
5	0	Documentation of an on-going Michigan OSHA-approved, safety-training program for employees to be used on the proposed job site.
<b><u>EMR 1.0 or Less</u></b>	<b><u>EMR greater than 1.0</u></b>	
10	5	Evidence of the bidder's worker's compensation Experience Modification Rating ("EMR"). Preference will be given to contractors and subcontractors who exhibit an EMR of 1.0 or less based on a three-year average.
<b><u>Completed</u></b>	<b><u>Not Completed</u></b>	
10	5	All Craft labor that will be employed by the firm for the project has completed at least the OSHA 30-hour training course for safety established by the U.S. Department of Labor, Occupational Safety & Health Administration.
<b><u>1:3 or Less</u></b>	<b><u>More than 1:3</u></b>	
10	5	Number of apprentices under the supervision of a journeyperson.
<b><u>Yes</u></b>	<b><u>No</u></b>	<b><u>Workforce Development</u></b>
15	0	Will bidder pay prevailing wages or greater together with benefits (i.e. Health care, pension and/or retirement program) on all City Construction Project work.
10	0	Documentation that the bidder has participated in a U.S. Department of Labor approved Industry-Registered Apprenticeship Program (IRAP) for the past three years, at a minimum, for each separate trade or classification in which it employs craft employees and shall continue to participate in such programs for the duration of the project.

<b>Provided</b>	<b>Not Provided</b>	
10	0	Documentation of how the bidder assesses the skills and qualifications of any employees who do not have master or journeyman certification or status, or are not participants in an Industry-Registered Apprenticeship Program (IRAP).
<b>Provided</b>	<b>Not Provided</b>	<b>Social Equity</b>
5	0	A statement from the bidder as to what percentage of its workforce can be drawn significantly from Monroe County residents, as a goal of the City is to utilize, in its construction activities, local residents as much as is economically feasible while retaining the high quality of construction required for its construction activities, consistent with applicable law.
5	0	Evidence of Equal Employment Opportunity Programs for minorities, women, veterans, returning citizens, and small businesses.
10	0	Assurance that the bidder is an equal opportunity employer and does not discriminate on the basis of race, sex, pregnancy, age, religion, national origin, marital status, sexual orientation, gender identity or expression, height, weight, or disability.

<b>Total Column A</b>	<b>Total Column B</b>	<b>Total Points A+B</b>	<b>Maximum Points 100 (Percentage)</b>	
				Pre-Qualification is 80% or better.

After review by the City of Monroe, the Bidder will be notified of their score. If the Bidder fails to achieve a score of 80% or more, the Bidder may elect to forego bidding on the Construction Project or the Bidder may submit additional information that was deemed to be incomplete or deficient to the City's Engineering Department. This information may be submitted any time prior to the award of a contract for a Construction Project. Once a Bidder is determined to have achieved a score of 80% or more, the Bidder shall be deemed pre-qualified for one year for the purpose of bidding on the City's Construction Projects subject to the Bidder's requirement to disclose any changes in condition or response as described in the immediately following subsection.

- 43.2 Bidder Information Questionnaire: Each Bidder on a Construction Project shall be required to submit the following information with their bid proposal in the form prescribed by the City's Engineering Department. Failure to submit any of the information may result in disqualification from further consideration unless



waived by the City Council. The information submitted as part of the Bidder Information Questionnaire shall include a verification signed under penalty of perjury. Bidder Information Questionnaires will be public records and information contained therein will be available for public review, except to the extent that such information is exempt from disclosure pursuant to applicable law. If a Bidder fails to provide any of the requested information, the City shall be entitled to consider the lack of response as adverse and/or negative to the Bidder's qualifications including rejection of the bid in its entirety in the discretion of the City. If the City learns any Bidder submitted false information, the City may terminate any contract and pursue remedies. The Bidder shall update its responses to the Bidder Information Questionnaire during the term of the contract within thirty calendar days after any change to responses previously provided, if such change would affect a Bidders' fitness and ability to continue performing the contract. The City may consider failure of the contractor to update the questionnaire with this information as a material breach of the contract and invoke remedies it feels appropriate. The Bidder Information Questionnaires will identify those criteria which will allow the City to evaluate the Bidder's ability to provide the highest quality and value to the City at the lowest cost. The City, in the exercise of the City's sole discretion, reserves the right to accept or reject any or all bids for any or all reason and to determine the bid most advantageous for the City. The City must evaluate the following criteria in the Bidder Information Questionnaires to determine the Bidder that will be awarded the City's contract. The City may at any time add additional information to the Bidder Information Questionnaires provided that all bidders and/or prospective bidders shall be afforded the same opportunity to receive and respond to a request for such additional information. The information required to be provided as part of the Bidder Information Questionnaires includes, but is not limited to:

- (a) General information about the bidder's company, its principals, and its history, including all former business names, and an explanation of any business name changes.
- (b) If the submitting bidder has ever operated under another name or is controlled by another company or business entity or in the past five years controlled or was controlled by another company or business entity, whether as a parent company, subsidiary or in any other business relation, it must attach a separate statement to its bid packet that explains in detail the nature of any such relationship. Additional information may be required from such an entity if the relationship in question could potentially impact contract performance.
- (c) Information regarding the state and local licenses and license numbers held by the bidder.
- (d) A confirmation that all subcontractors, employees and other individuals working on the construction project will maintain current applicable licenses required by law for all licensed occupations and professions.

(e) Documentation of master or journeyman certification or status for masters and journeymen to be used on the project, and the source of such certification or status.

(f) Verification that the bidder is in compliance with all applicable state and federal laws and visa requirements regarding the hiring of non-US citizens, and disclosure of any work visas sought or obtained by the bidder, any of the bidder's subcontractors, or any of the bidder's employees or independent contractors, in order to perform any portion of the project.

(g) A list of projects completed within the past five (5) years of comparable size/complexity, including dates, clients, approximate dollar value, and size. Documentation from these previous projects including but not limited to all extra costs relating to the bidder's timeliness, performance, quality of work, extension requests, contractual fines and penalties imposed, liens filed, history of claims for extra work and any contract defaults with an explanation of the reason for the default and how the default was resolved.

(h) Evidence of experience with construction techniques, trade standards, quality workmanship, project scheduling, cost control, management of projects of comparable size/complexity, and building codes by documenting the bidder's ability and capacity to perform the project. The bidder must identify those portions of the project it reasonably believes will be subcontracted and the names of the subcontractors, if known at the time of submission.

(i) Written verification of bonding capacity equal to or exceeding the amount of the bidder's scope of work on the project. The written verification must be submitted by a licensed surety company rated "B+" (or better) in the current A.M. Best Guide and qualified to do business within the State of Michigan.

(j) A list of all litigation and arbitrations currently pending and concluded whether by settlement or decision within the past five (5) years, including an explanation of each (parties, court/forum, legal claims, damages sought, and resolution). A list of all claims made against the bidder that were resolved through the payment of \$25,000.00 or more by the bidder or the bidder's insurance and/or bonding/surety companies.

(k) Disclosure of any violations of state, federal or local laws or regulations, including OSHA or MIOSHA violations, state or federal prevailing wage laws, wage and hour laws, worker's compensation or unemployment compensation laws, rules or regulations, issued to or against the bidder within the past five years.

(l) Disclosure of any debarment by any federal, state or local governmental unit and/or findings of non-responsibility or non-compliance with respect to

any public or private construction project performed by the bidder.

(m) Proof of insurance, including certificates of insurance, confirming existence and amount of coverage for liability, property damage, workers compensation, and any other insurances required by the proposed contract documents.

(n) A statement regarding the bidder's staffing capabilities and labor sources including subcontractors and a verification from the bidder that construction workers will not be misclassified as independent contractors in violation of state or federal law.

(o) Verification of an existing drug and alcohol testing and/or screening program for bidder, including, but not limited to a Fitness for Duty Program, or a comparable recognized program or provider.

(p) A statement affirming that the City will require and the bidder will provide a one-year maintenance bond valued at 5% of the total contract amount at the time of contract close-out with such bond effective at the time of final payment by the City.

(q) A statement affirming that the bidder will pay all craft employees that it employs on the project the current wage rates and fringe benefits as required under applicable federal, state, or local wage laws.

(r) A statement identifying what possible change orders could be necessary and what their approximate subsequent total costs would be.

(s) A statement from the contractor or subcontractor acknowledging their obligation to comply with this Ordinance in each contract and subcontract.

(t) Assurances that the project timeline the contractor submits will be followed and that the project will finish in a timely fashion.

(u) Any change in the Experience Modification Rating (EMR) since the submittal and scoring of the Responsible Contractor Pre-Qualification.

(v) The anticipated percentage of Monroe County residents that comprise the bidder's labor pool that will be used on the Construction Project.

#### 43.3 Subcontractor Compliance:

(a) A construction manager, general contractor or other lead or prime contractor must not be permitted to use a subcontractor on any work performed for the City in excess of the financial threshold identified in Section 114-13(E)(2) unless it has identified the subcontractor on its Bidder Information Questionnaire and/or Bid documents and such subcontractor has provided all information required under Responsible Contractor Pre-

Qualification and received a score equal to or greater than 80%.

(b) A subcontractor listed on a bidder's Subcontractor List must not be substituted unless written authorization is obtained from the City and the subcontractor is a responsible bidder.

(c) In the event that the City determines that a prospective subcontractor listed by the apparent bid awardee is ineligible pursuant to the Responsible Contractor Pre-Qualification scoring provisions, it may, after informing the prospective awardee, exercise one of the following options: (1) Permit the awardee to substitute a qualified and responsible bidder; (2) Require the awardee to self-perform the work in question if the bidder has the required experience, licenses and other qualifications to perform the work in question; or (3) Disqualify the prospective awardee.

(d) In the event that a subcontractor is disqualified under this Section, the general contractor, construction manager or other lead or prime contractor, as a condition of bidding on the City's work, shall agree that it will not make any type of claim against the City on the basis of a subcontractor disqualification.

43.4 Substantially Low Bid Review: In the event the amount of a bid appears disproportionately low when compared with estimates undertaken by or on behalf of the City and/or compared to other bids submitted, the City reserves the right to inquire further of the bidder to determine whether the bid contains mathematical errors, omissions, and/or erroneous assumptions, and whether the bidder has the capability to perform and complete the contract for the bid amount.

43.5 Enforcement:

(a) Contracts issued in connection with this Section shall provide that violation of this Section shall constitute a material breach thereof and entitles the City to terminate the contract and otherwise pursue legal remedies that may be available.

(b) Compliance with the Bidder Information Questionnaire provisions of this Ordinance must be required in contract amendments, if the initial contract was not subject to the provisions of this Section.

(c) Information that is provided under the processes set forth in this Section that is at any point deemed false or in an attempt to mislead the City entitles the City to terminate the contract and otherwise pursue legal remedies that may be available.

(d) Violations of this Ordinance may be reported to the City which must investigate such complaints. Whether based upon such a complaint or otherwise, if the City, in its sole and absolute discretion, has determined

that the contractor has violated any provision of this Section, the City may issue a written notice to the contractor that the violation is to be corrected within ten calendar days from receipt of notice. In the event the contractor has not corrected the violation, or taken reasonable steps to correct the violation within ten calendar days, then the City may:

- (i) Declare a material breach of the contract and exercise its contractual remedies thereunder, which are to include but not be limited to termination of the contract.
  
- (ii) Declare the contractor to be ineligible to bid in accordance with the procedures set forth in the Responsible Contractor Pre-Qualification Subsection of this Ordinance

**I N D E X**

**DIVISION E**

**GENERAL MATERIAL SPECIFICATIONS**

<b><u>PARA.</u></b>	<b><u>DESCRIPTION</u></b>	<b><u>PAGE</u></b>
1.	General	E-1
2.	Special Materials	E-1
3.	Aggregates	E-1
4.	Block	E-1, 2
5.	Brick	E-2
6.	Cement and Lime	E-2, 3
7.	Concrete	E-3-13
8.	Mortar	E-13
9.	Manholes, Catch Basins & Inlets	E-13
10.	Sewer Pipes	E-13-15
11.	Water Main Materials	E-15-19
12.	Manhole Steps	E-19
13.	Manhole, Catch Basin, Inlet Frames & Covers	E-19
14.	Structural Steel	E-19
15.	Landscaping Material	E-19, 20
16.	Water	E-20
17.	Casing Pipe	E-20, 21
18.	Control Density Backfill	E-21

**Revision Date: 03/16/18**

## DIVISION E

### GENERAL MATERIAL SPECIFICATIONS

1. GENERAL:

All materials shall be new and of the grades specified and shall be the best of their respective kinds for the uses intended. The terms "approved" and "or approved equal" mean that the Engineer must be consulted and his approval given in writing before the material in question is purchased or installed in the work. The approval of any material by the Engineer does not mean the acceptance of the material actually furnished if it should be found defective or inadequate for the purpose intended. Prior to the installation of any herein specified materials, the material manufacturer shall submit a sworn statement that the material has been inspected, tested, and complies with all specification requirements. Said certification shall be submitted to and approved by the Engineer prior to the installation of the material. All materials installed under provisions of this contract must also be certified to having been manufactured in the United States of America or Canada.

2. SPECIAL MATERIALS:

Special brands or grades of materials or devices specified or shown on the drawings are named for the purpose of establishing a standard of quality and character desired. Other materials of quality and adaptability for the purpose for which they are intended may be substituted, but shall have written approval of the Engineer as to quality and adaptability before being incorporated in the work.

3. AGGREGATES:

Aggregates shall not contain strong alkali or organic material which gives a darker than "standard" color when tested in accordance with latest revision of ASTM C-40.

3.1 Fine Aggregate: Fine aggregate shall meet or exceed the requirement as specified in the current edition of the MDOT Standard Specifications for Construction.

Fine aggregate to be utilized in the production of concrete shall either:

1. Contain no particles retained on a number 4 sieve, or
2. Contain no more than 2% soft particles or 4% soft and chert particles as determined by those particles retained on a number 4 sieve.

3.2 Coarse Aggregate: Coarse aggregate shall meet or exceed the requirement as specified in the current edition of the MDOT Standard Specifications for Construction.

3.3 Dense Graded Aggregates: Dense graded aggregates shall meet or exceed the requirement as specified in the current edition of the MDOT Standard Specifications for Construction.

4. BLOCK (Concrete):

Concrete block for manholes, catch basins, and inlets shall conform to ASTM C-139, with the following exceptions:

- 4.1 Shape: The blocks shall be solid curved blocks with the inside and outside surfaces curved to the required radii. The blocks shall have a groove or other approved type of joint at the ends so that the units interlock to form a strong rigid structure. Curve blocks shall have the inside and outside surfaces parallel.
- 4.2 Size: The nominal dimensions for length and height of the block shall be selected by the producer. The nominal dimension for width (thickness) shall be 6, 8 or 12 inches, as called for on the plans, with a tolerance of  $\pm 3$  percent. Where the specified wall thickness on the standard plans is 12 inches, a multiple block wall of two 6-inch wide blocks is permitted. The blocks shall be designed for length so that only full length or half length blocks are required to lay the circular wall of any one course.

Blocks intended for use in the cones or tops of manholes or other structures shall have such shape as may be required to form the structure as shown on the plans with inside and outside joints not to exceed 1/4 inch in thickness.

5. BRICK:

Bricks, when approved for use, shall be concrete conforming to the requirements for concrete building brick of ASTM C-55, Grade S-II.

6. CEMENT AND LIME:

- 6.1 General Requirements: Facilities shall be provided for sampling and inspecting of cement at either the mill, the distribution point, or at the site of the work. The cement shall be stored in such a manner as to permit easy access for proper inspection and identification of each shipment.

Portland cement shall not develop false set when tested by the mortar method in accordance with ASTM C 359. False set will be considered to have occurred if the penetration is less than 5 mm. at the 5, 8, or 11-minute intervals as defined in the test method. These limits shall apply only in the event of difficulties in placing and finishing the concrete due to premature stiffening.

The Contractor shall furnish the Engineer with a copy of the Certification of Quality of Cement, as provided by the producer.

Ten (10) days may be required from the time of sampling cement before results of tests are reported. The City will not consider claims for delays or demurrage for cement held for test by the Engineer when occasioned by failure to notify the City of source of material.

- 6.2 Testing: Testing will be done in accordance with the ASTM specification applicable to the particular material referred to herein except as otherwise provided in the Operating Procedure for Certifying, Sampling, and Testing Portland Cement as established by the Department or as otherwise specified.

- 6.3 Portland Cement:



- a. Type I, IA, III, and IIIA Cements: These Portland cements shall conform to ASTM C 150. The requirements for Gillmore setting time test and compressive strength through the 28-day test shall apply.

6.4 Masonry Cement: Masonry cement shall conform to ASTM C-91, type N, S and M.

6.5 Hydrated Lime: Hydrated lime shall conform to ASTM C-207, Type S and SA.

7. CONCRETE:

Concrete shall consist of a specified mixture of Portland cement or blended Portland cement fine aggregate, coarse aggregate, water and admixtures when required or permitted, combined in the proportions as specified for the various grades of concrete required. Unless otherwise specified, air-entrained concrete will be required. Where the term "sack" is used in this specification in relation to cement, it shall be interpreted as meaning a 94-pound sack of cement.

MATERIALS:

Cement	Division E	Sec. 6
Coarse Aggregate	Division E	Sec. 3.2
Fine Aggregate	Division E	Sec. 3.1
Water	Division E	Sec. 16
Admixtures	Division E	Sec. 7.2

- 7.1 Grade and Mix Requirements: The grade of concrete shall be specified by the Engineer and will be called out on the plans and/or the specifications. The grades specified and the mixture requirements shall be in accordance with Concrete Mixture Table as specified on the 1990 edition of the MDOT Standard Specifications For Construction.

CONCRETE MIXTURES TABLE

Grade of Concrete	Section Number Reference (k)	Class of Coarse Aggregate and Relative Quantity (l)	Cement Type (b)(c) Note: (1)=IA (2)=IS-A I(SM)-A (3)=IP-A,I(PM)-A	Cement Content		Fly Ash Lbs./Cu. Yd.	Water-Reducing or Water-Reducing Retarding Admixtures Optional Except Where Required (d)	Consistency (Slump) inches			Anticipated Minimum Strength of Concrete (g)				
				Lbs. per CYD	Sacks (94lb) per CYD			W/out Admixtures or w/Type A or D Admixture(e)	With Type F or G Admixtures		Flexural, psi		Compressive, psi		
									Prior to Addition of Admixtures	After addition of admixtures (f)	At 3 days	At 7 days	At 14 days	At 28 days	At 28 days
45D	4,5,6	6AA	(1), (2), (3)	658	7.0	0	Req'd.	0-3½	0-3	0-7		625	700	725	4500
40S	3	6A, 17A	(1), (2), (3)	611	6.5	0	Opt.	3-5	0-3	3-7		600	650	700	4000
			(1)	545	5.8	92	Req'd.								
35HE	1,2,12	6A	(1), (2)	658	7.0	0	Opt.	0-3	0-3	0-7	550	600		650	3500
			(3)	790	8.4	0	Opt.								
35T	4	6A	(1), (2), (3)	611	6.5	0	Opt.	3-7	0-4	3-8		550	600	650	3500
			(1)	545	5.8	92	Req'd.								
35P, 35S	1(h), 2, 4, 6, 7, 8, 12, 13, 15, 18, 21	6AA (a), 6A, 17A (j)	(1), (2), (3)	564	6.0	0	Opt.	0-3	0-3	0-7		550	600	650	3500
			(1), (2), (3)	526	5.6	0	Req'd.								
			(1)	517	5.5	78	Opt.								
			(1)	480	5.1	72	Req'd.								
30P, 30S	1, 14, 15, 16	6A, 17A(j)	(1), (2), (3)	517	5.5	0	Opt.	0-3	0-3	0-7		500	550	600	3000
			(1), (2), (3)	489	5.2	0	Req'd.								
			(1)	470	5.0	71	Opt.								
			(1)	451	4.8	68	Req'd.								
30M	9, 10, 11, 17, 19, 20, 21	Commercial grade concrete containing 517 pounds (5.5 sacks) of cement per cubic yard. Portland cement may be reduced up to 20 percent by weight when 1.4 pounds of fly ash are substituted for each 1.0 pound of cement removed.													
X		Unless otherwise specified on the plans or in the proposal, Grade X concrete shall have not less than 282 pounds (3.0 sacks) of cement per cubic yard. Portland cement may be reduced up to 20 percent by weight when 1.4 pounds of fly ash are substituted for each 1.0 pound of cement removed.													

Foot Notes to Concrete Mixtures Table:

- (a) Unless otherwise specified, Coarse Aggregate 6AA shall be used for exposed structural concrete used in bridges, retaining walls, and pumphouses.
- (b) Concrete mixtures containing Type IS-A, I(SM)-A, IP-A, or I(PM)-A cement, or containing ground blast-furnace slag or fly ash, shall not be used on Lower Peninsula projects between October 15 and April 1, nor in the Upper Peninsula between October 1 and April 15, except this restriction does not apply to Grade 40S concrete used in foundation piling below ground level, and Grade 35T concrete used in tremie construction.
- © Non-air entraining cement corresponding to the types of air-entraining cement listed may be used with an approved air-entraining admixture to produce the specified air content.
- (d) The quantity of admixture shall be as recommended by the manufacturer; or as directed by the Engineer, to provide reduction in mixing water. The admixture used in Grade 45D concrete shall be a water-reducing or a water-reducing retarding admixture and shall be used in such amounts as necessary to provide the necessary retardation of setting.
- (e) Occasional batches having a consistency outside the specified range may be used if the slump does not exceed the limits of the specified range by more than ½ inch.
- (f) Occasional batches having a consistency outside the specified limits may be used if the slump does not exceed the maximum limits specified by more than 1 inch. This increase in slump shall be due entirely to the addition of the Type F or G admixture.
- (g) The flexural and compressive strengths are not part of the specifications but are listed for informational purposes only and are the minimum strengths anticipated for the mix proportions specified for the various grades of concrete when cured under standard conditions.
- (h) Grade 35S concrete may be used for Miscellaneous Concrete Pavement.
- (i) The mix design basis for bulk volume (dry, loose) or coarse aggregate per unit volume of concrete is 68% for Grade 40S; 70% for Grades 45D, 35S, 35T, and 30S; 72% for Grades 35HE and 35P; and 74% for Grade 30P.
- (j) Coarse aggregate 17A shall not be used in Grade 35P or 30P concrete unless otherwise specified.

(k) Section Number Reference:

1. Concrete Pavements
2. Concrete Pavement Repairs
3. Foundation Piling
4. Structural Concrete Construction
5. Bridge Railings
6. Bridge Rehabilitation-Concrete
7. Bridge Rehabilitation-Steel
8. Culverts
9. Drainage Structure
10. Slope Protection
11. Paved Ditches
12. Concrete Driveways
13. Concrete Curb and Gutter
14. Bicycle Paths
15. Concrete Sidewalk, Sidewalk Ramps, and Steps
16. Concrete Barriers and Glare Screens
17. Guardrail, Guardrail Anchorages, and Miscellaneous Posts
18. Miscellaneous Precast Concrete Items
19. Rustic Construction
20. Fencing
21. Traffic Signs

## 7.2 Concrete Admixtures:

7.2.1 Air-Entraining Admixtures: Air-entraining admixtures for concrete shall conform to the requirements of ASTM C-260. Only air-entraining admixtures that appear on the MDOT list of approved admixtures may be used.

7.2.2 Concrete Accelerators: Chemical admixtures, other than calcium chloride, for accelerating the set of Portland cement concrete shall conform to the requirements for Type C or Type E admixtures of ASTM C-494. Only admixtures that appear on the MDOT list of approved admixtures may be used.

Calcium chloride for use in flake or pellet form or on the job preparation of admixture solutions shall conform to the requirements specified for 77% grade or 94% grade calcium chloride of ASTM D-98. The calcium chloride shall not be placed in contact with the cement, but shall be added to the mixing water and thoroughly mixed before the aggregate is added. The cement shall be added last.

7.2.3 Water-Reducing Admixtures and Water-Reducing Retarding Admixtures for Concrete: The water-reducing admixture shall conform to the requirements for Type A and the water-reducing retarding admixtures shall conform to the requirements for Type D of the specifications for chemical admixtures for concrete of ASTM C-494, with the additions stated below. Only the admixtures that appear on the MDOT approved list of admixtures may be used.

Before approval is given for the use of a water-reducing or a water-reducing retarding admixture, the Contractor shall submit evidence based on tests made in a recognized laboratory showing that the material meets the specified requirements.

- a. For admixtures to be used in prestressed concrete, concrete for bridge superstructure, concrete for bridge railings, or concrete containing galvanized steel or aluminum, no calcium chloride shall be added during manufacture and the chloride ion content by analysis shall not exceed 0.5 percent by weight of the admixture.
- b. Type A and Type D admixtures to be used in concrete for other purposes may contain calcium chloride provided that the admixture, when used at the normal dosage, does not contribute more than 0.10 percent chloride ion by weight of cement to the concrete mixture.

## 7.3 CONCRETE CURING MATERIALS:

### 7.3.1 Concrete Curing Materials for Pavements:

- a. White Membrane Curing Compound: White membrane curing compound for curing concrete shall conform to the requirements of ASTM C 309, Type 2, Class B Vehicle, with the following additions:
  1. Tests for moisture retention, reflectance, and drying time shall be based on a curing compound application rate of one gallon per 200 square feet of surface.
  2. Three weeks may be required from the time of sampling before results are reported. Compound on hand at the end of a construction season and carried over to the next season shall not be used until resampled and approved.

3. The compound shall be packaged in clean containers. The compound shall be thoroughly agitated to a uniform consistency with the pigment uniformly suspended before transferring the compound between containers and before use.
- b. Transparent Curing Compound for Base Course: Transparent membrane curing compound for curing base course concrete shall conform to the requirements of ASTM C 309, Type 1-D, Class B Vehicle. Testing shall be as specified under Subsections 7.3.1-a-1 and 2.

#### 7.3.2 Concrete Curing Materials for Structures:

- a. Transparent Membrane Curing Compound for Structures: Transparent membrane curing compound for curing structural concrete shall conform to the requirements of ASTM C 309, Type 1, Class B vehicle except that the compound shall be sufficiently transparent and free from permanent color to result in no pronounced change in color from the of the natural concrete. Testing shall be as specified under Subsections 7.3.1-a-1 and 2.
- b. Interim Curing Compound for Bridge Decks: The interim curing compound shall be a white-pigmented, modified, linseed oil based material, either of a water solubilized or an emulsion type and shall meet the requirements for Type 2 compounds of ASTM C 309, with the following exceptions and additions.

Tests for moisture retention will be made at an application rate of one gallon per 150 square feet.

Failure to meet the requirements for reflectance and drying time will not be cause for rejection.

- c. Insulating Blankets: Insulating blankets shall meet the requirements of Federal Specification HH-1-521e, Insulation, Building, Mineral-Wool; Batts, Loose-Fill, and Granular-Fill, Type 1-Batts, Class C, with enveloping membranes.

The thermal conductivity (k) of the insulating blanket shall not exceed 0.27 BTU per hour per square foot for a temperature gradient of one degree F per inch of thickness at mean temperature of 75 F.

The insulating blanket shall be completely enclosed in liners bonded to both sides of the insulating mat.

Insulating blankets shall have either the minimum thickness or the minimum R value specified in the following Table:

## INSULATION REQUIREMENTS

<b>Thickness of Pour, Inches</b>	<b>Insulation Requirements, minimum</b>			
	<b>For Unlined Steel Forms</b>		<b>For Wood-Lined Steel or Wood Forms</b>	
	<b>Inches</b>	<b>R Value</b>	<b>Inches</b>	<b>R Value</b>
<b>12 or less</b>	<b>2</b>	<b>7.0</b>	<b>2</b>	<b>5.75</b>
<b>Over 12 to 24</b>	<b>2</b>	<b>7.0</b>	<b>1½</b>	<b>5.75</b>
<b>More than 24</b>	<b>1½</b>	<b>5.25</b>	<b>1</b>	<b>4.0</b>

- d. Polystyrene Insulation: Polystyrene insulation shall be expanded polystyrene cut from preformed material having an average cell diameter of less 1.0 mm. The thermal conductivity (k) of the material shall not exceed 0.27 BTU per hour per square foot for a temperature gradient of one degree F per inch of thickness at mean temperature of 75 F when tested in accordance with ASTM C 177. The material shall also meet the following requirements:

<u>PROPERTY</u>	<u>REQUIREMENTS</u>	<u>ASTM METHOD</u>
Density, lb/cu ft	0.90 min.	C 303
Compressive Strength, psi	9.0 min	D 1621
Flexural Strength, psi	25.0 min	C 203
Water Absorption, % by volume	2.0 max	C 272

- 7.3.3 Burlap: Burlap shall be, at the time of using, in good condition, free of holes, dirt, clay or any other substance which would have a deleterious effect upon concrete. Burlap shall be of such quality that it will absorb water readily when dipped or sprayed and shall weigh not less than 10.8 ounces per square yard when dry and clean.
- 7.3.4 Waterproof Paper: Waterproof paper for curing concrete shall conform to the current ASTM or AASHTO "Specifications for Waterproof Paper for Curing Concrete", Designation C-171 and M-139 respectively.
- 7.3.5 Polyethylene Sheeting: White polyethylene sheeting shall consist of a single sheet having a thickness of not less than 4 mills (.004). Moisture retention shall conform to the requirements of ASTM Specifications Designation C-156, except the Air-Entraining Portland Cement shall be used in the test. The material shall be tested in accordance with the current ASTM Specifications Designation D-882 Method A.

### 7.4 CONCRETE JOINT MATERIAL:

- 7.4.1 Expansion Joint - Fiber Joint Filler for Concrete Construction: Fiber joint filler shall conform to the requirements of ASTM D 1751. Fiber joint filler shall have such physical characteristics as not to be deformed or broken by ordinary twisting, bending, or handling when exposed to atmospheric conditions.

For concrete pavement, fiber fillers shall be cut rectangular in shape and to a width as shown on the plans. Where holes for load-transfer bars are required, the holes shall be punched in accordance with the plans. Holes in the filler for concrete pavement repair shall be punched at the site of the repair after the location of load-transfer bars is determined.

7.4.2 Joint Sealants for Concrete Construction:

- a. Hot-poured Joint Sealant: Hot-poured type joint sealant shall conform to the requirements of ASTM C 3405 except that the fine aggregate incorporation into the concrete mixture used to make the bond blocks shall be 2NS sand.

7.5 CONCRETE REINFORCEMENT:

- 7.5.1 Bar Reinforcement for Structures: Bar reinforcement for structures shall be deformed bars meeting the requirements of ASTM A 706 or for Grade 60 steel bars of ASTM A 615, A 616, or A 617, except as follows:

Unless otherwise specified, spiral reinforcement shall meet the requirements for plain or deformed Grade 40 steel bars of ASTM A 615 or A 617 or for cold-drawn wire of ASTM A 82.

Bar reinforcement for prestressed concrete beams meeting the requirements for Grade 40 steel bars of ASTM A 615 or A 617 or Grade 50 steel bars of ASTM A 616 will be permitted.

- a. Bending: Bent bar reinforcement shall be cold shop bent to the shapes shown on the plans, and unless otherwise provided on the plans or by authorization, bends shall be made in accordance with the following requirements. Any field bending shall be done cold as specified herein. Any heat bending will be cause for rejection.

For ordinary bends, the finished bend diameter shall be as specified in the following Table:

Bar Size	Inside Diameter of Bend
Nos. 3 through 8	6 bar diameters
Nos. 9 through 11	8 bar diameters
Nos. 14 and 18	10 bar diameters

For bends in stirrups and ties, the inside diameter shall not be less than 4 bar diameters.

Tolerances in cutting and bending bars are as established in the Standard Practice of the Concrete Reinforcing Institute and Detailing Manual of the American Concrete Institute.

- b. Bundling and Tagging: Bar reinforcement shall be shipped in standard bundles, tagged, and marked in accordance with the CRSI Code of Standard Practice.
- c. Epoxy Coating: Steel reinforcement required to be epoxy coated shall be coated in accordance with the requirements of ASTM D 3963, with the following exceptions and additions:

1. The coating material, in addition to meeting the requirements of ASTM D 3963, shall be selected from one of the products on the MDOT Qualified Products List.
  2. The location of tests made by MDOT on samples obtained for determining thickness of coating, adhesion of coating, and holidays may be made either at the coating applicators plant or at the Laboratory. A sufficient quantity of bars over plan quantity shall be coated to permit splicing to replace bars removed for test samples.
  3. The coating applicator shall furnish written certification that the coated reinforcing bars were cleaned, coated, and testing in accordance with the requirements of ASTM D 3963.
  4. Bars may be coated before or after bending except any damage to the coating shall be repaired in accordance with the recommendations of the manufacturer of the epoxy coating.
- d. Bar Chairs and Wire Ties for Epoxy Coated Steel Reinforcement: The bar chairs and wire ties required for placing and fastening the steel reinforcement shall meet the following requirements:

*Bar chairs shall be plastic coated wire, epoxy coated wire, or plastic.*

*Wire ties shall be plastic coated wire, epoxy coated wire, or molded plastic clips.  
Tie-down wires shall be plastic coated.*

7.5.2 Welded Steel Wire Fabric Reinforcement: Welded steel wire fabric for reinforcement of concrete shall conform to ASTM A 185 and shall be fabricated as shown on the plans.

7.5.3 Bar Reinforcement for Pavements:

- a. Dowels and Bar Reinforcement for Curbing, Glare Screen, Concrete Barriers, and Filler Walls: Dowels and bar reinforcement for curbing, glare screen, concrete barriers, and the filler walls between bridge piers shall be deformed steel bars meeting the requirements of ASTM A 706 or for Grades 40, 50, or 60 of ASTM A 615, A 616, or A 617.
- b. Dowel Bars for Transverse Expansion and Contraction Joints: The dowels shall be straight, smooth, round bars conforming to the dimensions shown on the plans. Dowel bars shall have a minimum yield strength of 40,000 psi and a minimum tensile strength of 70,000 psi when tested after being welded to the dowel basket of 70,000 psi when tested after being welded to the dowel basket assembly, when welding is required.

Except for dowel bars for concrete pavement repair, the dowel bars shall be attached to a basket of approved design by welding or some mechanical means such that the dowels will be able to withstand the forces imposed by concrete placement and still maintain alignment.

For expansion joints, the dowel bars shall be fitted with expansion caps as shown on the plans. The material and design of the caps shall meet the approval of the Engineer before they may be used in the work.



For contraction joints, the free end of the dowel bar shall be free of burrs and shall be saw cut or sheared. If sheared, an expansion cap shall be placed on the free end.

Dowel bars for use in both expansion and contraction joints in concrete pavement repair shall be saw cut on both ends.

Dowel bars shall be protected from corrosion by of the following methods:

- c. Coatings for Dowel Bars: The bars shall be coated with one of the rust-inhibiting coatings included on the Department's list of prequalified coatings, with a precoating surface preparation procedure designed for the service, except that dowel bars for concrete pavement repair shall be shop coated on the cylindrical surface with a durable exterior type, rust-inhibitive paint. The coatings are classified as Type A or Type B coatings based on whether or not a bond breaker is required. Bars with Type A coatings do not require an additional bond-breaking coating.

The rust-inhibiting coatings on each Type A or Type B dowel bar shall have an average thickness equal to the average coating thickness on which the prequalification approval was based, within a tolerance of  $\pm 30$  percent. In addition, the average coating thickness shall not be less than 0.010 inch on any bar, with individual determinations within a tolerance of  $\pm 0.004$  inches of the average. The coating need not be applied to the end faces of the bars and will not be required within 3 inches of the end which will be fixed in the supporting basket by welding or other mechanical means.

To prevent bonding to concrete, Type B coated dowels shall also be coated with a bituminous material meeting the requirements of MC-70, MS-2a, or RC-250, per MDOT specifications. This coating may be applied by the supplier or by the Contractor. The supplier of the bituminous material shall furnish certification that the coating material shall be a minimum of 0.010 inch thick. The sleeve shall be closely wrapped around the dowel bar so that there will be no movement of the sleeve in relation to the bar and no areas in which the sleeve is not in contact with the bar. Lack of contact will be determined by the formation of dimples in the sleeve when tapped lightly with a ball-peen hammer or similar tool. The lap shall be fastened with a folded lock seam or a continuous weld. The sleeve will not be required within 3 inches of the end of the bar which will be fixed in the supporting basket by welding or other mechanical means.

In lieu of placing a sleeve on a carbon steel bar, a solid stainless steel bar may be furnished, provided it meets the other applicable requirements for dowel bars.

The dowels shall be coated with an approved material to prevent bonding prior to incorporation in the concrete.

- d. Devices for Transverse End-of-Pour Joints: Devices for end-of-pour joints shall be steel hook bolts or straight tie bars.

Hook bolts shall meet the requirements for hook bolts for longitudinal bulkhead joints as specified in Subsection 7.6-c.

Straight tie bars shall be No. 5 or larger steel deformed bars, 30 or more inches in length, and shall meet the requirements specified in ASTM A 615, A 616, A 617, or A 706. Straight ties bars shall be epoxy coated in accordance with the requirements specified in Subsection 7.5.1-c, except that the epoxy coating need not be applied within 4

inches of each end of the tie bar and any damage to the coating within 4 inches of each end of the bar need not be repaired.

#### 7.6 Lane Ties for Longitudinal Pavement Joints.

- a. Straight Tie Bars: Straight tie bars shall be No. 5 or larger steel deformed bars, 24 or more inches in length, and shall meet the requirements specified in ASTM A615, A 616, A 617, or A 706. The tie bars shall be epoxy coted in accordance with the requirements specified in Subsection 8.05.03-c, except that the epoxy coating need not be applied within 4 inches of each end of the tie bar and any damage to the coating within 4 inches of each end of the bar need not be repaired.
- b. Bent Tie Bars for Bulkhead Joints: Bent tie bars shall be No. 5 or larger steel deformed bars 24 or more inches in length as measure around the outside of the bend. The tie bars shall have a yield strength level of not less than 40,000 psi, and shall have sufficient strength, ductility, and workability to withstand being bent to approximately a 90 degree angle, restraightened, and then withstand the pull-out test requirements per MDOT specifications. The tie bars shall be epoxy coated in accordance with the requirements specified in Subsection 7.5.1-c, except that the epoxy coating need not be applied within 4 inches of each end of the tie bar and any damage to the coating within 4 inches of each end of the bar need not be repaired.
- c. Hook Bolts for Bulkhead Joints: Hook bolts for bulkhead joints shall consist of two hook bolts mechanically coupled to form a lane-tie assembly as shown on the plans. The lane-tie assembly shall have an ultimate tensile strength of not less than 24,000 pounds. The threaded portion of the hook bolts shall have nominal 3/4 inch-10 UNC threads and a shank diameter not less than 5/8 inch, nominal bar size (where an existing pavement is to be widened and the pavement contains smaller size couplings, the second half of the lane tie shall be a hook bolts of size compatible with the existing coupling.) The lane-tie assembly shall have a means to prevent the threading of the hook bolts beyond the center of the coupling. The minimum embedment length for standard hook bolts on each side of the joint shall be 7-5/8 inches.
- d. Expansion-Anchored Lane Tie Devices for Bulkhead Devices: Expansion-anchored lane-tie devices for longitudinal bulk-head joints must meet Department approval before being used in the work. The Department will maintain a list of approved anchors which have met the minimum requirements for size and resistance to pull-out and slippage. Hook bolts used with expansion anchors shall have a nominal thread size of 3/4 inch or larger, as necessary for the type of anchor used, and a nominal shank diameter of 5/8 inch or larger. The length shall be as necessary to engage the expansion anchor and extend beyond the face of the existing slab for a minimum of 7-5/8 inches.
- e. Other Longitudinal Bulkhead Joint Devices: Bulkhead joint devices other than bent bars, hook bolts, and expansion-anchored devices shall have a nominal shank diameter of at least 5/8 inch and such additional size as necessary to provide for nominal 3/4 inch-10 UNC threads. They shall have sufficient length and such configuration that, when properly installed in concrete, they will withstand a pull-out test of 12,000 pounds without slippage in excess of 1/32 inch. The second half of mechanically coupled devices shall have the same configurations and embedment length as the first half or shall be a hook bolt having the minimum embedment length specified.

- 7.7 Structure Expansion Anchors and Bolts: Expansion anchors for the size bolt required shall be torque-type anchors or self-drilling flush-type anchors, unless otherwise shown on the plans.
- Bolts shall be of the size and shape shown on the plans. The steel used in the bolts shall conform to the requirements for low-carbon steel threaded standard fasteners of ASTM A 307, Grade A Bolts.
8. MORTAR:  
Masonry mortar shall be composed of one part Portland Cement and 2½ parts of 2NS fine aggregate by volume. Not more than 15% of the volume of the cement of Hydrated Lime may be added to improve workability. Masonry cement may be used only with the approval of the Engineer.
9. MANHOLES, CATCH BASINS AND INLETS:
- 9.1 Manholes and Grade Adjusting Rings: Unless otherwise specified on the plans, all manholes and grade adjusting rings shall be constructed of precast reinforced concrete manhole sections conforming to the requirements of ASTM C-478 and C-443.
- 9.2 Catch Basins: Catch basin structures shall be constructed as detailed on the plans.
- 9.3 Inlet Structures: Inlet structures shall be constructed as detailed on the plans.
10. SEWER PIPES:
- 10.1 Acrylonitrile-Butadiene-Styrene Sewer Pipe: 8" thru 15" (A.B.S. Truss Sewer Pipe). When A.B.S. Truss Pipe is specified for installation, the pipe shall conform to the specifications of ASTM D-2680. All A.B.S. Truss Sewer Pipe shall provide an elastomeric gasket joint to prevent exfiltration or infiltration and shall conform to the requirements of ASTM D 3212.
- 10.2 Corrugated Metal Pipe (C.M.P.): All corrugated metal pipe shall be new of first quality and shall be furnished in such lengths as are indicated on the plans. Unless otherwise specified, the pipe shall be of the riveted type, with lap joint construction; shall be true and straight throughout its entire length, and free from all imperfections. Unless otherwise specified, the pipe shall meet all requirements of AASHTO M-36. The type and gauge of galvanized corrugated metal pipe to be furnished shall be as shown on the plans or specified including plain, perforated, bituminous coated, paved, and/or asbestos bonded.
- 10.3 Concrete Pipe:
- 10.3.1 Non-reinforced Concrete Pipe: Non-reinforced concrete pipe shall meet the requirements of ASTM C-14.
- 10.3.2 Reinforced Concrete Pipe: Reinforced concrete sewer pipe shall meet the requirements of ASTM C-76.
- 10.3.3 Reinforced Concrete Elliptical Pipe: Reinforced concrete elliptical sewer pipe shall meet the requirements of ASTM C-507.
- 10.3.4 Unless otherwise specified, all concrete pipe joints shall be rubber "O-Ring" gasket joint conforming to the requirements of ASTM C-443.
- 10.4 Ductile Iron Pipe: Ductile iron pipe shall meet the requirements of AWWA C151 (ANSI A21.51). The minimum pipe thickness shall be Pressure Class 350 per AWWA C150 (ANSI A21.50) for 12"

diameter pipe size & smaller and Pressure Class 250 per AWWA C150 (ANSI A21.50) for 14" diameter pipe size and larger. Pipe joints shall be bolted mechanical or push-on rubber gasketed meeting the requirements of AWWA C111 (ANSI A21.11).

All fittings (3"~24") shall meet the requirements of AWWA C153 (ANSI A21.53) Pressure Class 350 or AWWA C110 (ANSI A21.10) Pressure Class 350. All fittings shall be provided with a bolted mechanical or push-on rubber gasketed joint meeting the requirements of AWWA C111 (ANSI A21.11). All fittings shall be constructed of ductile iron.

All pipe and fittings shall be inside coated with a cement-mortar lining in accordance with AWWA C104 (ANSI A21.4) and be outside coated with a bituminous coating approximately 1 mil in thickness and wrapped with a polyethylene encasement. The polyethylene film shall be a minimum 8 mil thickness and installed as per AWWA C105. All nuts, bolts, and washers used on mechanical joint pipe shall be #304 stainless steel or COR-BLUE, Cor-Ten coated with a ceramic-filled, baked-on fluorocarbon resin as manufactured by Birmingham Fastener 'B' or approved equal.

Sections of restrained joint pipe shall require the main line pipe material to be Ductile Iron Pipe. In locations where Ductile Iron Mechanical Joint Pipe is used, the restrained joint shall be Megalug field installed joint restraint as manufactured by EBAA Iron, Inc., or approved equal and must be wrapped with a polyethylene encasement. The polyethylene film shall be a minimum 8 mil thickness and installed as per AWWA C105. The MEGA-BOND restraint coating system shall be provided on all casing bodies, wedge assemblies, and related parts. The restrained joint system shall be pressure rated for 350 psi (4"~16") and 250 psi (18"~24") and be rated in accordance with the performance requirements of ANSI/AWWA C111 / A21.11 rubber gasket joints for ductile iron pressure pipe and fittings. In locations where Ductile Iron Push-on Joints pipe is used the appropriate restraining gasket must be used in accordance with the pipe manufacture. Approved restrained joint gaskets are Fast Grip Gasket as manufactured by American Ductile Iron Pipe, Field Lok Gasket as manufactured by U.S. Pipe or approved equal. The use of restrained joint installations does not eliminate or waive the requirement to provide thrust blocks where called for on the plans, specifications or standard details.

- 10.5 Polyvinyl Chloride (PVC) Sewer Pipe: All 4" thru 15" PVC gravity sewer pipe shall conform to the requirements of ASTM D-3034, Type PSM, SDR Max 35, PVC sewer pipe and fittings. All 18" thru 27" PVC gravity sewer pipe shall conform to the requirements of ASTM F-679.

The term PSM is not an abbreviation, but rather an arbitrary designation for products having certain dimensions.

All PVC pipe shall provide an elastomeric gasket joint to prevent exfiltration or infiltration and shall conform to the requirements of ASTM D-3212. The critical sealing dimensions of the bell, spigot, and gasket shall be in accordance with the manufacturer's standard dimensions and tolerances. The elastomeric compound shall comply in all respects with the physical requirements specified in ASTM D-1869, C-361 and C-443. The pipe bell shall consist of an integral wall section with a solid cross section elastomeric gasket factory assembled, securely locked in place to prevent displacement. The gasket shall be the only element depended upon to make the joint flexible and watertight.

- 10.6 Vitrified Clay Pipe: Vitrified clay sewer pipe when approved for installation shall conform to the standards of ASTM C-700 extra strength pipe. Compression joints for vitrified clay pipe and fittings shall conform to ASTM C-425.

- 10.7 Smooth-Lined Corrugated Plastic Pipe: Smooth-lined corrugated plastic pipe when approved for use in storm sewer applications shall conform to the standards of AASHTO M 294 Smooth-Lined Corrugated PE Pipe, Type S, (SLCPP). Use of said pipe shall be in accordance with the 1990 edition of the Michigan Department of transportation Standard Specifications for Construction as revised on 06-04-92, 05-13-92, and 07-10-92.
- 10.8 Force Main Pipe: Sanitary Sewer Force main pipe shall be cement lined ductile iron pipe. Ductile iron pipe shall meet the requirements of AWWA C151 (ANSI A21.51). The minimum pipe thickness shall be Pressure Class 350 per AWWA C150 (ANSI A21.50) for 12" diameter pipe size & smaller. Pipe joints shall be bolted mechanical or push-on rubber gasketed meeting the requirements of AWWA C111 (ANSI A21.11). All pipe shall be inside coated with a cement-mortar lining in accordance with AWWA C104 (ANSI A21.4). Pipe shall be outside coated with a bituminous coating approximately 1 mil in thickness and wrapped with a polyethylene encasement. The polyethylene film shall be a minimum 8 mil thickness and installed as per AWWA C105.

It is also acceptable to use AWWA C900 PVC water main pressure pipe for sanitary sewer force main pipe. PVC pressure pipe shall be made from Class 12454-A or Class 12454-B virgin compounds as defined in ASTM D1784. PVC pressure pipe shall provide a hydrostatic design basis (HDB) rating of 4,000 psi @ 73.4°F per the requirements of PPI TR-3. The outside diameter (OD) of PVC pressure pipe shall conform with the OD dimensions of cast-iron pipe. PVC pressure pipe shall have a dimension ratio of 18 and a minimum pressure class of 150 psi. All pipe shall have an integral wall-thickened bell end designed for joint assembly using a factory installed elastomeric gasket conforming to ASTM F-477, D-3139, & UNI-B-11 to affect the pressure seal. All pipe shall be designed for direct connection into ductile iron pipe and fittings.

All nuts, bolts, and washers used on mechanical joint pipe shall be #304 stainless steel or COR-BLUE, Cor-Ten coated with a ceramic-filled, baked-on fluorocarbon resin as manufactured by Birmingham Fastener 'B' or approved equal.

Wherever sanitary sewer force mains deflect under other utility lines, stream crossings or be installed in casing pipes, the force main pipe material shall be ductile iron restrained joint pipe. The force main shall be installed equal to water main pipe and be furnished with thrust blocks as required for water mains (see section 10.4). Force mains shall be tested at 150psi for two hours and must meet the pressure and leakage requirements of AWWA C-600.

## 11. WATER MAIN MATERIALS:

Whenever stated in these specifications, any reference to AWWA Specifications shall mean the latest revision of the specification.

- 11.1 Polyvinyl Chloride (PVC) and Molecularly Oriented Polyvinyl Chloride (PVCO) Pressure Pipe: PVC pressure pipe shall meet the requirements of AWWA C900. PVCO pressure pipe shall meet the requirements of AWWA C909. Both PVC and PVCO pressure pipe are permitted in pipe sizes 8" through 12" diameter and must meet ANSI / NSF Standard 61 (Health) and 14 (Performance) standards. All PVC and PVCO pressure pipe shall be stamped NSF-pw. PVC and PVCO pressure pipe shall be made from Class 12454-A or Class 12454-B virgin compounds as defined in ASTM D1784. PVC pressure pipe shall provide a hydrostatic design basis (HDB) rating of 4,000 psi @ 73.4°F per the requirements of PPI TR-3. PVCO pressure pipe shall have a starting stock HDB rating of 4,000 psi @ 73.4°F per the requirements of PPI TR-3. Finished PVCO pressure pipe shall an HDB rating of 7,100 psi per ASTM D1598 and D2837. The outside diameter (OD) of PVC and PVCO pressure pipe shall conform with the OD dimensions of cast-iron pipe. PVC pressure pipe shall have a dimension ratio of 18 and a minimum pressure

class of 150 psi. PVCO pressure pipe shall have a minimum pressure class of 150 psi. All pipe shall have an integral wall-thickened bell end designed for joint assembly using a factory installed elastomeric gasket conforming to ASTM F-477, D-3139, & UNI-B-11 to affect the pressure seal. All pipe shall be designed for direct connection into ductile cast iron pipe and fittings.

- 11.1.1 Polyvinyl Chloride (PVC) Pressure Pipe 14" through 48" diameter: PVC pressure pipe shall meet the requirements of AWWA C905, must meet ANSI / NSF Standard 61 (Health) and 14 (Performance) standards, and shall be stamped NSF-pw. PVC pressure pipe will be permitted in pipe sizes 14" through 48" diameter. PVC pressure pipe shall be made from Class 12454-A or Class 12454-B virgin compounds as defined in ASTM D1784, providing a hydrostatic design basis rating of 4,000 psi @ 73.4°F per the requirements of PPI TR-3. The outside diameter (OD) of PVC pressure pipe shall conform with the OD dimensions of cast-iron pipe. The PVC pressure pipe shall have a dimension ratio of 18 and a pressure class of a minimum 235 psi. Pipe shall have an integral wall-thickened bell end designed for joint assembly using a factory installed elastomeric gasket conforming to ASTM F-477, D-3139, & UNI-B-11 to affect the pressure seal. Pipe shall be designed for direct connection into ductile cast iron pipe and fittings.
- 11.2 Ductile Iron Pipe: Ductile iron pipe shall meet the requirements of AWWA C151 (ANSI A21.51). The minimum pipe thickness shall be Pressure Class 350 per AWWA C150 (ANSI A21.50) for 12" diameter pipe size & smaller and Pressure Class 250 per AWWA C150 (ANSI A21.50) for 14" diameter pipe size and larger. Pipe joints shall be bolted mechanical or push-on rubber gasketed meeting the requirements of AWWA C111 (ANSI A21.11). All pipe shall be inside coated with a cement-mortar lining in accordance with AWWA C104 (ANSI A21.4). Pipe shall be outside coated with a bituminous coating approximately 1 mil in thickness and wrapped with a polyethylene encasement. The polyethylene film shall be a minimum 8 mil thickness and installed as per AWWA C105. All nuts, bolts, and washers used on mechanical joint pipe shall be #304 stainless steel or COR-BLUE, Cor-Ten coated with a ceramic-filled, baked-on fluorocarbon resin as manufactured by Birmingham Fastener 'B' or approved equal.
- 11.3 Prestressed Concrete Pressure Pipe: Prestressed concrete pressure pipe shall meet the requirements of the revision of AWWA C301. The pipe shall be designed for a sustained internal pressure of 150 psi.
- 11.4 Detectable Tracer Tape / Wire: This tape shall be installed for positive pipe locations by pipe/cable locators and a visible warning to excavators on PVC & PVCO pipe only. Install 24-inches above the water main pipe. The detection tape shall be not less than 2-inches wide; shall be inert, bonded layer plastic with a metalized foil core. The tape shall be colored blue per the APWA Uniform Color Code with minimum 1-1/4" high lettering warning of buried water line repeated at least every 24-inches. A detectable tracing wire shall be installed with all PVC & PVCO pipe at the pipe spring line. The wire shall be #12 Copper-Clad Steel (CCS) High Strength Soft Drawn 380# tracer wire as manufactured by Copperweld. Splices or connecting two wires shall utilize solder, crimp connections, split bolt connectors, greased wire nut or silicon filled wire nut as recommended by the manufacturer.
- 11.5 Fire Hydrants: Fire hydrants shall be East Jordan Iron Works 5BR-250 or Mueller 5-1/4" Super Centurion 250 having the following features: a 5-1/4" valve opening, 6" mechanical joint inlet as per ANSI A21.11, two (2) each 2-1/2" hose nozzles, one (1) 4-1/2" pumper nozzle, 1-1/2" pentagon shaped operating nuts for installation in a 5' 6" trench, open left, breakable flange and bolts, and factory painted yellow above grade and black below. All hose and pumper nozzles shall be national standard threaded. All hydrants shall be furnished with the drainage

hole factory plugged. Dry-barrel fire hydrants shall meet the requirements of AWWA C502. All hydrants are to be supplied with nuts, bolts and washers being #304 stainless steel (above and below grade). Each hydrant shall be wrapped with a polyethylene encasement below grade. The polyethylene film shall be a minimum 8 mil thickness and installed as per AWWA C105. All joints including the hydrant tee shall be restrained joints.

- 11.6 Resilient Seated and Resilient Wedge Gate Valves (3"-12"): Resilient seated gate valves shall have the following features: ductile or cast iron body, bronze mounted, non-rising stem, rubber-covered gate, open left, design operating pressure 250 psi, 2" operating nut, and mechanical joint ends as per AWWA C111 (ANSI 21.11). Gate valves shall not be used in water mains with diameters larger than 30 inches. All resilient seated gate valves shall meet the requirements of AWWA C509 in cast iron or ductile iron construction or AWWA C515 ductile iron construction. Acceptable manufacturers for applicable C509 and C515 Resilient Wedge Valves in these sizes are: EJIW, American Flow Control, Mueller, Clow, Kennedy, or as approved. All valve body internal and external surfaces and bonnet shall have a fusion bonded epoxy coating, complying with ANSI/AWWA C550, applied electrostatically prior to assembly. All nuts, washers, and bolts shall be #304 stainless steel. Each valve shall be wrapped with a polyethylene encasement with a minimum thickness of 8 mil and installed as per AWWA C105.
- 11.6.1 Resilient Wedge Valves (14" to 36"): When permitted on the plans, valves 14" to 30" shall be resilient wedge type rated for 250 psi cold water working pressure. Valve body, bonnet, wedge and operating nut shall be constructed of ductile iron meeting AWWA C515. The exterior of the ductile iron wedge shall be fully encapsulated with rubber. The wedge shall be symmetrical and seal equally in either direction. The 2" operating nut shall be constructed of ductile iron and have four (4) flats at the stem connection to assure even input torque to the stem. All gaskets to be pressure energized O-ring. Stem shall be sealed by three O-rings. The top two O-rings shall be replaceable with the valve fully open and while subject to full rated working pressure. Valves shall have thrust washers located with one above and one below the thrust collar to assure trouble free operation of the valve. All internal and external surfaces of the valve body and bonnet shall have a fusion bonded epoxy coating, complying with ANSI/AWWA C550, applied electrostatically prior to assembly. All nuts, washers and bolts are to be #304 stainless steel. Each valve shall be wrapped with a polyethylene encasement with a minimum thickness of 8 mil and installed as per AWWA C105. Acceptable manufacturers for C515 Resilient Wedge Valves in these sizes are: American Flow Control, Kennedy, or as approved.
- 11.7 Rubber-Seated Butterfly Valves (16" & larger): Butterfly valves shall be Kennedy Valve Manufacturing Company Style 4500 or Pratt Model "Ground Hog" having the following features: ductile-iron body, rubber-seated, open left, mechanical joint ends as per AWWA C111 (ANSI A21.11) and 2" square operating nut. All butterfly valves shall meet the requirements of AWWA C504, Class 150B. All valves used in 16" or larger diameter pipe shall be butterfly valves, unless specified. Equivalent butterfly valves may be accepted upon written approval of the City Engineer before Bid closing date. All valve body internal and external surfaces and bonnet shall have a fusion bonded epoxy coating, complying with ANSI/AWWA C550, applied electrostatically prior to assembly and all nuts, washers, and bolts are to be #304 stainless steel. Each valve shall be wrapped with a polyethylene encasement with a minimum thickness of 8 mil and installed as per AWWA C105.
- 11.8 Hydrant Valves: Hydrant valves shall be of the same specifications as resilient seated or resilient wedge gate valves as specified in Section 11.6. All hydrant valves shall be 6" in size.

- 11.9 Valve Boxes: Valves boxes shall be Tyler Pipe Series 6860 Box D having the following features: constructed of cast iron, three (3) pieced, 5-1/4" shaft, screw type adjustment, adjustable 45" - 66" extension range, and complete with a lid marked "WATER" in raised letters. Valve boxes shall be furnished with a #6 round base for 12" and smaller valves and a #8 round base or equivalent for 12" - 16" valves. Valve box base for valves larger than 16" shall be as approved by the Engineer. Approved equals are the Bibby-Ste-Croix D valve box and EJIW 8560 valve box D with a #6 base.
- 11.10 Fittings-Sizes 3" Through 24": All fittings shall meet the requirements of AWWA C153 (ANSI A21.53) Pressure Class 350 or AWWA C110 (ANSI A21.10) Pressure Class 350. All fittings shall be provided with a bolted mechanical or push-on rubber gasketed joint meeting the requirements of AWWA C111 (ANSI A21.11). All fittings shall be constructed of ductile iron. Fittings shall be inside coated with a cement-mortar lining in accordance with AWWA C104 (ANSI A21.4). Also fittings shall be outside coated with a bituminous coating approximately 1 mil in thickness and wrapped with a polyethylene encasement. The polyethylene film shall be a minimum 8 mil thickness and installed as per AWWA C105. All mechanical joint fitting bolts, nuts, and washers shall be supplied with #304 stainless steel or COR-BLUE, Cor-Ten coated with a ceramic-filled, baked-on fluorocarbon resin as manufactured by Birmingham Fastener 'B' or approved equal.
- 11.11 Fittings-Sizes 30" Through 64": All fittings shall meet the requirements of AWWA C110 (ANSI A21.10) Pressure Class 250. All fittings shall be provided with a bolted mechanical or push-on rubber gasket joint meeting the requirements of AWWA C111 (ANSI A21.11). All fittings shall be constructed of ductile iron. Fittings may be constructed of gray iron when ductile iron is not available. Fittings shall be inside coated with a cement-mortar lining in accordance with AWWA C104 (ANSI A21.4). Also fittings shall be outside coated with a bituminous coating approximately 1 mil in thickness and wrapped with a polyethylene encasement. The polyethylene film shall be a minimum 8 mil thickness and installed as per AWWA C105. All mechanical joint fitting bolts, nuts, and washers shall be supplied with #304 stainless steel or COR-BLUE, Cor-Ten coated with a ceramic-filled, baked-on fluorocarbon resin as manufactured by Birmingham Fastener 'B' or approved equal.
- 11.12 Tapping Sleeves: Water main tapping sleeves shall be #304 stainless steel including the flange. The shell, lift bar, and flange shall be stainless steel. The flange gasket shall be factory installed virgin SBR compound or equal for water mains. The tapping sleeve shall be provided with a stainless steel 3/4" NPT test plug for pressure testing the sleeve prior to tapping the main. The tapping sleeve and valve shall be installed and pressure tested at 90 lbs for 5 minutes with no loss to be approved to proceed with tapping the main. The test shall be witnessed by Water Department personnel. The tapping sleeve and valve shall be wrapped with a polyethylene encasement. The polyethylene film shall be a minimum 8 mil thickness and installed as per AWWA C105. Tapping sleeves shall be Romac Industries, Inc., "SST", Power Seal Pipeline Products Corp. Model 3490, or approved equal. Special tapping sleeves for tapping concrete cylinder pipe shall be Romac Industries, Inc., "FTS 435" steel fabricated tapping sleeve with stainless steel (#304 minimum) straps and fusion bonded epoxy coating per AWWA C213 or approved equal. All bolts, nuts, and washers shall be #304 stainless steel or COR-BLUE, Cor-Ten coated with a ceramic-filled, baked-on fluorocarbon resin as manufactured by Birmingham Fastener 'B' or approved equal. Approved equal tapping sleeves shall be subject to submittal of manufacturer specifications, approval of the Engineer and issuance of contract addendum prior to the bid due date.
- 11.13 Couplings: Water main couplings required for straight, transition, reductions, cut-in and end caps shall be ductile iron sleeve, flanges, and end caps. The gaskets shall be a rubber compound suitable for water mains. All bolts, nuts, and washers shall be #304 stainless steel or COR-BLUE, Cor-Ten coated with a ceramic-filled, baked-on fluorocarbon resin as



manufactured by Birmingham Fastener 'B' or approved equal. All couplings shall be furnished with a shopcoat enamel finish and wrapped with a polyethylene encasement. The polyethylene film shall be a minimum 8 mil thickness and installed as per AWWA C105. Couplings shall be Smith-Blair Omni Coupling System, Dresser Coupling Style 253, Power Seal Pipeline Products transition Coupling System, Hymax Coupling Series, or approved equal.

11.14 Restrained Joints: Wherever called out on the plans, sections of restrained joint pipe shall require the main line pipe material to be Ductile Iron Pipe. In locations where Ductile Iron Mechanical Joint Pipe is used, the restrained joint shall be Megalug field installed joint restraint as manufactured by EBAA Iron, Inc. and must be wrapped with a polyethylene encasement. The polyethylene film shall be a minimum 8 mil thickness and installed as per AWWA C105. The MEGA-BOND restraint coating system shall be provided on all casing bodies, wedge assemblies, and related parts. The restrained joint system shall be pressure rated for 350 psi (4"~16") and 250 psi (18"~24") and be rated in accordance with the performance requirements of ANSI/AWWA C111 / A21.11 rubber gasket joints for ductile iron pressure pipe and fittings. In locations where Ductile Iron Push-on Joints pipe is used the appropriate restraining gasket must be used in accordance with the pipe manufacture. Approved restrained joint gaskets are Fast Grip Gasket as manufactured by American Ductile Iron Pipe, Field Lok Gasket as manufactured by U.S. Pipe or approved equal. The use of restrained joints on water main installations does not eliminate or waive the requirement to provide thrust blocks where called for on the plans, specifications or standard details.

11.15 Bolts, Nuts, & Washers: All bolts, nuts, and washers used by a manufacturer to fabricate and assemble water main fire hydrants, resilient seat/wedge valves, and butterfly valves shall be #304 stainless steel.

All bolts, nuts, and washers used for the installation of water main tapping sleeves, couplings, and mechanical joint fittings shall be #304 stainless steel or COR-BLUE, Cor-Ten coated with a ceramic-filled, baked-on fluorocarbon resin as manufactured by Birmingham Fastener 'B' or approved equal.

11.16 Casing Pipe Spacers: All pipe inserted into casing pipes shall have casing spacers strapped to the pipe in accordance with the manufacturer specifications. Casing spacers shall: Have a body of either Stainless Steel or Ductile Iron and runners made of Ultra High Molecular Weight Polymer Plastic as manufactured by Advanced Product Systems or approved equal or be a Raci - High Density Polyethylene (HDPE) body and runner as manufactured by the Public Works Marketing, Inc. or approved equal.

## 12. MANHOLE STEPS:

12.1 Aluminum manhole steps shall be fabricated of aluminum alloy conforming to Federal Specification QQ-A-200/8 having a minimum tensile strength of 38,000 psi and a minimum yield strength of 35,000 psi. Elongation shall not be less than 10% in 2 inches and each step shall be capable of carrying a load in the center of the cross bar of 1,500 lbs. when projected 4 inches from the wall without permanent deformation. Steps shall have a tread 10 inches in width and a minimum 2-inch vertical hook on the ends embedded in concrete.

12.2 Plastic coated steel steps shall be fabricated of co-polymer polypropylene with ½" minimum deformed reinforcing rod. The step shall meet the requirements of ASTM 2146 under Type II, Grade 16906. The steel material shall be grade 60 and conform to the requirements of ASTM A-615.

13. MANHOLE, CATCH BASIN, INLET FRAMES AND COVERS: Manhole, catch basin, inlet frames and covers shall be supplied as specified in the plans.
14. STRUCTURAL STEEL: Structural steel shall meet the specifications of AISC and shall be fabricated as specified in the plans.
15. LANDSCAPING MATERIAL:
  - 15.1 Topsoil: Topsoil shall be dark loam containing a sufficient amount of organic matter free from grasses, weed roots, inorganic material, and subject to the approval of the engineer.
  - 15.2 Sod: Sod shall be nursery grown turf, densely rooted bluegrass free from weeds (Class A).
  - 15.3 Seed: Seed shall conform to the following:
    - a. Class A shall be 30% Perennial Rye, 30% Kentucky Blue, and 40% Creeping Red Fescue.
    - b. Class B shall be 50% Perennial Rye, 15% Kentucky Blue, and 35% Creeping Red Fescue.
    - c. No seed will be accepted with the date of test of more than six months prior to the date of sowing.
    - d. Certification of the seed mixture analysis and net weight must be provided to the Engineer.
  - 15.4 Fertilizer: Chemical fertilizer shall be a ready-mixed granular material containing equal amount (12-12-12) by weight of available Nitrogen (N), readily available Phosphoric Acid (P<sub>2</sub>O<sub>5</sub>) and total available Potash (K<sub>2</sub>O) mixed with not less than 40% by weight of filler. Certification of analysis and net weight must be supplied to the Engineer.
  - 15.5 Trees: Trees shall be 4-inch diameter, nursery grown and shall qualify under the Horticultural Standards ASA:Z60.1 and shall be of the species specified on the plans or specifications.
  - 15.6 Mulch: Mulch shall be clean wheat or oat straw chopped to a maximum length of three (3) inches, applied at the rate of 100 lbs. per 1000 square feet (2 tons per acre).
  - 15.7 Latex Base Adhesive for Mulching: Latex base adhesive shall be 48% styrene, 50% Butadiene, and 2% additive; 42.0 to 46.0% solids and a PH, as shipped, of 8.5 to 10.0.
16. WATER: The water used in concrete shall be clean, clear and free from injurious quantities of oil, acid, alkali, vegetable, organic or other matter. If the water is of questionable quality, it shall be tested in accordance with the "Standard Methods of Test of Quality of Water to be Used in Concrete" of the AASHTO Designation T-26 and subsequent revisions.

Contractor desiring to use water from the City water mains, whether from public hydrants or otherwise, will be required to make application to the City of Monroe Water Department and to conform to the rules and regulations provided in such cases by City Ordinance and Rules of Department.
17. CASING PIPE: Steel case pipe shall be used for construction at railroad or highway crossings as shown on the drawings or as specified. Steel casing pipe shall comply with the following minimum requirements or such minimum requirements as established by the authority having jurisdiction. Casing pipes at other locations shall also comply with the following minimum requirements unless otherwise indicated.

<b>TABLE OF MINIMUM WALL THICKNESS FOR STEEL CASING PIPE</b>		
<b>NOMINAL THICKNESS - INCHES</b>		
<b>COATED OR CATHODICALLY PROTECTED</b>	<b>UNCOATED AND UNPROTECTED</b>	<b>NOMINAL DIAMETER INCHES</b>
0.188	0.251	Under 14
0.219	0.282	14 & 16
0.250	0.313	18
0.281	0.344	20
0.312	0.375	22
0.344	0.407	24
0.375	0.438	26
0.406	0.469	28 & 30
0.438	0.501	32
0.469	0.532	34 & 36
0.500	0.563	38, 40 & 42
0.563	0.626	48
0.625	0.688	54

Smooth wall steel pipes with a nominal diameter of over 54 inches will not be permitted.

Steel pipe shall have a minimum yield strength of 35,000 psi. All joints shall be fully welded completely around the circumference of the pipe. Welds shall be ground smooth inside and out to prevent conflict with the soil or pipe placement. If coated pipe is used, the coating shall be repaired following welding.

18. **CONTROL DENSITY BACKFILL:** Control density backfill shall consist of a mixture of fly ash (as delivered from coal fired power plants meeting ASTM C-618 for fineness), Type I cement (ASTM C-150), treated water that is nondeleterious to the control density backfill and salvaged materials. The control density backfill shall have a minimum density of 134 pounds per cubic foot, have a minimum compressive strength of 50 psi and a maximum compressive strength of 100 psi. Control density backfill shall be "K-Krete" as provided by K-Krete, Inc., and Kuhlman Corporation, Toledo Ohio, or "Stabilized Backfill Mix" as provided by Messina Concrete, Monroe, Michigan or approved equal prior to bidding. Placement of the material must be in accordance with the manufacturer's specifications.

**I N D E X**  
**DIVISION F**  
**SANITARY & STORM SEWERS**

<b><u>PARA.</u></b>	<b><u>DESCRIPTION</u></b>	<b><u>PAGE</u></b>
1.	General	F-1
2.	Materials	F-1
3.	Existing Underground Structures and Utilities	F-1, 3
4.	Excavation	F-3-5
5.	Sheathing and Shoring	F-5, 6
6.	Bedding, Cradle and Encasement	F-6, 7
7.	Laying the Sewer Pipe	F-7
8.	Backfilling	F-7, 8
9.	Disposal	F-8, 9
10.	Connections to Existing Sewers and Drains	F-9
11.	House Connections, Wyes and Tees	F-9, 10
12.	Manholes, Catch Basins and Inlet Structures	F-10, 11
13.	Concrete Structures	F-11-16
14.	Testing Sanitary Sewers	F-117-21
15.	Testing (PVC and ABS Pipe)	F-21, 22
16.	Televising Sanitary and Storm Sewers	F-23
17.	Structures	F-23
18.	Pavement, Curb and Walk Restoration	F-23-25
19.	Restoration of Conditions	F-25, 26
20.	Landscaping Restoration	F-26
21.	Fences, Barricades, Etc.	F-26
22.	Protection of Trees & Shrubs	F-26, 27
23.	Maintenance of Traffic & Access to Property	F-27
24.	Basis of Payment	F-27-30

## DIVISION F

### SANITARY SEWER AND STORM SEWER CONSTRUCTION SPECIFICATIONS

1. GENERAL:

These specifications shall apply to the construction of sanitary sewers and storm sewers with all their appurtenances.

2. MATERIALS:

All materials necessary for the completion of the Contract shall be furnished by the Contractor unless otherwise specified.

2.01	Concrete	Division E	Para. 7
2.02	Cement	Division E	Para. 6
2.03	Aggregates	Division E	Para. 3
2.04	Water	Division E	Para. 16
2.05	Mortar	Division E	Para. 8
2.06	Concrete Reinforcement	Division E	Para. 7.5
2.07	Manholes, Catch Basins, Inlets	Division E	Para. 9
2.08	Asbestos-Cement Sewer Pipe (AC)	Division E	Para. 10.1
2.09	Acrylonitrile-Butadiene-Styrene Sewer Pipe (ABS TRUSS)	Division E	Para. 10.2
2.10	Concrete Pipe	Division E	Para. 10.4
2.11	Ductile Iron Pipe	Division E	Para. 10.5
2.12	PolyVinyl Chloride Pipe (PVC)	Division E	Para. 10.7
2.13	Vitrified Clay Pipe	Division E	Para. 10.8
2.14	Manhole Steps	Division E	Para. 12
2.15	Manhole, Catch Basin, Inlet Frames and Covers	Division E	Para. 13
2.16	Structural Steel	Division E	Para. 14
2.17	Landscaping	Division E	Para. 15
2.18	Block (Concrete)*	Division E	Para. 4
2.19	Brick*	Division E	Para. 5
2.20	Corrugated Metal Sewer Pipe (CMP)*	Division E	Para. 10.3

\*Material item acceptable for storm sewer construction only. The material shall not be used for sanitary sewer construction.

3. EXISTING UNDERGROUND STRUCTURES AND UTILITIES:

3.1 Prior to commencing excavation, the Contractor shall be required to adhere to the provisions of Act 53 of Public Acts of 1974. (MISS DIG)

3.2 Existing Sewers, Drains, Utilities: Unless otherwise directed, the Contractor shall protect and not damage any existing sewer or drain. If damage is done, the Contractor shall repair such damage and leave such sewer or drain in as good condition as when first encountered.

Sewer and drains, before backfilling shall be provided with structural steel or other Engineer approved supports across the trench and this expense shall be incidental to the item of "Excavation". Whenever existing water, gas, or other utility services, pipes or structures are encountered in the construction, they shall be protected by the Contractor. Any damage to them by the Contractor shall be reimbursed to the utility involved. If not paid before Contract completion, the City shall deduct such expenses from the final Contract payment.

Services, pipes or structures needing supports across or in the trench shall be properly supported with structural steel or other suitable material by the Contractor in coordination with the requirements of the utilities before any backfilling is attempted. Provision for the cutting of any utility services, which crosses the trench, shall be made by the Contractor with the utilities approval and such expense of cutting and reconnecting shall be borne by the Contractor. Any expense incurred by the Contractor because of interference of utility services, pipes or structures with the excavation shall be regarded as incidental to the item of "Excavation".

- 3.3 Crossing Under Existing Railroad Tracks: In laying the sewer under the railroad tracks, special care must be taken to properly shore up and protect the tracks and maintain traffic over them. This work shall be done in such a manner as will meet with the approval of the railroad companies involved; and the Contractor shall save the City harmless from any damage or injury resulting to such companies or individuals by reason of this work. The expense involved for the protection of tracks by the use of track supports or any other expenses involved in such crossing shall be borne by the Contractor.
- 3.4 Dust Control: All haul roads, detour roads, and other public and private roads, driveways, and parking lots used by the Contractor must be maintained in a dust-free condition during the life of this contract. The control materials and methods of application which are in accordance with the requirements of the agency having jurisdiction over the roadway or driveway. Such dust control materials shall be applied as often as is necessary to control the dust.

The use of road oils and waste oils to control dust is prohibited unless authorized by the Engineer.

Should the Contractor be negligent of his duties in providing dust control, the Owner may take the necessary steps to perform such work and will charge the Contractor for all costs.

The Contractor shall keep clean all streets used in his operations. Trucks hauling excavated materials, cement, sand, stone, or other loose materials from or to the site, shall be tight so that no spillage will occur. Before trucks start away from the site, their loads shall be carefully trimmed to prevent spillage.

4. EXCAVATION:

4.1 Earth: All excavation for sewer shall be done in open cut except when boring is required provided the method of backfilling is such, in the judgment of the Engineer, as to avoid any present or future injury to adjacent structures. Such open cut excavations shall meet the requirements and standards as set forth by MIOSHA. Where tunneling or boring is done, it shall be carried out in a manner acceptable to the Engineer.

4.2 The Contractor shall remove all paving and curb and clear the surface of the ground as required for the full width and length of the proposed trench and shall dispose of all trees, shrubs, refuse and excavated material, not required for backfill, in a satisfactory manner.

4.3 Width of Trench: The maximum width of trench at the top of pipe shall be as follows:

<b>PIPE DIAMETER</b>	<b>TRENCH WIDTH</b>
Through 12"	30"
15" through 30"	O.D. plus 18"
36" and larger	O.D. plus 24"

If the maximum trench width specified above is exceeded, unless otherwise authorized by the Engineer, the Contractor shall, at his own expense, construct a concrete cradle or other type of approved bedding to provide support for the additional load. When rock is encountered, that portion of the trench which is in rock shall have a width equal to the outside diameter of the pipe plus 6" on each side or as specified in Section 4.11. The outside diameter of the pipe shall be its diameter of the barrel and not of the bell.

4.3a. Trenching shall be completed in accordance with Section 4 of this Division. The recommended Standards for Wastewater Facilities, Section 33.82 may be used for reference.

4.4 For all pipe sewers, the bottom of the trench shall be excavated below the grade of the pipe a sufficient amount to permit the installation of a stone bedding the thickness shown on the plans and/or details.

4.5 The excavation shall be kept dry until structures are constructed and no water shall be allowed to come in contact with new concrete until it has taken its initial set.

4.6 Whenever the sewer trench crosses a paved surface such as streets, sidewalks, driveways, parking lots, etc., the trench width will be based upon excavating

the entire depth of the trench as a sheathed trench. If the Contractor so selects to excavate the trench in these areas without sheathing and therefore excavates a wider trench at the surface to meet the Michigan OSHA requirements, all costs of the excavation, pavement removal and replacement, stone or backfill beyond the sheathed trench shall be assumed by the Contractor.

- 4.7 Rock Excavation Defined: Rock excavation shall consist of excavating igneous, metamorphic and sedimentary rock which cannot be excavated without drilling and blasting, or the use of pneumatic hammers and all boulders of 1/3 cubic yard or more in volume. Rock that can be removed by means of a power driven mechanical shovel, unless boulders greater than 1/3 cubic yard in volume, shall be considered earth excavation.
- 4.8 When pre-blasting is used (fracturing of rock with explosives prior to actual trench excavation) the Contractor, if required by the Engineer, shall first verify that the rock cannot be removed by pick and shovel or by power driven mechanical shovel. Cost of such verification shall be at the Contractor's expense.
- 4.8 Open Cut, Tunnels and Boring and Jacking: In general, excavation shall be made in open cut from the surface and the Contractor will not be allowed to do any tunneling or boring without obtaining permission from the Engineer, and then only according to methods approved by him. This permission will only be given where a line is to be laid behind the curb, across a paved street, under street car or railroad tracks, or where, in the opinion of the Engineer, it is necessary to tunnel or bore short sections on account of proximity of adjacent walls, trees or structures. Such excavations then can be made in alternate sections of open cut and tunnel or boring, the length of the tunnel sections to be specified by the Engineer and the head room in them, unless otherwise specified, to be not more than three (3) feet measured from the top of the sewer or pipe.

Where required or ordered by the Engineer, the excavated tunnels shall be sheathed, shored or cased in a satisfactory manner unless otherwise specified.

The space between the outside of the sewer or pipe and the sides of the tunnel or casing shall be compactly filled with Class 4 concrete or as directed by the Engineer, after the sewer or pipe is completed.

- 4.9 Dewatering (Pumping and Bailing): The Contractor shall remove by pumping, bailing, or otherwise any water which may accumulate or be found in the trench and other excavations made under this Contract; and shall form all dams, flumes or other works necessary to keep them entirely free from water while the sewers, their appurtenances and their foundations, if any, are being constructed. Newly laid masonry shall be protected from injury, resulting from the unwatering work, by plank, by the use of canvas, tar paper, or by other



suitable methods as may be approved. The Contractor shall at all times have upon the works sufficient pumping machinery ready for immediate use. Water from the trenches and excavations shall be disposed of in such a manner as will not cause injury to the public health, nor to public or private property, nor to the work completed or in progress, nor to the surface of the street, nor cause a violation of the Soil Erosion Control Act as administered by the Monroe County Drain Commission.

4.10 Trench Excavation and Tunneling Near Trees: Trench excavation shall not approach nearer than 4 feet to any tree that is not designated, on the plans, to be removed. Trees 2-inches or less in diameter may be removed, "heeled in" and subsequently replanted in their original location, if proper precautions are taken to prevent permanent injury to the tree. Trenches approaching trees having a diameter greater than 8-inches shall begin and end at points located no nearer to such trees than the radius of the tree, expressed in inches, multiplied by 1 foot per inch. As an example, the trench shall not approach closer than 6 feet to a 12-inch diameter tree. Tunneling operations adjacent to or under trees shall begin and end at points which fall outside a radius (measured from the center of the tree) equal to:

- a. Four feet, around trees 8" or less in diameter.
- b. The radius of the tree in inches multiplied by 1 foot per inch.

4.11 Pipe Clearance in Rock: Ledge rock, boulders, and large stones shall be removed to provide a clearance of at least 6-inches below all parts of the pipe, fittings, or structures and to a clear width of 6-inches on each side of all pipe and appurtenances for pipes 24" or less in diameter, a clearance of 9" below and a clear width of 9" on each side of the pipe shall be provided for all pipes larger than 24" in diameter. The cost for additional stone bedding required for pipes and their appurtenances laid in rock shall be included in the unit bid price for rock excavation.

5. SHEATHING AND SHORING:

When necessary to avoid injury to workers or undermining or otherwise damaging any structures, trenches shall be properly and sufficiently shored and braced to prevent caving, slipping or cracking of the sides of the trench and shall be done to the satisfaction of the Engineer.

Trenches shall be properly and securely sheathed and shored, to the satisfaction of the Engineer. Where necessary, sheathing shall be driven ahead of the excavation as it advances. Unless otherwise specified, all timber and planking for foundation platforms and sheathing and shoring shall be of the grades necessary to insure safety of men and structures of work.

Sheathing which takes an arch thrust from the structure shall not be removed from below the springing line. Sheathing extending below the foundation of the structure

or against which work is constructed shall not be removed. The cost of this sheathing shall be included in the prices bid for excavation, or in the case of Class C excavation under the lineal foot method of payment, it shall be included in the price bid for the structure requiring excavation.

All other sheathing and shoring shall be removed unless ordered by the Engineer to be left in place in which case it will be paid for at the prices bid for one thousand (1000) feet board measure for the grades of lumber left in place.

No sheathing and shoring will be paid for above a line eighteen (18") inches below the surface of the ground.

When stated in the proposal or ordered by the Engineer, payment for matched and grooved sheathing will be based in each case on the length of trench occupied by such sheathing, with no allowance for wastage due to tongues and splines respectively.

No machinery, equipment, materials or flumes shall be placed upon, supported, braced or slung from the members comprised in the sheathing and shoring of the excavation, but shall be carried on independent supports with a safe bearing beyond the line of sheathing.

## 6. BEDDING, CRADLE, BASE AND ENCASEMENT:

6.1 Pipe Bedding: Pipe bedding shall be defined as that material placed from a minimum of 4" below the pipe barrel through 12" diameter and 6" for 15" diameter pipe and larger to 12" above the top of the pipe. It shall consist of crushed stone equivalent to MDOT specification 25A. The bedding shall be removed under the bell so that the pipe will bear uniformly on the barrel. The bedding shall be rodded or otherwise compacted under the pipe haunches in order to insure proper support. The stone bedding shall have a level surface extending to the sides of the trench.

6.1a Bedding cradle, base, and encasement shall be completed in accordance with Section 6 of this Division. The Recommended Standards for Wastewater Facilities, Section 33.83 may be used for reference.

6.2 Concrete: A concrete cradle, when specified, shall have a depth similar to that indicated for stone in Section 6.1. It shall be composed of Class 4 concrete.

6.3 Concrete Encasement: When necessary, sewers that are in shallow depths shall have concrete encasement completely around the sewer pipe and to a height above the barrel as specified on the plans. Concrete shall be level across the trench and shall be Class 4, unless otherwise specified. In general, encasement will be indicated on the plans or may be ordered by the Engineer.

- 6.4 Where sewers are constructed below existing water mains and other sewers, the trench shall be backfilled with the specified bedding material to the centerline of the existing pipes. The bedding shall be tamped in place in six (6") inch layers and extended three (3') feet minimum each way from the outside of the existing pipe.

7. LAYING THE SEWER PIPE:

- 7.1 The sewer pipe shall be laid upon the prepared bedding or cradle and shall be brought accurately to the proper alignment and grade. Straight alignment between manholes shall be checked by using a laser beam, lamping, or other acceptable practice. The Recommended Standards for Wastewater Facilities, Section 33.5 may be used as a reference. The bell of the pipe already laid shall be wiped clean and the spigot end of the pipe to be laid shall then be inserted and seated against the base of the socket. The actual procedure and use of lubricants shall be in accordance with the pipe manufacturer's recommendation and with the Engineer's approval to insure a tight system. The entire length of the pipe, except the bell, shall be supported by the stone cradle. The use of blocks under the pipe for support will not be permitted.

8. BACKFILLING:

- 8.1 Unless otherwise directed, all excavations shall be backfilled to a point one (1) foot above the pipe immediately after installation.
- 8.1a Backfilling shall be completed in accordance with Section 8 of this Division. The Recommended Standards for Wastewater Facilities, Section 33.83 and 33.84 may be used as a reference.
- 8.2 Material: All backfill material shall be free from cinders, ashes, refuse, vegetable matter, organic matter, frozen material, boulders, rock or other material which, in the opinion of the Engineer, is unsuitable.
- 8.3 Backfilling Around Structures: All backfill placed within three (3) feet of manholes, catch basins, inlets and other underground structures shall be approved material.
- 8.4 Drives, Parking Areas, Streets, Proposed Streets, Alleys and Sidewalks: The trench backfill under drives, parking areas, streets, proposed streets, alleys and sidewalks shall be of approved stone conforming to or similar to MDOT 21A placed in layers and thoroughly compacted to 95 percent of maximum density as determined by the AASHTO T180 Method. The maximum thickness of each layer shall generally be no greater than eight (8") inches and in all cases shall be of such thickness that the equipment used will provide the required density for the full depth of the backfill. This backfill shall include the area to the outside of shoulders in ditch sections and three (3') feet outside of metal in curb sections, and thence down on a ratio of 1 to 1 slope - unless otherwise

required by the governmental body or agency having jurisdiction over the area affected. In all cases, this fill shall be constructed to an elevation determined by the proposed grade of the surfacing. Drives, parking areas, streets, alleys, and sidewalks which are disturbed during the course of the construction shall be backfilled and restored to a useable condition as soon as each crossing is made.

9. DISPOSAL:

9.1 General: The excavated material shall be deposited in such a manner as to interfere as little as possible with the execution of the work of other contractors. So far as feasible, the excavated material may be placed in its final position, but it shall not be done in a manner to interfere with the satisfactory carrying out of the work. Such excavated material as cannot be placed directly in its final position shall be removed to a temporary spoils bank, from whence it shall be subsequently taken and placed in position.

Where directed by the Engineer, telford, gravel, surface load, sod, etc., shall be kept separate from the remainder of the excavated material and replaced in its original position after backfilling of the trench.

The Contractor will not be allowed, unless by written permission from the Engineer, to sell, remove or permit to be removed from the line of work, any sand, clay, gravel or earth excavated therefrom which may be suitable and required for refilling or embankment.

9.2 Places of Disposal: All excavated material not required or allowed for refilling or in embankments shall be removed and deposited at such locations as are specified, or, if no such locations are specified, the Contractor shall find suitable dumping places for all such material. No material shall be deposited on private property until written consent of the owner or owners thereof has been filed with the Engineer. All cost of disposal of surplus excavated material shall be included in the prices bid for excavation or items requiring excavation.

Excavated material shall be disposed of, all dumps shall be leveled by the Contractor in the following order of preference; or as directed by the Engineer:

- a. Along the site of the work to fill requirements of the work, materials for this purpose shall be of the same type or better than the existing material where fill is required or where necessary to replace as backfill.
- b. On private property facing the site of the project.
- c. On any City-owned property in or outside the city limits.
- d. Adjacent to the work upon the request of property owner upon property within a two-mile haul and as directed by the Engineer.

- e. Non-adjacent to the work within a two-mile haul as directed by the Engineer.
- f. Any balance remaining after the above requirements are filled shall be disposed of by the Contractor to his best advantage with no "Overhaul" compensation.
- g. The Contractor shall be entitled to the unit bid amount for "Overhaul" under the terms of this Contract for his compensation for hauling beyond the two-mile limit upon orders from the Engineer.

All "Overhaul" and free-haul shall be made by written orders of the Engineer on order blanks having a number sequence.

- 9.3 Salvage: In the case of structures the services of which is permanently abandoned, the Engineer will designate which of the materials are to be salvaged and which are to be abandoned. The Contractor shall remove and deliver to a designated point of storage, materials ordered to be salvaged, and unless otherwise specified no additional compensation will be allowed for this removal and hauling. He shall allow owners of privately-owned structures reasonable facilities for salvaging their property. Structures designed as abandoned and not mentioned in plans or specifications to be salvaged shall become the property of the Contractor, and shall be removed from the work without additional compensation. The Contractor shall not move nor disturb the structures in any way without the approval of the Engineer.

10. CONNECTIONS TO EXISTING SEWERS AND DRAINS:

Unless otherwise noted on the plans or in the proposal, no extra allowance will be made to the Contractor for breaking into existing manholes, walls, or drains. The Contractor shall point up all manholes or barrels or drains where such connections are made and shall leave same in neat condition. In case the connection is made to a drain, the first pipe entering the drain shall be cut down in length so that when inserted in the barrel of the drain, the spigot end of the pipe will be flush with the inside surface of the drain, and the bell of the entering pipe shall rest against the outside surface of the barrel around the entering sewers in sufficient quantity so that at least the first foot of sewer is entirely encased in concrete.

11. HOUSE CONNECTIONS, WYES, AND TEES:

- 11.1 Wyes, Tees, Stoppers, Markers, Drop Connections: The Contractor shall place 6-inch "Y" or "T" branches at such points along the line of the sewer as shown on the drawings or as may be designated by the Engineer. All branches shall be closed with watertight stoppers, secured in place as directed by the Engineer. Suitable markers shall be furnished and placed by the Contractor at the end of each branch. The Contractor shall build drop connections as shown on the plans and where directed by the Engineer.

- 11.2 House Connections: Where sewer services are already built, the Contractor shall connect them to the new sewer. In cases of excessive depths of trench or in rock it may be necessary to build risers for services and these shall, if indicated in plans, proposal, or by the Engineer, be encased in MDOT 30S concrete, six (6) inch thickness or more from the outside barrel of the pipe.
- 11.3 Wyes and Tees: When wyes and/or tees are left without connections being made, they shall have a manufacturer's recommended watertight stopper. The wyes or tees may be specified to have risers encased in concrete.

12. MANHOLES, CATCH BASINS AND INLET STRUCTURES:

- 12.1 Manholes, catch basins, and inlets shall be built according to the details of the plans. They shall be built of precast reinforced concrete or approved cement blocks. When cement blocks are used, they shall be plastered inside and outside with 1/4" cement mortar.
- 12.2 The upper core section (3'-0" or 3'-6") of manholes shall be eccentric. The cast iron ring shall be set in accordance with the plans and carefully adjusted to the grade set by the Engineer. Cast iron ring and cover shall be as specified on the plans.
- 12.3 Structures shall be thoroughly bonded to the barrel of the sewer and all connections to pipes made without projections or voids. Structures supported partially or entirely by the arch of the sewer shall not be built until the sewer has been completed at least twenty-five (25') feet on each side of the structure or until the sewer has been in place three (3) days.
- 12.4 Casting Grade Adjustments: Adjustments to meet the final design grade shall be set with precast reinforced concrete adjusting rings as detailed in the plans. The total maximum height of the adjusting rings shall not exceed sixteen (16") inches.
- 12.5 Bedding and Backfills: All structure based whether of precast type or poured-in-place type shall be placed on a 6-inch compacted stone bedding. Backfill around structures which are or will be under a street, drive, alley, parking area or sidewalk shall be with crushed stone compacted to 95% maximum density. Other material such as K-Krete, when approved by the Engineer may be used. Cost for the bedding and backfill material shall be included in the unit bid price for the structures installed.
- 12.6 Rock Excavation: Where rock is encountered, the excavation shall be to a depth which will allow the placing of the 6-inch stone cushion mentioned in paragraph 12.5. Rock shall be removed to a clear distance of 8-inches around the perimeter of the structure. The aforementioned shall delineate pay limits for rock excavation around structures.

12.7 Steps: Manhole steps shall be of the materials, size, length and shape as shown on the plans. They shall be firmly built into the walls not more than sixteen (16") inches apart.

12.8 Frames and Covers: Manhole frames and covers shall be as specified on the plans.

13. CONCRETE STRUCTURES:

13.1 Concrete: Concrete shall consist of a mixture of Portland cement, aggregates and water, proportioned in accordance with the requirements of this specification. Admixtures shall be included in these primary ingredients when specified.

The concrete work shall conform to the plans and as indicated elsewhere in these specifications. In general, all concrete shall be of MDOT 35S unless otherwise specified.

13.2 Handling and Placing: No concrete shall be used which does not reach its final position in the forms within one (1) hour after water is first added to the mix, except when the concrete is continually agitated when the time may be extended to one and one-half (1-1/2) hours.

13.3 Depositing Concrete Under Water: Concrete until it has set shall not be exposed to the water by which it is surrounded, it shall not be deposited in water except with the approval of the Engineer and under his immediate supervision; and in this case the method of placing shall be as hereinafter designated.

Concrete deposited in water shall be MDOT 35T with ten (10) percent excess cement. To prevent segregation, it shall be carefully placed in a compact mass, in its final position, by means of a tremie, a bottom dump bucket or other approved method, and shall not be disturbed after being deposited. Still water shall be maintained at the point of deposit and the forms under water shall be watertight.

For parts of structures under water, when possible, concrete seals shall be placed continuously from start to finish, the surface of the concrete shall be kept as nearly horizontal as practicable at all times. To insure thorough binding, each succeeding layer of a seal shall be placed before the preceding layer has taken initial set. All laitance or other foreign matter shall be removed from the top surface before any concrete is placed upon it in the dry.

A tremie shall consist of a tube having a diameter of not less than ten (10") inches, constructed in sections having flanged couplings fitted with gaskets. The tremies shall be supported so as to permit free movement of the discharge end over the entire top surface of the work and so as to permit rapid lowering

when necessary to retard or stop the flow of concrete. The discharge end shall be plugged at the start of work so as to prevent water entering the tube and shall be entirely sealed at all times; the tremie tube shall be kept full to the bottom of the hopper. When a batch is dumped into the hopper, the flow of concrete shall be induced by slightly raising the discharge end, always keeping it in the deposited concrete. The flow shall be continuous until the work is complete.

13.4 Spudding and Vibration:

13.41 Spudding: Spudding shall be used in all work if deemed necessary by the Engineer. The spuds shall be of such lengths that they will reach the bottom of the concrete poured. Care should be taken to spud the concrete in and around the reinforcing and at the form faces so that the entrapped air will be brought to the surface.

13.42 Vibration: All concrete, except that in sewer cradles, immediately after having been placed in the forms, shall be subjected to high frequency vibration by means of a vibrating tool arranged to be inserted within the mass of the concrete from above. The tool shall be of such diameter that it will not disturb or wedge the reinforcement from its specified position. The tool shall impart sufficient energy to the concrete to make it plastic and flowing, so that when the forms are removed there will be no stony pockets or segregation. The tool shall operate at frequencies in excess of five thousand (5,000) impulses per minute and shall be allowed to remain in the concrete long enough to puddle the concrete thoroughly but no longer.

In the placement of concrete in roof slabs, the vibrating tool shall be provided with a short handle so constructed that vibration of the tool will not be transmitted to the operator and permitting the operator to control the position of the tool with ease. As the concrete is deposited in the forms, the vibrating tool shall be inserted at close intervals and to a depth which will permit the tool to vibrate the concrete through the lateral motion of the tool and at the same time permit the tool to transmit vibrations to the supporting forms. The tool shall be inserted under the flanges of girder beams, re-entrant angles in the forms and wherever it is necessary to force the concrete to flow into proper position. The tool shall be inserted at locations close enough together to insure that the whole mass of concrete being treated shall have been subjected to adequate vibration.

If it is evident after the tool has operated for a reasonable length of time that stony pockets still remain due to a deficiency of mortar, such stony pockets shall be removed, fresh concrete substituted and vibration repeated until the condition of segregation disappears.



The Contractor shall have a sufficient number of vibrating tools available to accomplish the results desired.

- 13.5 Construction Joints: Concrete shall be deposited continuously and as rapidly as possible until the unit of operation, as approved by the Engineer, is completed. Construction joints at points not provided for in the plans shall be subject to the approval of the Engineer. When rectangular sewers of sidewalls and roof shall be constructed to its full thickness without interruption, so as to form a monolith, the length of each section to be such as to permit it to be completed within the working hours of a day.

Adjoining sections shall be bonded by a tongue and groove joint of sufficient section to resist shear, or by approved methods of embedded stones projecting beyond the surface.

- 13.6 Curing: All exposed surfaces of finished and unfinished work shall be kept constantly moist by sprinkling with water at short intervals, or by such means as the Engineer shall direct, and this moistening shall be continued until, in the opinion of the Engineer, the concrete has sufficiently hardened.

- 13.7 Protection: Sufficient tarpaulin or other covering shall be provided to protect freshly laid work from the action of the elements.

13.71 No wheeling, working or walking on finished surfaces will be allowed for twenty-four (24) hours after the concrete is deposited.

13.72 Temperatures: When the air temperature falls to 40 F. or less, no concrete shall be deposited unless the aggregate and water have first been heated so that the mixture shall have a temperature on leaving the mixer between 70 F. and 100 F. When the temperature falls to 20 F. or less, concrete pouring shall be stopped and shall not be resumed until the temperature has risen above 20 F. In places protected from the weather, mass concrete may be poured upon approval of the Engineer. All concrete during curing shall be protected during freezing weather by straw, hay, tarpaulins or salamanders or all for not less than 72 hours after pouring.

This section shall be subject to the special provisions if provided in any other section of this specification.

13.73 Frozen Base: No concrete shall be poured on a frozen, dry or uncompacted subgrade.

13.74 Hot Weather Curing: All exposed surfaces of concrete shall be protected from the sun and the wind and kept wet in dry weather for fourteen (14) days after placing.

- 13.8 General Concrete Finish: Unless otherwise specified, concrete surfaces shall be finished as follows:

Immediately after the face forms are removed, the surface shall be freed from inequalities and projections by scraping. All voids shall be filled by floating with cement mortar, and the entire surface shall be brushed or broomed with a thin wash, composed of equal parts of cement and fine, sharp sand, in as many successive coats as may be required to produce an even surface in finish and color.

- 13.9 Reinforcement: All reinforcement bars shall have the dimensions and shall be placed as shown on the plans and details. The bars shall be supported at intervals of not more than three (3) feet by bent steel or molded concrete chairs of approved pattern, to maintain them in position with respect to the forms, and they shall be wired together at all intersections with two turns of No. 12 wire.

All bars shall be protected from exposure to the weather until used and immediately before placing them in the concrete they shall be thoroughly cleaned of scale and any rust, grease or dirt that may have accumulated on them.

Exposed reinforcement intended for bonding with future extensions shall be protected from corrosion.

The reinforcement shall be bent to shapes shown on the plans. The radii of bends shall be equal to or greater than twice the diameter of the bar, measured from the inside of the curved bar, except for stirrups in which the bends shall be equal to or less than the diameter of the bar. When bars are heated for bending, they shall not be heated to a higher temperature than that producing a dark cherry red color. Only competent persons shall be employed for cutting and bending, and proper appliances shall be provided for the work.

All reinforcement shall be furnished in the full lengths indicated upon the plans. No splicing or bars, except where shown on the plans, will be permitted without the written approval of the Engineer. Splices which are permitted shall have a length of not less than forty (40) times the nominal diameter of the bars, and shall be well distributed or else located at points of low tensile stress. No splices will be permitted at points where the section is not sufficient to provide a minimum distance of two (2") inches between the splice and the nearest adjacent bar or the surface of the concrete. The bars shall be rigidly clamped or wired at all splices in a manner approved by the Engineer.

- 13.10 Forms: All centers or forms shall be collapsible, of ample strength, rigidly braced, with smooth surfaces against the concrete. Ribs and bracing may be constructed of either wood or steel, and must be of adequate strength to prevent deviation in the line. Ribs shall be cut or fabricated to exact

dimensions, and all ribs shall be matched before the sheathing is fastened to them. Unless otherwise specified on the plans, sheathing over ribs shall be constructed of steel plates, rolled and fabricated to exact size and curvature before assembling. Steel plates used for this purpose shall be securely fastened to the ribs, and shall be of such thickness and weight that they will not buckle or crumple under load. They shall be of such size as to reduce the number of joints to a minimum. All joints shall be butt joints, and shall fit together in such a manner as to leave no large marks on the finished concrete surfaces. Sections of forms shall be constructed with all ends exact duplicates, so that when the form is moved ahead, after pouring, the rear end of the section will fit exactly into the front end of the arch in place. Any section in which the space at any point between it and the arch, as outlined above, is more than one-eighth (1/8) of an inch, shall not be used on the work; this restriction to apply to each movement of the section. All forms shall be maintained in first class condition during the entire period of their use, and any repairs ordered repaired may again be used in the work. Steel filler plates of the correct size, shape and strength, shall be provided for forming bends or curves in the sewer.

In the determination of the time for removal of false work and forms, consideration shall be given to the location and character of the structure, the weather and other conditions influencing the setting of the concrete, and the materials used in the mix. Methods of form removal likely to cause over-stressing of the concrete shall not be used. In general, the forms shall be removed from the bottom upwards. Forms and their supports shall not be removed without the approval of the Engineer. Supports shall be removed in such a manner as to permit the concrete to uniformly and gradually take the stresses due to its own weight.

If form removal is not controlled by tests for compressive strength, the following periods, exclusive of days when the temperature is below forty (40 ) degrees F., may be used as a guide for form removal.

- for arches. . . . .14 to 21 days
- for reinforced slabs. . . . .14 to 21 days
- for walls . . . . . 7 days

Should the Contractor desire to remove the forms in a shorter time than designated above, the removal must be controlled by tests for the strength of the concrete, and the forms shall not be slackened until the concrete has attained a compressive strength of at least fifteen hundred (1500) pounds per square inch. This compressive strength shall be determined by the testing laboratory designated by the municipality from specimens cast at the time of pouring of the concrete. The specimens shall be stored and cured under conditions similar to the concrete in the sewer structure. The cost of these tests shall be borne by the Contractor. The Contractor shall be responsible for all damage caused by the premature removal of forms.

- 13.11 Grouted Rip rap: The stones shall be laid as specified for Plain Rip rap, Section 13.13. The spaces between the stones shall be filled with Type III mortar. Mortar shall be placed from bottom to top and sufficient mortar shall be used and worked with suitable tools to completely fill all voids, except that the face surface of the stone shall be left exposed. Any excess mortar shall be removed with a stiff brush. The mortar shall be cured for a minimum period of four days by being kept continuously wet or by the application of transparent membrane curing compound for structures.
- 13.12 Headers: Toe and side headers, one foot wide and two feet deep, unless otherwise shown on the plans, shall be constructed according to the details shown on the plans.
- 13.13 Plain Rip rap: The bank on which the plain rip rap is to be placed shall be trimmed to a uniform slope as shown on the plans. The rip rap shall commence in a trench below the toe of the slope, as shown on the plans, and shall progress upward, each stone being laid by hand and firmly bedded into the slope and against the adjoining stones. The stones shall be laid perpendicular to the slope with the surfaces in contact and with well broken points. The rip rap shall be thoroughly compacted as the construction progresses, and the finished surface of the rip rap shall present an even, tight surface. The thickness of the rip rap other than precast concrete blocks, shall be not less than 4-inches, measured perpendicular to the slope. Individual stones shall be laid with their 4-inch minimum dimension perpendicular to the plane of the surface to be rip rapped. Machine placing will be allowed for rip rap placed below water and for precast concrete blocks.
- 13.14 Heavy Rip rap: The bank on which the heavy rip rap is to be placed shall be trimmed to a uniform slope as shown on the plans. Heavy rip rap shall be constructed in accordance with the requirements of plain rip rap except that the thickness of the rip rap, other than precast concrete blocks, shall be not less than 18 inches measured perpendicular to the slope. Individual stones shall be laid with their 18-inch minimum dimension perpendicular to the plane of the surface to be rip rapped. Machine placing will be allowed for heavy rip rap.
- 13.15 Pointing: Pointing shall not be done in freezing weather or when the stone contains frost.

Joints not pointed at the time the stone is laid shall be thoroughly wet with clean water and filled with mortar. The mortar shall be well driven into the joints and finished with an approved pointing tool. The wall shall be kept wet while pointing is being done, and in hot or dry weather the pointed masonry shall be protected from the sun and kept wet for a period of at least three (3) days from completion. After the pointing is completed and the mortar set, the work shall be thoroughly cleaned and left in a neat and workmanlike condition.

14. TESTING SANITARY SEWERS: (All Pipe Materials Except PVC and ABS)

- 14.1 Testing for Infiltration: All sanitary sewers shall be installed with watertight joints and shall be tested to measure the infiltration of ground water. Where sewers are constructed below the ground water table, they shall be inspected for excessive leakage at all joints. In small diameter sewers this may be done by lamping between manholes, and wherever possible, a TV camera shall be used to locate the points of excessive leakage. Any joints or locations of excessive leakage shall be repaired prior to final testing. After the sewers have been visually inspected and all observed leakage stopped, the infiltration into the sanitary sewers shall be measured. The Contractor shall isolate sections of the sewer by the installation of bulkheads in the pipe as required and the measurement shall be made by means of a V-notch weir or other Engineer approved method. If the measured leakage with a four foot head exceeds 100 gallons per inch diameter per mile of pipe per day, the Contractor shall locate the points of excessive leakage and make the necessary repairs. If the natural ground water provides a 2 foot or more head over the top of the sewer pipe of the test section, an infiltration test shall be made with the allowable infiltration being calculated by the following formula:

$$\text{Allowable Infiltration} = (\text{Actual Average Ground Water Head Above the Test Section} / 4' \text{ Maximum})^{0.50} \times 100 \text{ gal/inch/mi/day}$$

Four inch perforated plastic pipe observation wells or other Engineer approved method shall be furnished at each manhole at the Contractor's expense for the determination of the ground water level (See Standard Detail Sheet). In the event the line does not meet the infiltration test as stated above, the test shall be repeated after repairs. Final tests shall be made by the City of Monroe at the Contractor's expense.

At the direction of the Engineer, exfiltration tests shall be required where ground water is not adequate.

NOTE: When Asbestos Cement Pipe is approved and used for sanitary sewers, the allowable leakage shall be 100 gallons per inch of diameter per mile per 24 hours.

- 14.2 Test for Exfiltration: Where the ground water provides less than a two foot head over the top of the sewer pipe, an exfiltration test shall be conducted by filling the inside of the sewer with water to the basic four foot head or four feet above the average ground water level over the test section, whichever is the greater elevation. The allowable water loss shall be 100/gal/in/mi/day as calculated in Section 14.1.

All lengths of sewers to be tested by either method shall be limited to 1,600 feet or less for main sewer sizes 8" diameter through 18" diameter, and 1,200 feet or less for main sewer sizes 21" diameter and larger.

When the sewer is filled with water, twenty-four hours time shall be allowed for water absorption in the pipe. Final tests and expenses paid shall be similar to that under "Test for Infiltration".

For the purpose of establishing the basic four foot head on 6", 8", 10", and 12" sewers, the head shall be measured from the invert of the sewer pipe at each manhole location and averaged across the test section. All larger sewers shall have the basic four foot head measured above the center of the sewer pipe at each manhole location and averaged over the test section. Excepting large diameter pipe, this procedure shall be used for infiltration and exfiltration tests. For large diameter pipe, 48" and greater, a minimum head of 2' above the top of the pipe shall be maintained to perform either test.

14.3 Manhole Leakage: All manholes shall be tested for leakage. The manholes may be tested by the use of plugs on outlet sewers, and filling the manholes with water to the top of the manhole. The water must stand for a twenty-four hour period to allow for absorption before testing for leaks and shall not exceed the 100/gal/in/mi/day leakage rate. The manhole may be tested by vacuum testing as follows:

- a. Plug the manhole inverts and exits (other than the manhole top access) using suitably-sized pneumatic or mechanical plugs.

CAUTION: FOLLOW ALL MANUFACTURER'S RECOMMENDATIONS AND WARNINGS REGARDING SAFE AND PROPER INSTALLATION OF SUCH PLUGS. MAKE SURE THE PLUGS ARE PROPERLY RATED FOR THE PRESSURES REQUIRED IN THE TEST. THE STANDARD TEST OF 5 INCHES MERCURY IS EQUIVALENT TO ABOUT 2.5 PSIG (0.15 BAR) BACK PRESSURE. IT IS RECOMMENDED THAT THE PLUGS USED HAVE AT LEAST TWICE THE SAFETY FACTOR (OR A RATING OF 5 PSIG/0.3 BAR BACK PRESSURE).

- b. Brace the pipeline inverts if the lines entering the manhole have not been back-filled. This will prevent the pipe from dislodging and being pulled into the manhole.
- c. Install and operating the manhole testing unit into the manhole according to the manufacturer specifications.
- d. The manhole tester unit shall evacuate the manhole to 5 inches Hg for one minute with no loss.
- e. If the vacuum does not drop any amount of mercury within the test time, the manhole is considered acceptable and passes the test. If the manhole fails and leaks, the needed repairs shall be made and the manhole must be tested again until satisfactory results are obtained at the Contractor's expense.

- 14.4 Retesting: All sewers shall be retested after leaks are repaired. The City of Monroe shall have the right to retest, after repairs, at the Contractor's expense.
- 14.5 Low Pressure Air Testing: Upon direction and approval of the Engineer, low pressure air tests may be used to test the sewer for infiltration.

All tests shall be conducted under the supervision of the Engineer with the Contractor furnishing all labor, material and equipment to perform the test.

The Contractor may desire to make an air test prior to backfill for his own purposes but the line acceptance test shall be conducted after backfilling has been completed in accordance with other portions of these specifications.

All wyes, tees, or ends of lateral stubs shall be suitably capped to withstand the internal test pressures. Such caps shall be easily removable for future lateral connections or extensions.

After a manhole-to-manhole section of line has been backfilled and cleaned, it shall be plugged at each manhole with pneumatic plugs inflated to the appropriate internal pressure. The design of the pneumatic plugs shall be such that they will hold against the line test pressure without requiring external blocking or bracing, although blocking and bracing is recommended for personal safety.

There shall be three hose connections to the pneumatic plug. One hose shall be used only for inflating of the pneumatic plug. The second hose shall be used for continuously reading the air pressure rise in the sealed line. The third hose shall be used only for introducing low pressure air into the sealed line.

There shall be a 0-30 psig gauge for reading the internal pressure of the line being tested. Calibrations from the 0-10 psig range shall be in tenths of pounds (not ounces) and this 0-10 portion shall cover 90 percent of the complete dial range.

Low pressure air shall be introduced into the sealed line until the internal air pressure reaches 4.0 psig greater than the average back pressure of any ground water pressure that may be over the pipe. At least two minutes shall be allowed for the air pressure to stabilize. After the stabilization period, the internal air pressure shall be repressurized to 4.0 psig and the third hose shall be disconnected.

The portion of line being tested shall be accepted if the portion under test does not lose air at a rate greater than 0.003 cfm per square foot of internal pipe surface when tested at an average pressure of 3.5 psig greater than any back pressure exerted by ground water that may be over the pipe at the time of the test.

The above requirement shall be accomplished by performing the test as follows:  
 The time requirement for the pressure to decrease from 3.5 to 2.5 psig (greater than the average back pressure of any ground water that may be over the pipe) shall not be less than the time given in the air tests as shown below:

CONCRETE PIPE ONLY (ASTM C 924)

(1 psig Drop Allowable) Minimum Test Time for Various Pipe Sizes

Nominal Pipe Size, in.	T (time), min/100 ft	Nominal Pipe Size, in.	T (time) Min/100 ft
4	0.3	15	2.1
6	0.7	18	2.4
8	1.2	21	3.0
10	1.5	24	3.6
12	1.8		

CLAY PIPE ONLY (ASTM C 828)

(1 psig Drop Allowable) Minimum Test Time for Various Pipe Sizes

Nominal Pipe Size, in.	T (time), min/100 ft	Nominal Pipe Size, in.	T (time) Min/100 ft
3	0.2	21	3.0
4	0.3	24	3.6
6	0.7	27	4.2
8	1.2	30	4.8
10	1.5	33	5.4
12	1.8	36	6.0
15	2.1	39	6.6
18	2.4	42	7.3

ALL OTHER PIPE

(1 psig Drop Allowable)  
 (Except Clay, Concrete, ABS & PVC Pipe)

<b>PIPE SIZE (INCH)</b>	<b>TIME</b>
4	2½ Minutes
6	4 Minutes
8	5 Minutes
10	6-1/2 Minutes
12	7-1/2 Minutes
15	9-1/2 Minutes



In areas where ground water is known to exist, the Contractor shall install a one-half inch diameter capped pipe nipple, approximately 10 inches long, through the manhole wall level with the top of the sewer lines entering the manhole. This shall be done at the time the sewer line is installed. Immediately prior to the performance of the line acceptance test, the ground water level shall be determined by removing the pipe cap, blowing air through the pipe nipple into the ground so as to clear it, and then connecting a clear plastic tube to the pipe nipple. The hose shall be held vertically and a measurement of the height in feet of water shall be taken after the water stops rising in this plastic tube. The height in feet shall be divided by 2.3 to establish the pounds of pressure that will be added to all readings. For example, if the height of water is 11.5 feet, then the added pressure will be 5 psig. This makes the 4.0 psig to be 9.0 and the 3.5 psig to be 8.5 psig. The one pound allowable drop and the timing remains the same. Note: Air testing of these pipe materials shall not be permitted if the air pressure required for the test is greater than 9 psig.

If any section of the sewer fails to meet this requirement, the Contractor shall perform a television inspection of the faulty section and repair or replace at his own expense all defective materials or workmanship. The test procedure shall be repeated until the results are acceptable.

15. TESTING: (PVC Pipe and ABS Pipe)

15.1 Testing for Tightness: After the pipe has been laid and backfilled, the line may be tested between manholes by a low pressure air test or water infiltration or exfiltration test. The specifying Engineer shall designate the type of test to be performed and the manner in which it shall be conducted.

15.2 Low Pressure Air Testing: When a low pressure air test is required, the Standard Test Method for Installation Acceptance of Plastic Gravity Sewer Lines Using Low Pressure Air (ASTM F 1417, as amended) shall be used. The minimum requirements for air testing shall be 0.5 psig pressure drop, from 4.0 psig to 3.5 psig as shown in the following table:

ABS & PVC PIPE ASTM F 1417) (0.5 PSIG Drop Allowable)  
Minimum Specified Time Required for a 0.5 psig Pressure Drop  
for Size and Length of Pipe Indicated

Nominal Pipe Size, in.	Minimum Time, mins.	Length for Minimum Time, ft.	Time for Longer Length, s
4	1:53	597	0.190 L
6	2:50	398	0.427 L
8	3:47	298	0.760 L
10	4:43	239	1.187 L
12	5:40	199	1.709 L
15	7:05	159	2.671 L
18	8:30	133	3.846 L
21	9:55	114	5.235 L
24	11:20	99	6.837 L
27	12:45	88	8.653 L
30	14:10	80	10.683 L
33	15:35	72	12.926 L
36	17:00	66	15.384 L

Note: Air testing of these pipe materials shall not be permitted if the air pressure required for the test is greater than 9 psig.

- 15.3 Infiltration/Exfiltration Testing: When an infiltration or exfiltration test is required, the provisions of Section 13.0 shall apply unless otherwise specified by this section. The maximum allowable amount of infiltration/exfiltration measured by test shall be at a rate of not greater than 50 gallons per inch of pipe diameter per mile per 24 hours.

When using the exfiltration test method, the average internal pressure in the system under test shall not be greater than 5 pounds per square inch (11.5 ft. hd.), and the maximum internal pressure in any part of the system under test shall not be greater than 10.8 pounds per square inch (25 ft. hd.).

- 15.4 Test for Deflection: (PVC Pipe) After the pipe has been laid and backfilled, the specifying Engineer shall require appropriate deflection testing. This test is conducted by pulling a pointed mandrel through the pipe, as described on Standard Detail Sheet. The Engineer shall designate the method of testing to be used. Thirty (30) days after completion, the maximum allowable deflection shall not exceed 5% of the pipe's internal diameter. Testing shall be conducted on a manhole-to-manhole basis or in total, as specified. To assure accurate measurement, it is important the line to be tested is completely water flushed. Deflection shall be measured in accordance with ASTM D 2122.

- 15.5 Test Rejection: Should the result of any test fail to meet the criteria established in this specification, the Contractor shall, at his own expense, locate and repair rejected section and retest until it is within specified allowance.

16. TELEVISION SANITARY AND STORM SEWERS:

As a requirement for final acceptance of sanitary and storm sewer installations and after required infiltration, exfiltration, air testing and deflection testing have been performed and approved, the contractor shall have an independent agency prepare and submit to the Engineer a television video on VHS format and hand written log of every main line sewer installed under this contract document. Said television service shall be incidental to the contract.

17. STRUCTURES:

17.1 New Structures shall be constructed as indicated on the plans and of the materials specified. In general, structures will be indicated in the Proposal as a unit and this work shall include necessary excavation of earth and rock, furnishing of materials, labor, clean up, etc., incidental for the completion of the whole unit of construction.

17.2 Existing Structures encountered in the work which necessitates some alteration or demolishing will be indicated on the plans and, if not, any work necessary to the progress of the project shall be ordered by the Engineer.

17.3 Alteration or Demolishing of any Structure, etc., will be indicated in the Proposal. In general, when this work is not included in the Proposal, it shall be regarded as incidental to item of excavation with no additional payment.

18. PAVEMENT, CURB AND WALK RESTORATION:

18.1 General: The Contractor shall replace all pavement, sidewalk and curb and gutter that is broken or removed during the sewer construction. All such replacement shall be done in accordance with the City's specifications for each type of work. All materials and workmanship shall be subject to inspection by the Engineer.

18.2 Work Included: Under the heading Pavement, Curb and Walk Restoration is included the work of tearing up such areas of pavement other than macadam or telford, as may be required for the construction of sewers, sewer appurtenances therein; of removing and disposing of all materials torn up; of placing temporary pavement to carry traffic until such time as the backfill has settled and the permanent pavement may be laid; of subgrading for the permanent pavement, including the accurate removal and the disposal of all materials for the width of the proposed pavement, below the existing surface to a depth not exceeding that of the pavement and foundation to be laid; of

compacting or rolling of subgrade as specified or directed by the Engineer; and of permanently repaving these areas.

- 18.3 Temporary Pavement: In placing the temporary pavement, the backfill shall be compacted or puddled as described under "Backfilling", up to the level of the pavement subgrade, after which the pavement as shown on the plans shall be placed and compacted as far as possible, without requiring the use of a roller. This temporary pavement may be crowned at the discretion of the Engineer, but in no case shall this crown be more than three-quarters (3/4) of an inch in height for each foot of width of repavement. The Contractor shall maintain this temporary pavement in condition adequate for its usual traffic, until such time as it is replaced by the permanent pavement, and shall be liable for any claims or damages arising from his neglect to maintain the temporary pavement.
- 18.4 Permanent Pavement: The permanent pavement shall be laid at such times as the Engineer may permit, but in no case in less than two (2) weeks after the trench was backfilled, except as specified below, nor more than one (1) year after the temporary pavement was laid. The Contractor shall replace the permanent pavement during the above stated period upon receipt of notice from the Engineer. Such replacement must be under local inspection and in accordance with the local standard specifications for the kind of pavement to be laid.

When specified on the plans or in the proposal, and permitted under local laws, regulations and ordinances, permanent paving over trenches may be laid immediately after the sewer structure is completed and the trench backfilled and properly compacted to subgrade elevation. In this case, the permanent surface course shall be supported on a concrete or reinforced-concrete base having the thickness and reinforcement shown or specified on the plans. This base shall have a satisfactory bearing at least one (1) foot each side on the trench, and shall be designed to support the maximum allowable surface loads over the trench.

The Contractor shall guarantee all permanent pavement for a period specified in the Contract. If, within the period of guarantee, any of the work shall prove to be defective either in materials or workmanship, or if damage occurs by settlement of the backfill, the Contractor shall immediately upon demand of the Engineer (whose decision as to such defectiveness shall be binding and conclusive upon the parties hereto) repair and replace the same, at the Contractor's own cost and expense. All repairs and replacement shall be done to the satisfaction of the Engineer and subject to his approval.

Concrete pavements shall be replaced with Class 1 concrete.

- 18.5 Walks and Curbs: Walks and curbs shall be of Class 1 concrete laid to proper lines and grades after proper settlement of the trench backfill. Under walks the

trench backfill shall be thoroughly tamped or flushed or both as necessary with the top one (1) foot to be of approved crushed stone well tamped.

19. RESTORATION OF CONDITIONS:

All rubbish or refuse and all unused materials and tools shall be removed promptly from the premises, and as the work progresses it shall be carefully cleaned and kept clean from such rubbish and refuse. Before the work will be considered as having been completed, the sites and places affected by the work shall be thoroughly cleared and left clean; free from debris, construction plant, buildings, and materials; fit for travel and other proper use; and in as good condition as existed before the work was begun.

Grass plots disturbed shall be resodded or planted anew. The restoration work shall be governed by a record of existing conditions made and filed in the office of the Engineer previous to the commencement of work.

19.1 Work included shall be grading, the replacement of trees, shrubs and topsoil, and placement of topsoil, fertilizer, seed and mulch, or fertilizers, seed and mulch, and sod.

19.2 Materials:

Topsoil	Division E	Section 15.1
Sod	Division E	Section 15.2
Seed	Division E	Section 15.3
Fertilizer	Division E	Section 15.4
Trees	Division E	Section 15.5
Mulch	Division E	Section 15.6
Latex Base Adhesive	Division E	Section 15.7

19.3 Time of Placement:

- Seed: April 15 to May 15; August 15 to October 1
- Sod: April 15 to June 15; August 15 to November 1
- Trees: (Bare-root) April 1 to May 15; September 15 to October 1
- Trees: (Balled) March 1 to June 1; September 1 to November 1

19.4 Placement:

19.41 Topsoil, Fertilizer, Seed and Mulch: Three inches (3") of topsoil shall be placed on the subbase and fertilizer applied at a rate not less than 20 lbs. per 1000 sq. ft. Class A seed shall be sown in an amount not less than 5 lbs. per 1000 sq. ft. After sowing, the surface shall be lightly raked, mulch applied, rolled with a light lawn roller and thoroughly wetted.

19.42 Fertilizer, Seed and Mulch:

- a. Fertilizer shall be applied on the slope surface or the R.O.W. surface, and worked into the soil to a depth of not less than one (1") inch. When a hydro-seeder is used, seed and fertilizer may be mixed in a water solution and applied in one operation.
  - b. Class B seed shall be incorporated into the soil to a depth not to exceed 1/4 inch. Seed shall be placed from the time ground is workable in the spring until June 1 and from August 15 to October 1.
  - c. Mulch shall be spread uniformly over the surface. Asphalt emulsion shall be sprayed on the mulch at time of placement.
- 19.43 Sod: Sod shall be placed on two (2) inches of topsoil previously placed on the trench. Sod shall be moist. Ditch bottoms and side slopes shall be sodded when the slopes are greater than 3% and 3 horizontal to vertical respectively.

20. LANDSCAPING RESTORATION:

- 20.1 Trees: Trees shall be planted at locations directed by the Inspector. Tree holes shall be 6" deeper and 12" wider than the root spread of the tree to be planted. The main root area shall be covered to a depth of at least three (3) inches after the soil is tamped around the tree roots. Trees shall be guyed.
- 20.2 Sod, Seed and Trees: Sod, seed and trees shall be watered by the Contractor one week after installation.
- 20.3 Guarantees: All seed, sod and trees shall be guaranteed for one (1) year from placement. Any sliding or washing out which may occur before final acceptance of the Contract shall be repaired in a satisfactory manner.
- 20.4 Approvals: Contractor shall submit for approval the names of suppliers of material to be used before work under this section commences.

21. FENCES, BARRICADES, ETC.:

The Contractor, at his own expense, shall erect and maintain all necessary fences, barricades, red lanterns, and danger signals. The lights shall be kept burning from sunset until sunrise, and necessary watchmen shall be provided for the safety of the public. The Contractor shall observe such rules relative to signals and safeguards as the police regulations, harbor regulations, laws and ordinances require.

22. PROTECTION OF TREES AND SHRUBS:

The Contractor shall exercise every precaution to protect from injury all trees and shrubs not directly on the line of the sewer, and upon completion of the work shall restore the ground to its original condition without additional compensation. Where

directed by the Engineer, he shall tunnel beneath trees, being careful not to disturb the roots any more than is necessary. No additional compensation will be allowed for this work above the prices bid for excavation and sewer structure.

23. MAINTENANCE OF TRAFFIC AND ACCESS TO PROPERTY:

Traffic of all kinds shall be maintained continuously and access to buildings shall be provided for at all times, unless otherwise specified in the Contract Documents, or where temporary interference is authorized by the Engineer, in which case it shall be interrupted only for such time as is necessary to provide temporary substitutes for surfaces disturbed by the construction and to restore street and sidewalk surfaces after the completion of the work. Provision shall be made for owners and occupants to reach their premises. Where partial occupation of the street is allowed, materials and equipment shall be so placed as to insure a minimum of interference with traffic. The work shall be so conducted that annoyance to residents and interference with the normal use of the properties will be reduced to a minimum. The flow in gutters and inlets shall be maintained. When access to any adjacent property is temporarily cut off, owing to occupation of the street by the Contractor, he shall render every assistance to the owner or occupant in handling materials of every description that must be delivered to or removed from such property, including ashes, rubbish and garbage, and such materials shall be taken to or from the nearest accessible point that, in the opinion of the Engineer, is convenient for handling. No additional compensation will be allowed for the various items of expense above noted. When the Engineer permits the closing of a street, the detouring of traffic or the temporary closing of a traffic lane; the Contractor shall provide all necessary signing, barricading, flashers and flagmen as required by the Michigan Manual of Uniform Traffic Control Devices.

24. BASIS OF PAYMENT:

Payment to the Contractor shall be done in accordance with the following unless otherwise noted on the plans, in the proposal or in the General Conditions and Specifications:

24.1 Protection of Existing Structures and Utilities: No extra compensation shall be considered for the required labor and materials to provide adequate protection to existing structures and utilities located within the project area.

24.2 If indicated in the proposal as a separate bid item, earth excavation shall be paid for at the unit price in the proposal per cubic yard of excavation from the top of ground to the top of rock or to the base of trench when applicable. Earth excavation made for the purpose of installing sewer pipe, manholes, and other appurtenances for the sewer installation shall be incidental to the unit price of the item. When applicable, measurement of earth excavation shall be determined by measuring the rectangular width and depth specified in Earth Excavation, and the length of the trench along the centerline of the trench. This item shall include all necessary labor, equipment, and materials, such as

shoring unless otherwise specified for a complete unit of work. Pumping and bailing shall be incidental to this item.

- 24.3 Rock Excavation: Rock excavation shall be paid for at the unit price in the proposal per cubic yard of rock measured to the rectangular width and depth specified under Rock Excavation and measured along the centerline of the trench. Pay for this item shall include all necessary blasting, drilling, labor, equipment and material for the complete removal of the rock as required in these specifications.
- 24.4 New Structures in general will be paid for by the unit lump sum price for a completed structure which includes all the necessary excavation, furnishing of materials, labor, equipment, etc. A new structure may be broken down into its component parts of construction and if so, will be indicated in the Proposal.
- 24.5 Existing Structures to be altered or demolished shall be paid for at the unit lump sum price or component unit prices if stated in the Proposal. This work shall entail the making or demolishing of a completed structure.
- 24.6 Tunnels, Bore and Jacking shall be paid for at the unit price per lineal foot for the necessary earth and rock excavation, sheathing, shoring, casing, concrete backfill, except the sewer pipe laid in place, but including any other items necessary for a completed operation. Tunnels which are less than ten (10) feet in length and necessary to pass under trees, walks or other structures shall be incidental to the item excavation, and the Contractor is not to receive added compensation for such work.
- 24.7 Sheathing and Shoring:
- 24.71 General: Sheathing and shoring shall be incidental to the item of Earth Excavation unless specifically mentioned in the Proposal, in which case, it will be paid for at the unit price per M.B.F. of usage and shall include all labor, materials, and other equipment necessary for the safety of men, structures, etc.
- 24.72 Left in Place sheathing and shoring shall be paid for at the unit price per M.B.F. and shall be payment in full for the sheathing and shoring involved. The labor, materials, and equipment used in addition to the sheathing and shoring shall be incidental to the item of Earth Excavation.
- 24.8 Base and Cradle:
- 24.81 Stone shall be incidental to the item of Pipe Sewers.
- 24.82 Concrete shall also be included in the item of Pipe Sewers.



- 24.9 Concrete Encasement shall be paid for at the unit price per lineal foot of encasement measured along the centerline of the sewer from the top of the cradle to the top of encasement and for the width of the trench and shall include the concrete and its proper placement.
- 24.10 Pumping and Bailing shall be incidental to the item of Earth Excavation.
- 24.11 Pipe Sewers shall be paid at the unit price per lineal foot in the proposal and shall include the pipe, joint materials, stone or concrete base and cradle, and any other material, labor or equipment necessary for a complete unit of construction and shall be measured along the centerline of the sewer from center-to-center of manholes.
- 24.12 Backfill Earth and Stone: Earth and stone backfill shall be incidental to the construction item requiring the excavation unless otherwise specified.
- 24.13 Disposal: Disposal of excavated material, per the specified paragraphs A, B, D, and F of Section 9.2, page F-8, shall be incidental to the item excavation.
- 24.14 Overhaul: Overhaul, as specified in paragraph G of Section 9.2, page F-8, shall be paid on the proposal rate per mile of travel per compacted cubic yard of excavated material.
- 24.15 Salvage: The Contractor shall not receive compensation for salvaging, transporting, and delivering specified materials from structures that are specified for removal or abandonment.
- 24.16 Connections to Existing Sewers and Drains shall be incidental to the total construction of this project.
- 24.17 House Connections, Wyes and Tees:
- 24.171 House Connections shall be paid for at the unit price per each connection to include necessary pipes, joints, encasement or shoring, etc., to make a complete job.
- 24.172 Wyes and Tees shall be paid for at the unit price each for the furnishing of such wyes or tees together with their plugs and necessary joints, labor, equipment, and any other essential materials.
- 24.18 Manholes and Drop Manholes shall be paid for at the unit price for a completed structure, including earth and rock excavation, base, walls, pipe, covers and frames, labor, materials, equipment, etc., necessary.

- 24.19 Manhole Frames, Covers, Castings and Steps: Frames, covers, castings and steps shall be incidental to the unit lump sum price of the construction items.
- 24.20 Concrete Structures shall be paid for at the unit lump sum price or by its unit component prices and such compensation shall be for any necessary use of materials, labor, or equipment essential for a complete unit of construction.
- 24.21 Pavement, Curb and Gutter, and Sidewalk Restoration:
- 24.211 Pavements shall be paid for at the unit price per square yard, pavement removed and replaced, to include any excavation, forming, concrete, reinforcing or other materials, labor, equipment necessary.
- 24.212 Curb and Gutter shall be paid for at the unit price per lineal foot which shall include excavation, removal, replacement, forming, concrete, reinforcing or other materials, labor, equipment necessary.
- 24.213 Walks shall be paid for at the unit price per square foot of old walk removed and new walk laid including intersection ramps when specified and is to include concrete, forms, excavation, and any other labor, materials, or equipment necessary to complete unit of work.
- 24.22 Restoration: Unless otherwise noted in the plans or specifications, the Contractor shall receive no compensation for restoration as specified in Section 18.0.
- 24.23 Landscaping: Landscaping shall be paid for at the unit price stated in the proposal. If no unit price/lump sum is stated in the proposal, this item shall be considered incidental to the project cost.
- 24.24 Barricades and Traffic Control: The Contractor shall not receive compensation for providing barricades and traffic control.

# I N D E X

## DIVISION G

### WATER MAIN CONSTRUCTION SPECIFICATIONS

<u>PARA.</u>	<u>DESCRIPTION</u>	<u>PAGE</u>
1.	General	G-1
2.	Materials	G-1
3.	Responsibility for Materials	G-1, 2
4.	Handling Pipe and Accessories	G-2
5.	Alignment and Grade	G-2, 3
6.	Protection of Existing Utilities and Structures	G-3, 4
7.	Excavation and Preparation of Trench	G-4-6
8.	Places of Disposal	G-6, 7
9.	Pipe Laying	G-7-10
10.	Setting Valves, Valve Boxes, Fittings & Blow-offs	G-9
11.	Use of Main	G-9
12.	Hydrants	G-9, 10
13.	Plugging Dead Ends	G-10
14.	Hydrostatic Tests	G-10, 11
15.	Air Test	G-11
16.	Disinfection of Completed Pipe Line	G-11, 12
17.	Structures	G-12
18.	Valve Manholes	G-12, 13
19.	Concrete Structures	G-13-17
20.	Pavement, Curb and Walk Restoration	G-17, 18
21.	Restoration of Conditions	G-18
22.	Landscaping Restoration	G-18
23.	Basis of Payment	G-19

Revised: 3/16/18

## DIVISION G

### WATER MAIN CONSTRUCTION SPECIFICATIONS

1. GENERAL:

These specifications form a part of the Contract Documents and shall govern the handling and installation of water mains with all their appurtenances.

2. MATERIALS:

All materials necessary for the completion of the Contract shall be furnished by the Contractor unless otherwise specified.

Aggregates	Division E	Section 3.0
Block (Concrete)	Division E	Section 4.0
Brick	Division E	Section 5.0
Cement	Division E	Section 6.0
Concrete	Division E	Section 7.0
Concrete Reinforcement	Division E	Section 7.5
Mortar	Division E	Section 8.0
Manholes, Catch Basins & Inlets	Division E	Section 9.0
Asbestos-Cement Water Pipe	Division E	Section 11.1
Polyvinyl Chloride (PVC) Pressure Pipe	Division E	Section 11.3
Ductile Iron Water Pipe	Division E	Section 11.4
Prestressed Concrete Water Pipe	Division E	Section 11.5
Detectable Tracer Tape	Division E	Section 11.6
Dry-Barrel Fire Hydrants	Division E	Section 11.7
Gate Valves	Division E	Section 11.8
Butterfly Valves	Division E	Section 11.9
Hydrant Valves	Division E	Section 11.10
Valve Boxes	Division E	Section 11.11
Fittings	Division E	Section 11.12
Manhole Steps	Division E	Section 12.0
Manhole Frames and Covers	Division E	Section 13.0
Structural Steel	Division E	Section 14.0
Landscaping	Division E	Section 15.0
Water	Division E	Section 16.0
Casing Pipe	Division E	Section 17.0

3. RESPONSIBILITY FOR MATERIALS:

3.1 Responsibility for Material Furnished by Contractor: The Contractor shall be responsible for all material furnished by him and he shall replace at his own expense all such material that is found to be defective in manufacture or that has become damaged in handling after delivery by the manufacturer.

3.2 Responsibility for Safe Storage: The Contractor shall be responsible for the safe storage of material accepted by him, and intended for the work, until it has been incorporated in the completed project.

4. HANDLING PIPE AND ACCESSORIES:

4.1 Care: Ductile cast iron or other pipe, fittings, valves, hydrants and other accessories shall, unless otherwise directed, be unloaded at the point of delivery hauled to and distributed at the site by the Contractor; they shall at all times be handled with care to avoid damage. In loading and unloading, they shall be lifted by hoists or skid, or rolled on skidways in such manner as to avoid shock. Under no circumstances shall they be dropped. Pipe handled on skidways must not be skidded or rolled against pipe already on the ground.

4.2 At Site of Work: In distributing the material at the site of the work, each piece shall be unloaded opposite or near the place where it is to be laid in the trench.

4.3 Care of Pipe Coating: Pipe shall be handled in such manner that a minimum amount of damage to the coating will result. Damaged coating shall be repaired in a manner satisfactory to the Engineer.

4.4 Pipe Kept Clean: The interior of all pipe, fittings, and other accessories shall be kept free from dirt and foreign matter at all times.

4.5 Frost Protection: Valves and hydrants before installation shall be drained and stored in a manner that will protect them from damage by freezing.

5. ALIGNMENT AND GRADE:

5.1 General: All pipe shall be laid and maintained to the required lines and grades; with fittings, valves and hydrants at the required locations; and with joints centered and spigots home; and with all valve and hydrant stems plumb.

5.1.1 Protecting Underground and Surface Structures: Temporary support, adequate protection and maintenance of all underground and surface utility structures, drains, sewers and other obstructions encountered in the progress of the work shall be furnished by the Contractor at his own expense under the direction of the Engineer.

5.1.2 Deviations Occasioned by Other Utility Structures: Wherever existing utility structures or branch connections leading to main sewers or to main drains, or other conduits, ducts, pipes or structures present obstructions to the grade and alignment of the pipe, they shall be permanently supported, removed, relocated, or reconstructed by the Contractor through cooperation with the owner of the utility, structure or obstruction involved. In those instances where their relocation or reconstruction is impracticable, a deviation from line and grade will be ordered and the change shall be made in the manner directed, and with extra compensation allowed therefore.

- 5.1.3 Deviation with Engineer's Consent: No deviation shall be made from the required line or grade except with the written change order of the Engineer.
- 5.2 Subsurface Exploration: Underground structures which may be encountered or which may effect the progress of the work have been determined from careful field survey and are shown on the plans in as much detail and with such accuracy as is practicable. The City does not guarantee the location shown to be absolutely correct. Any inconsistencies or inaccuracies in the location of structures revealed during the progress of construction does not relieve the Contractor from responsibility for damage to same nor in any way entitle him to extra compensation under the terms of this Contract. House connections to sewers, water and gas services are not shown, but shall be anticipated in construction and the Contract shall use due and proper precautions to protect same from injury.
- 5.3 Depth of Pipe Cover: All pipe shall be laid to have a depth of cover of five (5) feet when in earth excavation and four and one-half (4-1/2) feet of cover when rock is encountered, measured from the established street grade or the surface of the permanent improvement to the top of the barrels of the pipe or depths of cover otherwise indicated on the contract drawings or as required in Supplementary Specifications.

6. PROTECTION OF EXISTING UTILITIES AND STRUCTURES:

- 6.1 Prior to commencing excavation, the Contractor shall be required to adhere to the provisions of Act 53 of Public Acts of 1974.
- 6.2 Existing Sewers, Drains Utilities: Unless otherwise directed, the Contractor shall protect and not damage any existing utility. If damage is done, the Contractor shall repair such damage and leave such utility in as good condition as when first encountered. Water mains, sewers and drains, before backfilling, shall be provided with structural steel or other Engineer approved supports across the trench, and this expense shall be incidental to the item of "Excavation".

Whenever existing water, gas or other utility services, pipe or structures are encountered in the construction, they shall be protected by the Contractor. Any damage to them by the Contractor shall be reimbursed to the utility involved. If not paid before Contract completion, the City shall deduct such expenses from the final Contract payment.

Services, pipes or structures needing supports across or in the trench shall be properly supported with structural steel or other suitable material by the Contractor in coordination with the owner of the utilities before any backfilling is attempted. Provision for the cutting of any utility services, which crosses the trench, shall be made by the Contractor with the utilities, and such expense of cutting and reconnecting shall be borne by the Contractor. Any expense incurred by the Contractor because of interference of utility services, pipe or structures with the excavation shall be regarded as incidental to the item of "Excavation".

- 6.3 Crossing Under Existing Railroad Tracks: In laying the water main under railroad tracks, special care must be taken to properly shore up and protect the tracks and

maintain traffic over them. This work shall be done in such a manner as will meet with the approval of the railroad companies involved; and the Contractor shall save the City harmless from any damage or injury resulting to such companies or individuals by reason of this work.

The Contractor shall encase the main that is laid under railroad tracks or in railroad rights-of-way with concrete as indicated on plans.

The expense involved for the protection of tracks by the use of track supports or any other expenses involved in such crossing shall be borne by the Contractor.

## 7. EXCAVATION AND PREPARATION OF TRENCH:

7.1 Description: The trench shall be dug to the alignment and depth required and only so far in advance of pipe laying as the Engineer shall permit. The trench shall be so braced and drained in accordance with the requirements as established by MIOSHA. It is essential that the discharge from pumps be led to natural drainage channels, to drains, or to storm sewers.

7.1.1 Width: The trench width may vary with and depend upon the depth of trench and the nature of the excavated material encountered; but in any case, shall be of ample width to permit the pipe to be laid and jointed properly and the backfill to be placed and compacted properly. The width of trench from a point two feet above the top of the pipe to the bottom of the trench shall be 24" excavation for all sizes up to and including 12" pipe, and for all larger sizes it shall be 12" wider than the nominal diameter of the pipe plus 9" on each side for that portion excavated in earth only.

7.2 Pipe Foundation: The trench shall have a flat bottom conforming to the grade to which the pipe is to be laid. The pipe shall be laid upon a 3" stone cradle carried up to a point equal to 1/2 the diameter of the pipe. The barrel of the pipe shall have an even bearing for its full length.

7.2.1 Correcting Faulty Grade: Any part of the trench excavated below grade shall be corrected with the approved bedding material, thoroughly compacted.

7.2.2 Pipe Foundation in Poor Soil: When the bottom uncovered at subgrade is soft and, in the opinion of the Engineer, cannot support the pipe, a further depth and/or width shall be excavated and refilled to pipe foundation grade as required, or other approved means shall be adopted to assure a firm foundation for the pipe.

7.3 Pipe Clearance in Rock: Ledge rock, boulders, and large stones shall be removed to provide a clearance of at least 6" below all parts of the pipe, valves, or fittings, and to a clear width of 6" on each side of all pipe and appurtenances for pipes 16" or less in diameter; for pipes larger than 16", a clearance of 9" below and a clear width of 9" on each side of pipe shall be provided. Adequate clearance for properly jointing pipe laid in rock trenches shall be provided at bell holes.

- 7.3.1 Subgrade in Rock Trench: Excavations below subgrade in rock or in boulders shall be refilled to subgrade with approved material and thoroughly compacted.
- 7.3.2 Rock Excavation Defined: Rock shall be boulders over one-third (1/3) cubic yard in size within the area of the trench, or it shall be hard, durable ledge rock that cannot be easily removed by use of pick and shovel or by means of a power driven mechanical shovel.

When blasting is done it shall be by permission of the Engineer, and the Contractor shall assume all risks for damage incurred by any property, structures, persons, etc.

- 7.3.3 Blasting Procedure: Blasting for excavation will be permitted only after securing the approval of the Engineer and only when proper precautions are taken for the protection of persons or property. The hours of blasting will be fixed by the Engineer. Any damage caused by blasting shall be repaired by the Contractor at his expense. The Contractor's methods or procedure, relative to blasting, shall conform to local, state laws and municipal ordinances.
- 7.3.4 When pre-blasting is used (fracturing of rock with explosives prior to actual trench excavation) the Contractor, if required by the Engineer, shall first verify that the rock cannot be removed by pick and shovel or by power driven mechanical shovel. Cost of such verification shall be at the Contractor's expense.

7.4 Bell Holes Required: Bell holes of ample dimensions shall be dug in earth trenches at each point to permit the jointing to be made properly.

7.5 Braced and Sheeted Trenches: Wherever necessary to prevent caving, excavations in sand, gravel, sandy soil or other unstable material shall be adequately sheeted and braced. Where sheeting and bracing are used, the trench width shall be increased accordingly. Trench sheeting shall remain in place until the pipe has been laid, tested for defects and repaired, if necessary, and the earth around it compacted to a depth of two (2) feet over the top of the pipe.

7.6 Care of Surface Material for Reuse: If local conditions permit their reuse, all surface material suitable for reuse in restoring the surface shall be kept separate from the general excavation material.

7.6.1 Manner of Piling Excavated Material: All excavated material shall be piled in a manner that will not endanger the work and that will avoid obstructing sidewalks and driveways. Gutters shall be kept clear or other satisfactory provisions made for street drainage.

7.7 Trenching by Machine or by Hand: The use of trench-digging machinery will be permitted except in places where operation of same will cause damage to trees, buildings, or existing structures, above or below grade, in which case hand methods shall be employed.



- 7.8 Barricades, Guards and Safety Provisions: To protect persons from injury and to avoid property damage; adequate barricades, construction signs, torches, red lanterns and guards, as required, shall be placed and maintained during the progress of the construction work and until it is safe for traffic to use the trenched highway. Whenever required, flagmen shall be provided to prevent accidents. Rules and regulations of the local authorities respecting safety provisions shall be observed.
- 7.9 Traffic and Utility Controls: Excavations for pipe laying operations shall be conducted in a manner to cause the least interruption to traffic. Where traffic must cross open trenches, the Contractor shall provide suitable bridges at street intersections and driveways. Hydrants under pressure, valve pit covers, valve boxes, curb stop boxes, fire or police call boxes, or other utility controls shall be left unobstructed and accessible during the construction period.
- 7.9.1 Flow of Drains and Sewers Maintained: Adequate provision shall be made for the flow of sewers, drains and water courses encountered during construction, and the structures which may have been disturbed shall be satisfactorily restored upon completion of the work.
- 7.9.2 Property Protection: Trees, fences, poles, and all other property shall be protected unless their removal is authorized; and any property damaged shall be satisfactorily restored by the Contractor and shall be incidental to pipe installation.
- 7.9.3 Interruption of Water Service: No valve or other control on the existing system shall be operated for any purpose by the Contractor without approval of the Engineer, and all consumers affected by such operation shall be notified by the Contractor at least one hour before the operation and advised of the probable time when the service will be restored.

8. PLACES OF DISPOSAL:

All excavated material not required or allowed for refilling or in embankments shall be removed and deposited at such locations as are specified, or, if no such locations are specified, the Contractor shall find suitable dumping places for all such material. No material shall be deposited on private property until written consent of the owner or owners thereof has been filed with the Engineer. All costs of disposal of surplus excavated material shall be included in the prices bid for excavation or items requiring excavation.

- 8.1 Excavated material shall be disposed of, all dumps shall be leveled by the Contractor in the following order of preference:
- a. Along the site of the work to fill requirements of the work, material for this purpose shall be of the same type or better than the existing material where fill is required or where necessary to replace as backfill.
  - b. On private property facing the site of the project.

- d. On any City-owned property in or outside of the City's limits.
- d. Adjacent to the work upon the request of property owners upon property within two (2) miles haul and as directed by the Engineer.
- e. Nonadjacent to the work beyond two (2) miles haul and as directed by the Engineer.
- f. Any balance remaining after the above requirements are filled shall be disposed of by the Contractor to his best advantage with no overhaul compensation.

The Contractor shall be entitled to "Overhaul" under the terms of this Contract for his compensation for hauling beyond the two (2) mile limit upon orders of the Engineer. All free haul and "Overhaul" shall be made by written orders of the Engineer on order blanks having a number sequence.

- 8.2 Salvage: In the case of structures, the service of which is permanently abandoned, the Engineer will designate which of the materials are to be salvaged and which are to be abandoned. The Contractor shall remove and deliver to a designated point of storage, materials ordered to be salvaged, and unless otherwise specified, no additional compensation will be allowed for this removal and hauling. He shall allow owners of privately-owned structures reasonable facilities for salvaging their property. Structures designed as abandoned and not mentioned in plans or specifications to be salvaged shall become the property of the Contractor, and shall be removed from the work without additional compensation. The Contractor shall not move nor disturb the structures in any way without the approval of the Engineer.

9. PIPE LAYING:

- 9.1 Manner of Handling Pipe and Accessories into Trench: Proper implements, tools, and facilities satisfactory to the Engineer shall be provided and shall be used by the Contractor for the safe and convenient prosecution of the work. All pipe, fittings, valves and hydrants shall be carefully lowered into the trench piece by piece by means of derrick, ropes, or other suitable tools or equipment in such a manner as to prevent damage to pipe or coating, on fittings or pipe. Under no circumstances shall pipe or accessories be dropped into the trench.
- 9.2 Pipe Kept Clean: All foreign matter or dirt shall be removed from the pipe before it is lowered into its position in the trench, and it shall be kept clean by approved means during and after laying.
- 9.3 Joints: The Contractor shall keep the trench free from water, and the assembly of pipe and couplings shall be made with dry and clean materials wherever possible. Joints for cement asbestos pipe shall be Ring-tite couplings or equal.

Couplings shall be assembled in such a manner that the couplings and rubber rings are placed concentrically over the ends of adjacent pipe in accordance with the manufacturer's instructions. After assembly of couplings, the ends of the pipe within

the coupling shall be separated a minimum of 3/8" to allow for the expansion and contraction of the pipe.

Joints made between asbestos cement pipe and cast iron pipe or fittings shall be made by entering the asbestos cement pipe into standard or special bells on the cast iron pipe or fittings. In those cases where special bells are required but are not available, adapters with standard spigots and special bells shall be provided. The space between the asbestos cement pipe and the bell of the cast iron pipe or fitting shall be not less than 1/4" and shall be free from oil.

Whenever a joint lubricant is required for joining pipe sections together, the lubricant shall be supplied by the pipe manufacturer.

- 9.4 Cutting of Pipe: Whenever it is necessary to cut pipe, it shall be done with a sharp saw in such a manner as to make a clean, even cut.
- 9.5 Connections: Service connections shall be made by inserting a corporation stop into the barrel of the asbestos cement pipe. The insertion shall be made with a standard drilling and tapping machine under the direction of the City of Monroe Water Department.
- 9.6 Protecting Pipe: During the progress of the work, the Contractor shall take all precautions necessary to protect the pipe from injury. All damaged pipe shall be removed and replaced at the Contractor's expense.
- 9.7 Backfill: Backfill along side and to a depth of one foot over the top of the pipe shall be selected material from the site, if possible. Only loose dirt or sand, free from stones, shall be used and shall be uniformly tamped in place along the full length of the pipe. Tamping should be done in layers not exceeding four (4) inches thick. The remaining selected backfill need not be tamped. The balance of the backfill may be placed in the trench by hand or mechanical means.

The Contractor shall provide MDOT Spec. 23A stone aggregate backfill and power tamp such backfill in 12" layers up to plan grade at all locations where excavation occurs under existing roadways, driveways or sidewalks, or where the trench edge is within five (5) feet of pavement.

- 9.8 Steel Casings and Borings: Where shown on the plans and where indicated, the Contractor shall install steel casing pipe by the combined boring-jacking operation method. The pipe shall be new and unused mill primed welded steel pipe conforming to ASTM-A-252 Grade 2 or better specifications.

The casing pipe shall have a cutting edge and the boring head shall be contained within the casing, with the casing leading the boring head. The casing shall be installed concurrently and ahead of the face of the excavation. In no case shall water be used in conjunction with the boring operation.

The Contractor shall bulkhead the ends of the casing and/or fill the casing with sand or other materials around the pipe as demanded by State or other authorities.

Also, where indicated on the plans or if ordered by the Engineer, the Contractor shall bore under trees, without a casing, and such work shall be a part of the unit price for water mains installed in place.

10. SETTING VALVES, VALVE BOXES, FITTINGS, AND BLOW-OFFS:

- 10.1 Jointing to Asbestos Cement Pipe: Each cast iron valve or fitting, when connected to asbestos cement pipe, shall have a bell with an inside profile such that a seal can be made between the machined pipe end and the bell with a rubber ring, or shall be equipped with a bell having an inside diameter sufficient to receive the pipe and provide a caulking width between the pipe and bell of at least 1/4" for the full circumference of the pipe.
- 10.2 Support of Fittings: Each valve shall be permanently supported independently of the pipe in accordance with the details shown on the plan sheet entitled "Water Detail Standards".
- 10.3 Preparation of Bell and Spigot Ends: Before laying valves or fittings; all lumps, blisters and excess coating shall be removed from the bell. The inside of the bell shall then be wire-brushed and both the inside of the bell and the spigot end of the pipe wiped clean and dry. When sulphur base joint compound is used, oil and grease also shall be removed. All surfaces to be joined shall be kept clean until joints are made.
- 10.4 Valve Boxes: Cast iron valve boxes shall be firmly supported and maintained centered and plumb over the wrench nut of the gate valve, with box cover flush with the surface of the finished pavement or at such other level as may be directed.
- 10.5 Reaction or Thrust Blocks: Reaction or thrust blocks shall be applied at bends, tees, plugs and where changes in pipe diameter occur at reducers or in fittings. The design of concrete thrust blocks shall be as specified on the plan sheet entitled "Water Detail Standards".
- 10.6 Back-siphonage to be Prevented: Drainage branches or blow-offs shall not be connected to any sewer or submerged in any stream or be installed in any other manner that will permit back-siphonage into the distribution system.

11. USE OF MAIN:

The owner shall have the progressive use of the water mains after they are tested and chlorinated between valved sections.

12. HYDRANTS:

- 12.1 General Location: Hydrants shall be located in a manner to provide complete accessibility, and in such manner that the possibility of damage from vehicles or pedestrians will be minimized. Unless otherwise directed, the setting of any hydrant shall conform to the following:

- 12.1.1 Location Regarding Curb Lines: When placed behind the curb, the hydrant barrel shall be set so that no portion of the pumper or hose nozzle cap will be closer than 3 feet from the curb face or less than 20 feet from the curb line intersection of any street; if set between streets, the hydrant shall be placed in the manner designated by the Engineer.
- 12.1.2 Location Regarding Sidewalk: When set in the lawn space between the curb and the sidewalk, or between the sidewalk and the property line, no portion of the hydrant or nozzle cap shall be within 6" of the sidewalk.
- 12.2 Position of Nozzles: All hydrants shall stand plumb, and shall have their nozzles parallel with or at right angles to the curb, with the pumper nozzle pointing normal to the curb, except hydrants having hose nozzles at an angle of 45 shall be set normal to the curb. They shall conform to the established grade, with nozzles at least 12" above the ground.
- 12.3 Connection to Main: Each hydrant shall be connected to the main pipe with a 6" cast-iron branch controlled by independent 6" gate valve, except as otherwise directed.
- 12.4 Drainage of Hydrant: All hydrants shall be furnished and installed with the drainage hole factory plugged.
- 12.5 Anchorage for Hydrant: The bowl of each hydrant shall be well braced against unexcavated earth at the end of the trench with concrete thrust block or it shall be tied to the pipe with suitable rods or clamps. Hydrants shall be firmly braced until the backfill is firmly tamped around them.
- 12.6 Cleaning: Hydrants shall be thoroughly cleaned of dirt or foreign matter before setting.
13. PLUGGING DEAD ENDS:
- Standard plugs shall be inserted into the bells of all dead ends of pipes, tees or crosses, and spigot ends shall be capped. Plugs or caps shall be jointed to the pipe or fitting in the manner specified.
14. HYDROSTATIC TESTS:
- After any section of pipe is laid between valves, the pipe shall be filled with water and subjected to a hydrostatic pressure of 150 lbs per square inch for a period of two hours in accordance with AWWA C605 for both ductile iron pipe and PVC pipe. Allowable leakage will be based on 10.5 gallons/inch/mile/24 hours. Tests shall be performed by the Contractor and witnessed by the Engineer. The actual cost of the test shall be borne by the Contractor. All mains to be tested with hydrants in place and with hydrant connection valves open.
- 14.1 Procedure: Each section of pipe line shall be slowly filled with water and the specific test pressure, measured at the point of lowest elevation shall be applied by means of a pump connected to the pipe, in a manner satisfactory to the Engineer.

The pump, pipe connection and all necessary apparatus, except gauges and meters, shall be furnished by the Contractor. The owner will furnish gauges and measuring devices for the test. When required, all material and labor necessary to make taps into the pipe shall be furnished by the Contractor at no cost to the City.

14.2 Expelling Air Before Test: Before applying the specified test pressure, all air shall be expelled from the pipe. To accomplish this, taps shall be made, if necessary, at points of highest elevation and afterward tightly plugged.

14.3 Connection to Existing Mains: When the pipe is to be connected to an existing valve or main, the Contractor shall make the connection only after the new water main pipe has been pressure tested and chlorinated. The Contractor may elect to connect the new water main to the existing pipe or valve prior to pressure testing; however, if such is done, the Contractor shall first verify to his satisfaction and shall be responsible for insuring that the existing pipe or valve is capable of meeting the pressure test requirements.

15. AIR TEST:

Prior to tapping an existing main for a new main extension, the Contractor shall install the tapping saddle and apply a 90 pound air test for 5 minutes with no loss to insure against leakage of the saddle during the tapping operation.

16. DISINFECTION OF COMPLETED PIPE LINE:

Before being placed in service and before certification of completion by the Engineer, all new water systems, or extensions to existing systems or valved section of such extension, or any replacement in the existing water system, or any exposed section of the existing system shall be flushed and disinfected in accordance with the current State of Michigan procedures and or AWWA C651. Water mains shall be thoroughly flushed prior to disinfection at a velocity of not less than 2.5 feet per second.

16.1 Chlorination: The Contractor will perform all necessary work to chlorinate the water mains and its appurtenances. A chlorine solution (Chlorine used shall conform to the NSF Standard 60 or 61) shall be injected into the water main of sufficient strength to create a minimum 50 ppm chlorine solution (maximum 500 ppm) in the main. The type of chlorine used, mixing rates and application rate shall be approved by the Engineer. The strong chlorine solution shall remain in the water main at least 24 hours and maximum of 72 hours prior to flushing. Immediately at the time of flushing the chlorinated water from the main, a water sample for testing the strong chlorine solution shall be taken by the City Water Department. After the main has been thoroughly flushed at a velocity of not less than 2.5 feet per second, another sample shall be taken to test for residual chlorine. Sufficient notification shall be given to the City Water Department by the Contractor as to the date and time such samples are to be taken. The Contractor shall re-chlorinate the water main if test conducted on the samples taken do not meet current City Water Department standards. At the time of chlorination, all hydrant valves and intermediate main line valves shall be operated. All cost of chlorination, installation of corporations and related materials and labor shall be at the Contractor's expense.

16.2 Chemical and Bacteriological Test: Immediately following chlorination, all treated water shall be thoroughly flushed from the main at a velocity of not less than 2.5 feet per second until the replacement water through its length shall, upon test by the City Water Department, both chemically and bacteriologically, be proven equal in quality to the water in the source supply system.

17. STRUCTURES:

17.1 New Structures shall be constructed as indicated on the plans and of the materials specified. In general, structures will be indicated in the Proposal as a unit and this work shall include necessary excavation of earth and rock, furnishing of materials, labor, clean-up, etc., incidental for the completion of the whole unit of construction.

17.2 Existing Structures encountered in the work which necessitates some alteration or demolishing will be indicated on the plans and, if not, any work necessary to the progress of the project shall be ordered by the Engineer.

17.3 Alteration or Demolishing of any Structure, etc. will be indicated in the Proposal. In general, when this work is not included in the Proposal, it shall be regarded as incidental to item of Excavation with no additional payment.

18. VALVE MANHOLES:

18.1 Manholes shall be built according to the details of the plans and at locations shown. They shall be built of precast concrete or block laid radially with each seventh course as stretchers with one-quarter inch mortar joints.

18.2 The upper three feet of manholes shall be eccentric dome, drawing in on all sides to fit the ring. The ring shall be set in a bed of mortar and carefully adjusted to the grade set by the Engineer. Cast iron ring and cover shall be as specified on the plans.

18.3 Manholes shall be thoroughly bonded to the barrel of the water main and all connections to pipes made without projections or voids. Interior and exterior of block shall be plastered with one-half inch cement mortar.

18.4 Casting Grade Adjustments: Adjustments to meet the final design grade shall be set with precast reinforced concrete adjusting rings as detailed on the plans. The maximum allowed depth of adjusting rings shall be twelve (12) inches.

18.5 Earth Excavation: The excavating for manholes shall be vertical or slanting with no overhang over the work. It shall be to the same depth as the bottom of the stone bedding for the manhole base and shall have diameter not less than three (3) feet greater than the outside diameter of round manholes or three (3) feet greater than any side dimension of square or rectangular manholes.

18.6 Rock Excavation: Where rock is encountered, the excavation shall be vertical and to the same depth as for earth excavation. It shall be of the same diameter or side dimension as for earth when manholes are of brick, but can be of the same

diameter or side dimension as the outside of the manhole when it is built of concrete.

18.7 Steps: Manhole steps shall be of the material, size, length and shape as shown on the plans. They shall be firmly built into the walls not more than sixteen (16) inches apart.

18.8 Frames and Covers: Manhole frames and covers shall be as specified on the plans.

19. CONCRETE STRUCTURES:

19.1 Concrete: Concrete shall consist of a mixture of Portland cement, aggregates and water, proportioned in accordance with the requirements of this specification. Admixtures shall be included with these primary ingredients when specified.

19.2 Handling and Placing: No concrete shall be used which does not reach its final position in the forms within one (1) hour after water is first added to the mix, except when the concrete is continually agitated when the time may be extended to one and one-half (1-1/2) hours.

19.3 Depositing Concrete Under Water: Concrete, until it has set, shall not be exposed to the water by which it is surrounded, it shall not be deposited in water except with the approval of the Engineer and under his immediate supervision; and in the case the method of placing shall be as hereinafter designated.

Concrete deposited in water shall be Class 1 with ten (10) percent excess cement. To prevent segregation, it shall be carefully placed in a compact mass, in its final position, by means of a tremie, a bottom dump bucket or other approved method, and shall not be disturbed after being deposited. Still water shall be maintained at the point of deposit and the forms under water shall be watertight.

For parts of structures under water, when possible, concrete seals shall be placed continuously from start to finish, the surface of the concrete shall be kept as nearly horizontal as practicable at all times. To insure thorough binding, each succeeding layer of a seal shall be placed before the preceding layer has taken initial set. All laitance or other foreign matter shall be removed from the top surface before any concrete is placed upon it in the dry.

A tremie shall consist of a tube having a diameter of not less than ten (10) inches, constructed in sections having flanged couplings fitted with gaskets. The tremies shall be supported so as to permit free movement of the discharge and over the entire top surface of the work and so as to permit rapid lowering when necessary to retard or stop the flow of concrete. The discharge end shall be plugged at the start of work so as to prevent water entering the tube and shall be entirely sealed at all times; the tremie tube shall be kept full to the bottom of the hopper. When a batch is dumped into the hopper, the flow of concrete shall be induced by slightly raising the discharge end, always keeping it in the deposited concrete. The flow shall be continuous until the work is complete.

19.4 Spudding and Vibration:



19.4.1 Spudding shall be used in all work if deemed necessary by the Engineer. The spuds shall be of such lengths that they will reach the bottom of the concrete poured. Care should be taken to spud the concrete in and around the reinforcing and at the form faces so that the entrapped air will be brought to the surface.

19.4.2 Vibration: All Class 1, 2, and 3 concrete, except that in pipe cradles, immediately after having been placed in the forms, shall be subjected to high frequency vibration by means of a vibrating tool arranged to be inserted within the mass of the concrete from above, the tool being so arranged that, due to its own weight, it will embed itself in the concrete to the full depth of the concrete just placed. The tool shall be of such diameter that it will not disturb or wedge the reinforcement from its specified position. The tool shall impart sufficient energy to the concrete to make it plastic and flowing so that when the forms are removed, there will be no stony pockets or segregation. The tool shall operate at frequencies in excess of five thousand (5,000) impulses per minute and shall be allowed to remain in the concrete long enough to puddle the concrete thoroughly but no longer.

In the placement of concrete in roof slabs, the vibrating tool shall be provided with a short handle so constructed that vibration of the tool will not be transmitted to the operator and permitting the operator to control the position of the tool with ease. As the concrete is deposited in the forms the vibrating tool shall be inserted at close intervals and to a depth which will permit the tool to vibrate concrete through the lateral motion of the tool and at the same time permit the tool to transmit vibrations to the supporting forms. The tool shall be reinserted under the flanges of girder beams, re-entrant angles in the forms and wherever it is necessary to force the concrete to flow into proper position. The tool shall be inserted at locations close enough together to insure that the whole mass of concrete being treated shall have been subjected to adequate vibration. If it is evident after the tool has operated for a reasonable length of time that stony pockets still remain due to a deficiency of mortar, such stony pockets shall be removed, fresh concrete substituted and vibration repeated until the condition of segregation disappears.

The Contractor shall have a sufficient number of vibrating tools available to accomplish the results desired.

19.5 Construction Joints: Concrete shall be deposited continuously and as rapidly as possible until the unit of operation, as approved by the Engineer, is completed. Construction joints at points not provided for in the plans shall be subject to the approval of the Engineer.

19.6 Curing: All exposed surfaces of finished and unfinished work shall be kept constantly moist by sprinkling with water at short intervals, or by such means as the Engineer shall direct, and this moistening shall be continued until, in the opinion of the Engineer, the concrete has sufficiently hardened.

- 19.7 Protection of Surfaces: Sufficient tarpaulin or other covering shall be provided to protect freshly laid work from the action of the elements.
- 19.7.1 No wheeling, working or walking on finished surfaces will be allowed for twenty-four (24) hours after the concrete is deposited.
- 19.7.2 Temperatures: When the air temperature falls to 40 F. or less, no concrete shall be deposited unless the aggregate and water have first been heated so that the mixture shall have a temperature on leaving the mixer between 70 F. and 100 F. When the temperature falls to 20 F. or less, concrete pouring shall be stopped and shall not be resumed until the temperature has risen about 20 F.
- 19.7.3 Frozen Base: No concrete shall be poured on a frozen, dry or uncompacted subgrade.
- 19.7.4 Hot Weather Curing: All exposed surfaces of concrete shall be protected from the sun and the wind and kept wet in dry weather for fourteen (14) days after placing.
- 19.8 General Concrete Finish: Unless otherwise specified, concrete surfaces shall be finished as follows:
- Immediately after the face forms are removed, the surface shall be freed from inequalities and projections by scraping. All voids shall be filled by floating with cement mortar, and the entire surface shall be brushed or broomed with a thin wash, composed of equal parts of cement and fine, sharp sand in as many successive coats as may be required to produce an even surface in finish and color.
- 19.9 Reinforcement: All reinforcement bars shall have the dimensions and shall be placed as shown on the plans and details. The bars shall be supported at intervals of not more than three (3) feet by bent steel or molded concrete chairs of approved pattern, to maintain them in position with respect to the forms, and they shall be wired together at all intersections with two turns of No. 12 wire.
- All bars shall be protected from exposure to the weather until used, and immediately before placing them in the concrete they shall be thoroughly cleaned of scale and any rust, grease or dirt that may have accumulated on them.
- Exposed reinforcement intended for bonding with future extensions shall be protected from corrosion.
- The reinforcement shall be bent to shapes shown on the plans. The radii of bends shall be equal to or greater than twice the diameter of the bar, measured from the inside of the curved bar, except for stirrups in which the bends shall be equal to or less than the diameter of the bar. When bars are heated for bending, they shall not be heated to a higher temperature than that producing a dark cherry red color. Only competent persons shall be employed for cutting and bending and proper appliances shall be provided for the work.

All reinforcement shall be furnished in the full lengths indicated upon the plans. No splicing of bars, except where shown on the plans, will be permitted without the written approval of the Engineer. Splices which are permitted shall have a length of not less than forty (40) times the nominal diameter of the bars, and shall be well distributed or else located at points of low tensile stress. No splices will be permitted at points where the section is not sufficient to provide a minimum distance of two (2) inches between the splice and nearest adjacent bar or the surface of the concrete. The bars shall be rigidly clamped or wired at all splices in manner approved by the Engineer.

19.10 Forms: All centers of forms shall be collapsible, of ample strength, rigidly braced, with smooth surfaces against the concrete. Ribs and bracing may be constructed of either wood or steel, and must be of adequate strength to prevent deviation in the line. Ribs shall be cut or fabricated to exact dimensions, and all ribs shall be matched before the sheathing is fastened to them. Unless otherwise specified on the plans, sheathing over ribs shall be constructed of plywood, cut plywood to exact size and curvature before assembling. Plywood used for this purpose shall be securely fastened to the ribs, and shall be of such size as to reduce the number of joints to a minimum.

All joints shall be butt joints, and shall fit together in such a manner as to leave no large marks on the finished concrete surfaces. Sections of forms shall be constructed with all ends exact duplicates, so that when the form is moved ahead, after pouring, the rear end of the section will fit exactly into the front end. Any section in which the space at any point as outlined above, if more than one-eighth (1/8) of an inch, shall not be used on the work; this restriction to apply to each movement of the section. All forms shall be maintained in first class condition during the entire period of their use, and any repairs ordered repaired may again be used in the work.

In the determination of the time for removal of false work and forms, consideration shall be given to the location and character of the structure, the weather and other conditions influencing the setting of the concrete, and the materials used in the mix. Methods of form removal likely to cause overstressing of the concrete shall not be used. Forms and their supports shall not be removed in such a manner as to permit the concrete to uniformly and gradually take the stresses due to its own weight.

If form removal is not controlled by tests for compressive strength, the following periods, exclusive of days when the temperature is below forty (40) degrees F., may be used as a guide for form removal:

- for arches..... 14 to 21 days
- for reinforced slabs..... 14 to 21 days
- for walls..... 7 days

Should the Contractor desire to remove the forms in a shorter time than designated above, the removal must be controlled by tests for the strength of the concrete, and the forms shall not be slackened until the concrete has attained a compressive strength of at least fifteen hundred (1500) pounds per square inch. This compressive

strength shall be determined by the testing laboratory designated by the municipality from specimens cast at the time of pouring of the concrete. The specimens shall be stored and cured under conditions similar to the concrete structure. The cost of these tests shall be borne by the Contractor. The Contractor shall be responsible for all damage caused by the premature removal of forms.

20. PAVEMENT, CURB AND WALK RESTORATION:

- 20.1 General: The Contractor shall replace all pavement, sidewalk and curb and gutter that is broken or removed during the water main construction.

All such replacement shall be done in accordance with the City's specifications for each type of work.

All materials and workmanship shall be subject to inspection by the Engineer.

- 20.2 Work Included: Under the heading Pavement, Curb and Walk Restoration is included the work of tearing up such areas of pavement other than macadam or telford, as may be required for the construction of water main appurtenances therein; of removing and disposing of all materials torn up; of placing a temporary pavement to carry traffic until such time as the backfill has settled and the permanent pavement may be laid; of subgrading for the permanent pavement, including the accurate removal and the disposal of all materials for the width of the proposed pavement, below the existing surface to a depth not exceeding that of the pavement and foundation to be laid; of compacting or rolling of subgrade as specified or directed by the Engineer; and of permanently repaving these areas.

- 20.3 Temporary Pavement: In placing the temporary pavement, the backfill shall be compacted or puddled as described under "Backfilling" up to the level of the pavement subgrade, after which the pavement, as shown on the plans, shall be placed and compacted as far as possible without requiring the use of a roller. This temporary pavement may be crowned at the discretion of the Engineer, but in no case shall this crown be more than three-quarters (3/4) of an inch in height for each foot of width of repavement. The Contractor shall maintain this temporary pavement in condition adequate for its usual traffic, until such time as it is replaced by the permanent pavement, and shall be liable for any claims or damages arising from his neglect to maintain the temporary pavement.

- 20.4 Permanent Pavement: The permanent pavement shall be laid at such time as the Engineer may permit, but in no case in less than two weeks after the trench was backfilled, except as specified below, nor more than one (1) year after the temporary pavement was laid. The Contractor shall replace the permanent pavement during the above stated period upon receipt of notice from the Engineer. Such replacement must be under local inspection and in accordance with the local standard specifications for the kind of pavement to be laid.

When specified on the plans or in the proposal, and permitted under local laws, regulations and ordinances; permanent paving over trenches may be laid immediately after the water main structure is completed and the trench backfilled and properly compacted to subgrade elevation. In this case, the permanent

surface course shall be supported on a concrete or reinforced concrete base having the thickness and reinforcement shown or specified on the plans. This base shall have a satisfactory bearing at least one (1) foot each side of the trench, and shall be designed to support the maximum allowable surface loads over the trench.

The Contractor shall guarantee all permanent pavement for the period specified in the Contract. If, within the period of guarantee, any of the work shall prove to be defective either in materials or workmanship, or if damage occurs by settlement of the backfill, the Contractor shall immediately upon demand of the Engineer (whose decision as to such defectiveness shall be binding and conclusive upon the parties hereto) repair and replace the same at the Contractor's own cost and expense. All repairs and replacements shall be done to the satisfaction of the Engineer and subject to his approval.

Concrete pavements shall be replaced with Class 1 concrete.

20.5 Walks and Curbs: Walks and curbs shall be of Class 1 concrete laid to proper lines and grades after proper settlement of the trench backfill. Under walks the trench backfill shall be thoroughly tamped or flushed or both as necessary with the top one (1) foot to be of approved crushed stone well tamped.

21. RESTORATION OF CONDITIONS:

All rubbish or refuse and all unused materials and tools shall be removed promptly from the premises, and as the work progresses it shall be carefully cleaned and kept clean from such rubbish and refuse. Before the work will be considered as having been completed, the sites and places affected by the work shall be thoroughly cleared and left clean; free from debris, construction plant, buildings, and materials; fit for travel and other proper use; and in as good condition as existed before the work was begun. Grass plots disturbed shall be resodded or planted anew. The restoration work shall be governed by a record of existing conditions made and filed in the office of the Engineer previous to the commencement of the work.

22. LANDSCAPING RESTORATION:

Work included shall be grading, the replacement of trees, shrubs and topsoil, and placement of topsoil, fertilizer, seed and mulch, or fertilizer, seed and mulch. Sod shall be placed if specified in the proposal.

22.1	<u>Materials:</u>		
	Topsoil	Division E	Section 15.1
	Sod	Division E	Section 15.2
	Seed	Division E	Section 15.3
	Fertilizer	Division E	Section 15.4
	Trees	Division E	Section 15.5
	Mulch	Division E	Section 15.6
	Latex Base Adhesive	Division E	Section 15.7

22.2 Time of Placement:  
Seed: April 15 to May 15; August 15 to October 1

Sod: April 15 to June 15; August 15 to November 1  
Trees: (Bare-Root) April 1 to May 15; September 15 to October 1  
Trees: (Balled) March 1 to June 1; September 1 to November 1

22.3 Placement:

Topsoil, Fertilizer, Seed and Mulch: Four inches (4") of topsoil shall be placed on the subbase and fertilizer applied at a rate not less than 20 lbs. per 1000 sq. ft. Class A seed shall be sown in an amount not less than 5 lbs. per 1000 sq. ft. After sowing, the surface shall be lightly raked, mulch applied, rolled with a light lawn roller and thoroughly wetted.

23. BASIS OF PAYMENT:

Unless otherwise noted, the compensation to the Contractor for the water main installation of the diameter specified will be paid for at the Contract price per lineal foot, measured in place along the center line of pipe, which price shall be payment in full for all necessary excavation, sheeting or bracing, draining, laying, jointing, bedding, testing, backfilling, disposal of surplus excavated materials, restoration of trees, fences, shrubs, lawns, special backfill, replacement of roadway, driveway, sidewalk, and final clean-up.

Measurements will be based on actual pipe installed. Valves, hydrants, tee and fittings will be paid for at the unit price bid.

**DIVISION J**  
**LABOR STANDARDS**

**1. POLICY:**

All contract bid projects involving the construction, alteration, repair and improvement of city owned buildings and facilities, or the construction and reconstruction of streets, sidewalks, water mains, sanitary sewers and storm sewers, in which the cost is anticipated to exceed a total bid amount of \$50,000.00 shall require the payment of minimum wage rates in accordance with the Federal Davis-Bacon Act for all skilled tradespersons and laborers employed on the project. Current wage rates will be provided in the contract documents at the time of advertisement, and may be amended via bid addendum at any time prior to bid opening. Bidders who are unable to meet such requirements after submission of a bid shall be subject to having their bid security sacrificed. Once contract work has begun, certified payrolls must be submitted weekly to the City from the contractor, and shall include any subcontractors whose total subcontract value is greater than \$5,000.00, unless such subcontract is limited to the purchase or lease of materials, property, and / or equipment only. The City may, at its sole discretion, perform employee interviews to verify compliance with these standards. Should the contractor at any time fail to compensate employees as required, the City may avail itself of any remedy provided for in its standard contract language, including, but not limited to, withholding of payment or termination of the contract, and such failure shall constitute reasonable cause to withhold future contract awards for a time frame consistent with City ordinances.

Adopted October 17, 2011 by Resolution of the City Council

**DIVISION K  
SUPPLEMENTAL SPECIFICATIONS  
SOUTH CUSTER BOOSTER PUMP STATION EXPANSION**

**1. SCOPE OF WORK:**

This project consists of expanding the capacity of the South Custer Booster Station. The Work includes, but is not limited to, temporary relocation and wiring of the existing generator, demolition, saw cutting and coring; exterior underground and interior plumbing / piping modifications and expansion; pump installation; building expansion consisting of concrete and masonry construction, roofing system, electrical additions and modifications including generator installation, coordination with the electrical utility; HVAC improvements; SCADA improvements including installation and commissioning of a SCADA panel; and other related work as specified for the capacity expansion of the South Custer Booster Station.

**2. QUESTIONS ON CONTRACT:**

Any questions on this contract / bid documents should be asked in writing (email) no later than Friday, June 16, 2023 at 4:30 P.M., to provide adequate time for preparation of an Addendum, if necessary. **Contact person for questions on this contract is Patrick M. Lewis, P.E., Director of Engineering and Public Services at [patrick.lewis@monroemi.gov](mailto:patrick.lewis@monroemi.gov).** Should an addendum be necessary, this is intended for publication by the close of business on Wednesday, June 21, 2023.

**3. PRE-BID MEETING:**

There will be an **OPTIONAL** pre-bid meeting beginning on Tuesday, June 13, 2023 at 2:00 P.M. in the First Floor Conference Room of Monroe City Hall, 120 East First Street, Monroe, MI 48161. This meeting is not required for bidders to submit on this project, but it is encouraged. Representatives from the City and the design engineer will be available to answer questions, and relevant technical questions will be answered via subsequent addendum for all bidders.

**4. SITE WALK-THROUGH:**

Contractors desiring access to the facility for use in preparing their bids at times other than the pre-bid meeting should contact Chris Knight, Superintendent of Water Filtration at 734-241-5947 or [christopher.knight@monroemi.gov](mailto:christopher.knight@monroemi.gov). Inquiries should be made to the designated project contact prior to the deadline for questions, to ensure adequate time for preparation of an Addendum, if necessary, related to site visit questions.

**5. TECHNICAL SPECIFICATIONS / PLANS:**

Technical specifications for this project are listed either on the plan set or within the technical specification as prepared by Jones & Henry Engineers, Ltd. Any conflict between the plan set / technical specifications and City's contract



documents shall be resolved in favor of the plan set / technical specifications for technical matters, and the remainder of the contract documents for non-technical matters.

**6. PROGRESS PAYMENTS:**

As bids will be submitted on a lump sum basis, Contractor shall submit a Schedule of Values for approval no later than the pre-construction meeting, and this approved schedule will be the basis of payment for the duration of the contract. In no event shall the total of up-front general costs (mobilization, bonds, insurance, site trailer, etc.) exceed 5% of the contract value.

**7. PERMITS:**

Contractor(s) shall be required to abide by the terms of any permits required for the site. The applicable permits are delineated below, and if contractor believes during the bidding process that other agency permits apply or if the scope of work to satisfy the expected permits is materially different than stated below, it shall be their responsibility to bring this to the attention of the City prior to submission of their bid. The City of Monroe will be responsible for paying any applicable permit fees, and either the City or the Contractor will be required to make application (or has done so already) as delineated in each item separately below.

- a) Monroe Charter Township Building Permits – both Building and trades (Electrical, Plumbing, Mechanical) permits will be required from the Monroe Charter Township Building Department. Placement of a site office (if desired by the contractor) or other similar structure may also require a permit. Contractor is required to secure any and all necessary permits from the Building Department prior to commencement of work as may be determined by their own activities. The Contractor will be required to submit trade permit applications to Monroe Charter Township, although the City has already made application for the Building permit. The Contractor must provide their estimate of value and information to supplement the Building permit application already in progress.
- b) Monroe County Drain Commissioner’s Office (MCDC) Soil Erosion and Sedimentation Control – a permit has not yet been issued, though all applicable measures are believed to be shown on the project plans, and Contractor will be responsible for conforming to the terms of the permit both where explicitly called out or can be reasonably inferred. Where normal and customary “good housekeeping” measures such as street sweeping are required, these shall be incidental to the contract. The City will make application on behalf of the project, Contractor may need to provide on-site contact and be the responsible party for inspection. All provisions of Part 91, Soil Erosion and Sedimentation Control, of the Natural Resources and Environmental Protection Act (NREPA), P.A. 451 of 1994, as amended, shall apply to this project.

- c) Michigan Department of Energy, Great Lakes, and the Environment (EGLE) Act 399 - EGLE is presently reviewing the permit application, which was previously submitted by the City. Significant changes to the plans and specifications are not expected.
- d) Michigan Department of Transportation (MDOT) - as work is occurring within the right-of-way of South Custer Road (M-50), permission will be required from MDOT. However, as work will be occurring outside of the pavement area, unless lane closures are required by the Contractor, it is believed that work can occur under the City's existing annual "blanket" permit. Should the Contractor's activities require lane closures, these must occur within any time / date restrictions imposed by MDOT, and the Contractor will need to be a party to an individual permit application. It is not believed that fees will apply if an individual permit is required but if this is the case, Contractor will be responsible for the permit fees.

**8. GENERATOR DIRECT PURCHASE BY CITY:**

As noted in the plans and specifications, the City of Monroe is purchasing the generator equipment itself, and is expected to make award of the selected product at its June 20 City Council meeting. Generator shall either be Michigan CAT or Cummins models, and shop drawings will be provided to the awarded contractor. Generator will be delivered to the site by the supplier.

**9. PROJECT COMPLETION DATE / LIQUIDATED DAMAGES:**

Division B of the contract lists a completion date for the work of June 30, 2024. However, as it is recognized that material / equipment lead times are highly uncertain, for each calendar day beyond March 31, 2024 that delivery of one or more major material / equipment items is delayed, this completion date will be extended by one additional calendar day, provided bidder makes timely order following contract award. Liquidated damages of \$200 per calendar day shall apply, in order to ensure adequate progress once equipment has been delivered. However, as this is not intended to be punitive, reasonable extensions will be granted based on material delivery dates and typical factors as described in contract Division D.

## **APPENDIX**

This appendix includes the following items that are hereby incorporated into the Supplemental Specifications:

- Technical Specifications, Prepared by Jones & Henry Engineers, Ltd. (448 pages)
- Davis-Bacon Wage Rates, Determination MI20230092, dated 02/24/2023 (7 pages)
- Responsible Bidder Pre-Qualification Package (12 pages)
- Responsible Contractor Pre-Qualification Scoring Sheet (3 pages)

# Technical Specifications for South Custer Booster Pump Station Expansion

*Monroe Charter Township, Michigan  
3561 Custer Road; Monroe, Michigan 48161*



2023

## ISSUED FOR BID

Robert E. Clark – Mayor

### Members of City Council

Paula L. Whitman

Deb Staelgraeve

Kellie M. Vining

Michelle Germani

Brian Lamour

Andrew B. Felder

### Administration

Vince Pastue – City Manager

Barry S. LaRoy – Director of Water and Wastewater Utilities

Patrick M. Lewis – Director of Engineering and Public Services

Christopher Knight – Water Filtration Plant Superintendent

Kevin Armstrong – Water Distribution Superintendent



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*Troy McCallin Brehmer*  
5/26/2023



**TABLE OF CONTENTS**

	<b>Page</b>
<b>Foreword to Technical Specifications</b>	
<b>DIVISION 1 - GENERAL REQUIREMENTS</b>	
01043	Coordination and Control of the Work 1 – 8
01090	Reference Standards 1 – 2
01300	Submittals 1 – 8
01350	Common Product Requirements 1 – 4
01610	Disinfection of Potable Water Structures 1 – 2
01800	Construction Survey Work 1 – 4
01810	Audio-Video Recording 1 – 4
<b>DIVISION 2 - UNDERGROUND, PAVEMENT, AND SITE WORK</b>	
02110	Removal of Structures and Obstructions 1 – 6
02200	Excavation and Backfill 1 – 10
02600	Pavements, Curbing, and Walks 1 – 6
02800	Sodding, Seeding, and Mulching 1 – 4
02900	Site Plantings 1 – 4
<b>DIVISION 3 - CONCRETE</b>	
03100	Concrete Formwork 1 – 4
03150	Waterstop 1 – 4
03200	Concrete Reinforcement 1 – 6
03300	Cast-in-Place Concrete 1 – 28
03310	Grout 1 – 4
03400	Structural Precast Concrete 1 – 8
<b>DIVISION 4 - MASONRY</b>	
04200	Unit Masonry 1 - 22
<b>DIVISION 5 - METALS</b>	
05500	Metal Fabrications 1 – 14
05510	Metal Stairs 1 – 6
05520	Metal Pipe Railing 1 – 6
05530	Metal Bar Grating 1 – 4
<b>DIVISION 7 - THERMAL AND MOISTURE PROTECTION</b>	
07200	Wall and Ceiling Insulation 1 – 4
07532	Adhered Rubber Membrane Roofing System 1 – 6
07600	Flashing and Sheet Metal Work 1 – 4
07630	Gutters and Downspouts 1 – 2
07800	Roof Accessories 1 – 2
07900	Caulking and Sealants 1 – 4
<b>DIVISION 8 - DOORS AND WINDOWS</b>	
08120	Aluminum Doors and Frames 1 – 4
08125	Heavy Duty Aluminum Doors and Frames 1 – 6

538-7766.001  
06/2023

South Custer Booster Pump Station Expansion

08700	Finish Hardware	1 – 4
<b>DIVISION 9 - FINISHES</b>		
09900	Painting	1 – 16
<b>DIVISION 10 - SPECIALTIES</b>		
10251	Firefighting Equipment	1 – 2
10702	Signs and Tags	1 – 4
10800	Toilet and Bath Accessories	1 – 2
<b>DIVISION 11 - EQUIPMENT AND SYSTEMS</b>		
11050	Common Equipment Requirements	1 – 8
11735	Pumping Equipment	1 – 10
<b>DIVISION 15 - MECHANICAL</b>		
15010	General Mechanical Provisions	1 – 6
15210	Piping	1 – 20
15211	Small Piping and Valves	1 – 16
15250	Valves	1 – 8
15400	Plumbing	1 – 14
15500	Heating, Ventilating, and Air Conditioning	1 – 10
15502	Testing, Adjusting, & Balancing of HVAC Systems	1 – 4
15503	Fans	1 – 4
15504	Mechanical System Insulation	1 – 8
15506	Ductwork	1 – 6
<b>DIVISION 16 - ELECTRICAL</b>		
16010	Electrical General Provisions	1 – 4
16020	Grounding and Bonding	1 – 6
16030	Electrical Identification	1 – 4
16060	Hangers and Supports	1 – 4
16220	Diesel Generators	1 – 4
16230	Variable Frequency Drive	1 – 6
16251	Surge Protective Devices (SPD)	1 – 4
16347	Short-Circuit Coordination Study – Arc Flash Hazard Analysis	1 – 10
16410	Panelboards	1 – 6
16421	Motor Control Center	1 – 10
16430	Disconnect Switches	1 – 4
16431	Circuit Breakers	1 – 6
16440	Automatic Transfer Switches	1 – 2
16510	Lighting	1 – 8
16902	Metering and Control Equipment	1 – 14
16903	Control Panels	1 – 8

IF ANY OF THE PAGES LISTED ABOVE ARE NOT INCLUDED IN THESE CONTRACT DOCUMENTS, PLEASE ADVISE.

END OF SECTION

## FOREWORD TO THE SPECIFICATIONS

This PART includes the Specifications and is composed of Divisions with each Division further separated into Sections. The first two digits of the five digit group Section number are Division designations.

Sections are divided into four parts. PART 4, entitled Special Provisions, has been added to some Sections and includes special or additional requirements of the Owner or other agencies, special construction requirements, and supplemental specifications. In cases of conflicting or overlapping provisions, those in PART 4 shall take precedence.



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**SECTION 01043  
COORDINATION AND CONTROL OF THE WORK**

**PART 1 GENERAL**

**1.01 SCOPE**

- A. This Section includes coordination and control of the Work.

**1.02 SUBMITTALS**

- A. Submittals shall be in accordance with the requirements of Section 01300 and shall include:
  - 1. Information for the Record:
    - a. Bypass Pumping plan and procedures.
    - b. Haul routes to and from Site.
    - c. Plan and procedures for any shutdowns and bypass pumping.
    - d. Coordination drawings shall include, but not be limited to, all process piping including, but not limited to, bill of material, laying length, embedded conduit runs, and embedded plumbing lines.

**1.03 LINES AND GRADES**

- A. All Work under this Contract shall be built in accordance with the lines and grades shown on the Drawings or as altered or modified by authority of the Owner and Engineer.

**1.04 EXISTING STRUCTURES SHOWN ON DRAWINGS**

- A. Where underground and surface structures are shown on the Drawings, the location, depth, and dimensions of such structures are believed to be reasonably correct but are not guaranteed.
- B. Such structures are shown for the information of the Contractor, but information so given is not to be construed as a representation that such structures will in all cases be found or encountered just where shown, or that they represent all the structures which may be encountered.

**1.05 COOPERATION OF CONTRACTOR**

- A. The Contractor shall conduct his operations so as to interfere as little as possible with those of the Owner, other contractors, utilities, or any public authority on or near the Work.
- B. The Owner reserves the right to perform other Work by contract or otherwise, and to permit other public bodies, public utility companies, and others to do Work on or near the project during progress of the Work. If a conflict arises, the Owner will determine when and how the Work shall proceed.

- C. Claims for delay or inconvenience due to operations of such other parties on Work specified, shown on the Drawings, as directed or which can be reasonably expected to be encountered by the nature and location of the Work will not be considered.
- D. Operations entailing the use of construction equipment and lights outside the hours or 8:00 am and 5:00 pm or outside the hours allowed for construction by local ordinances or regulations are prohibited unless otherwise authorized by the Owner or Engineer.
- E. Closing off clear access to any public alley, street, road, avenue, or boulevard without the prior consent of municipal officials and the Engineer is prohibited.

**1.06 PERMANENT PAVEMENT AND FINAL RESTORATION**

- A. Permanent pavement and final restoration shall be completed prior to the close of the last paving season prior to the Contract's final completion.

**1.07 PERMANENT PAVEMENT AND FINAL RESTORATION**

- A. When sewer construction is being done between April 15 and November 1, the final pavement restoration work shall be complete by November 1.
- B. Pavement restoration shall include, but not limited to, replacement of pavement, driveways, and sidewalks.
- C. The fine grading, topsoil, and seeding operation shall be no further behind the pavement restoration than 500 lineal feet.
- D. If at any time the pavement restoration and the fine grading, topsoil, and seeding operation does not meet the above conditions, no further mainline pipe laying will be permitted until the Contractor is in compliance.
- E. In order to comply with the above conditions, the Contractor shall complete the pipeline and all appurtenances including, but not limited to, testing, in order to begin final pavement restoration and the fine grading, topsoil, and seeding operation.
- F. When sewer construction is being done between November 15 and April 15, the Contractor shall install the main pipeline and all appurtenances and complete the testing. On April 15, final pavement restoration and the fine grading, topsoil, and seeding operation shall begin, and two months later on June 15, the final pavement restoration shall be no more than 500 lineal feet behind the mainline pipe laying operation and the fine grading, topsoil, and seeding operation shall be no more than 500 lineal feet behind the pavement restoration or mainline sewer laying shall be stopped until these conditions are met.

**1.08 TEMPORARY PAVEMENT RESTORATION**

- A. The Contractor shall maintain the booster pump station access road for operating personnel, deliveries of operating supplies, normal maintenance vehicles, and other equipment incidental to the operation and maintenance of the treatment facility.

- B. The Contractor shall provide and maintain temporary pavement for all roads in which construction occurs. Temporary pavement shall be in accordance with Section 01565.

**1.09 TEMPORARY PARKING FACILITIES**

- A. Parking spaces for the Contractor's personnel shall be provided and maintained in usable condition by the Contractor at all times. Provisions shall be made so that sediment is not tracked onto paved roadways from the vehicles operated by the Contractor's personnel. The parking areas shall consist of temporary parking areas or new permanent parking areas shown on the Drawings. Temporary parking areas are to be located in the area designated by the Owner and Engineer. At the completion of the project, temporary parking areas shall be removed and the surface restored as specified, shown on the Drawings, as directed or to its original condition.
- B. The Contractor's personnel shall not utilize existing permanent parking areas unless specifically noted otherwise on the Drawings.

**1.10 TEMPORARY WATER, HEATING, LIGHTING, AND POWER**

- A. The Contractor shall provide all water, heat, lighting, and power required to construct and protect the Work until Final Completion.
- B. The source for temporary power shall be from the electric utility or portable power source.
- C. The source for temporary water can be from the water utility if available. The Contractor shall furnish all backflow prevention devices, flow meter and appurtenances as may be required by the water utility. Should the water utility impose a charge for furnishing, to the Contractor, the meter, or appurtenances the Contractor shall pay all the fees. The Contractor shall pay all charges for the water metered.
  - 1. If a water utility is not available, the Contractor shall be responsible for furnishing water and all cost associated including, but not limited to, procurement, hauling, pumping equipment, and appurtenances.
- D. The Contractor shall pay for all significant amounts of electric power utilized by the Contractor in the construction of the facility. All electric power used for such significant uses as pumping groundwater and heating shall be separately metered and paid for by the Contractor.
- E. The installation for electric power shall meet the requirements of federal, state, and local authorities and regulatory agencies.

**1.11 DISPOSAL OF DEBRIS**

- A. All debris resulting from construction operations, i.e., packaging, waste materials, damaged equipment, etc., shall be trucked from the Site by the Contractor and disposed of at spoil sites.
- B. The Contractor shall police the hauling of debris to ensure that all spillage from haul trucks is promptly and completely removed from public or private rights-of-way.

- C. All debris shall be disposed of in accordance with federal, state, and local laws and regulations.

**1.12 CONTROL OF NOISE**

- A. The Contractor shall eliminate noise to as great an extent as possible at all times. Air compressors shall be equipped with silencers and the exhaust of all gasoline motors and other power equipment shall be provided with mufflers. In the vicinity of hospitals, libraries, and schools, precautions shall be taken to avoid noise and other nuisance, and the Contractor shall require strict observances of all pertinent ordinances and regulations. Any blasting permitted in such locations shall be done with reduced charges.

**1.13 SMOKE PREVENTION**

- A. Strict compliance with all ordinances regulating the production and emission of smoke will be required, and the Contractor shall accept full responsibility for all damage that may occur to property as a result of negligence in providing required control.

**1.14 DEBRIS AND DUST CONTROL**

- A. The Contractor shall apply water, dust palliative, or both, for the alleviation or prevention of dust nuisance caused by his operations. Dust control operations shall be performed by the Contractor as site conditions dictate or as order by the Owner and Engineer.
- B. The Contractor shall utilize mechanical equipment to remove all debris from all streets, drives and walks to the satisfaction of the Owner and Engineer. Cleaning shall be performed at a minimum of daily and as directed by the Owner and Engineer.
- C. The cost of all debris and dust control methods shall be the responsibility of the Contractor.

**1.15 SANITARY REGULATIONS**

- A. The Contractor shall provide all necessary housing accommodations for the workers for changing clothes and for protection during inclement weather. Toilet accommodations shall also be maintained for the use of the employees on the Work. The accommodations shall be in approved locations, properly screened from public observance and shall be maintained in a strictly sanitary manner. The Contractor shall obey and enforce all other sanitary regulations and orders; shall take precautions against infectious diseases and the spread of same; and shall maintain at all times satisfactory sanitary conditions around all shanties, tool and supply houses, and on all other parts of the Work.

**1.16 USE OF EXPLOSIVES**

- A. When the use of explosives is authorized for the prosecution of the Work, the Contractor shall use the highest degree of care so as not to endanger life or property. The Contractor shall be responsible for any and all damage resulting from use of explosives.

- B. The Contractor agrees and warrants that he will observe state laws and local ordinances and regulations relative to the use and storing of such explosives as may be kept on the job and all such storage places shall be marked clearly, "DANGER -- EXPLOSIVES".

**1.17 EMERGENCY MAINTENANCE SUPERVISOR**

- A. The Contractor shall submit to the Engineer the names, addresses, and telephone numbers of two employees responsible for performing emergency maintenance and repairs when the Contractor is not working. These employees shall be designated in writing by the Contractor to act as his representative and shall have full authority to act on his behalf as specified in GC 6.2 of the General Conditions.
- B. The Contractor shall post at job Site, in a conspicuous location, the emergency numbers for the project.
- C. The Contractor shall be responsible for contacting the local fire, police, and emergency response personnel and organizations in advance of the Work. The Contractor shall be responsible for the coordination and compliance with emergency response plans, whether developed by the governing agency, laws, or the Contractor for the project.
- D. At least one of the designated employees shall be available for a telephone call any time an emergency arises.

**1.18 PUBLIC SERVICE STRUCTURES**

- A. Public service structures shall be understood to include all poles, tracks, pipes, wires, conduits, house-service connections, vaults, manholes, and other appurtenances, whether owned or controlled by the Owner or other public bodies or by privately-owned corporations, used to supply the public with transportation, heating, electric, telephone, gas, water, sewer, or other services.
- B. At least a week in advance of breaking ground, the Contractor shall notify the registered underground protection service, all public bodies, and other owners of such facilities of the proposed location of his operations, advising them that their property may be affected and that such measures as they may deem necessary should be promptly taken to protect, adjust, remove, or build them.
- C. In developed residential and commercial areas, the Contractor shall assume each building and dwelling has water and sewer services and that they shall be protected and repaired as needed as part of the pipeline installation. No additional payment will be made for Work associated with supporting or repairs of such services.
- D. Three conditions which may be encountered will be dealt with as follows:
  - 1. Structures which are adjacent to but not included within the limits of an excavation required for performance of the Work shall be protected, supported, and maintained in service by the Contractor at his expense.
  - 2. Structures within the limits of the Work which can be satisfactorily supported and maintained in service and which do not require removal and rebuilding in

the judgment of the Engineer shall be thus supported by the Contractor at his expense, including cost of repair of damage incident to his operations.

- a. Supports for water and gas mains, sewers, conduits, and similar structures shall be constructed of timber or other acceptable materials; shall be supported from undisturbed foundations, and shall be sufficiently substantial to ensure against settlement when pipe trenches or other excavations are backfilled. In all cases where permits or inspection fees are required by utilities in connection with changes to or temporary support of their conduits, the Contractor shall secure such permits and pay all permit and inspection fees.
  - b. The Contractor shall assume full responsibility for maintaining all public service structures in service and shall support and protect, or remove and rebuild them at his own expense. Such services shall not be interrupted without permission of the owner of the public service structure.
3. In case relocation of pipelines or other utility structures is required because of direct interference, as determined jointly by the Owner, the Engineer, and the Contractor, with the installation of the Work, the Contractor shall notify the Owners of the utility structure involved.
- a. The Contractor will not be reimbursed for the cost of the relocation if the interference is shown on the Drawings, described in the Specifications, apparent on visual inspection, or specifically included in the Work to be performed by the Contractor.
  - b. The Contractor will not be paid for time lost because of such direct interference. Where it is the policy of any utility owner to perform such Work with his own forces, the Contractor shall cooperate to the fullest extent with such utility owner.

#### **1.19 UNAUTHORIZED OR PROHIBITED WORK**

- A. Work done beyond the lines shown on the Drawings or ordered, Work done without required inspection, except as herein provided, or any extra work done without authority will be considered as unauthorized and will not be paid for under the provisions of the Contract. Work so done may be ordered removed at the Contractor's expense. Work done without lines and grades being given shall be considered as unauthorized and subject to rejection.
- B. Disposing of excess or unsuitable materials, including but not limited to excavated material, demolition debris, clearing and grubbing debris, in wetlands or flood plains.
- C. Locating stockpiles in environmentally sensitive areas.
- D. Pumping of sediment-laden water from trenches or excavations directly into any surface waters, stream, wetlands, or sewers. Pumped water shall be properly filtered and desilted prior to discharge.

- E. Open burning without a permit.
- F. Discharging injurious silica dust concentrations into the atmosphere within 200 feet of any residential or commercial, or public or private places of human occupancy.

**1.20 DRAINING OF TANKS AND PIPELINES**

- A. Unless otherwise indicated, tanks, pipelines, and other similar structures that are to be removed from service, to complete the Work will be initially drained by the Owner.
- B. Draining will be by gravity or by a permanently installed pump, if available.
- C. After the tank has been drained by the Owner to the lowest level possible with existing means for drainage, the Contractor shall remove and dispose of remaining liquid and accumulated solids, as required to complete the Work.

**PART 2 PRODUCTS**

Not used.

**PART 3 EXECUTION**

Not used.

**PART 4 SPECIAL PROVISIONS**

**4.01 REQUIRED SAFETY DOCUMENTATION TO BE SUBMITTED**

- A. On all projects that require the Contractor's or subcontractor's personnel to occupy permitted confined spaces and/or hazardous atmospheres on the Site, the Contractor shall submit to the Owner, a written proposed safety program. The safety program shall comply with all Federal, State, and local requirements. If the Owner has a safety plan that is more stringent than the Federal and State requirements, it will be made available to the Contractor for review. The submittal of the proposed safety program to the Owner shall be made well in advance of the start of construction at the Site. The submittal shall include a written Safety Management Plan including Confined Space Entry procedures. The Contractor shall be responsible to maintain documentation that anyone employed by the Contractor, subcontractors, or suppliers of any tier to the Contractor occupying such hazardous locations has received the appropriate confined space entry training and other applicable training. The Contractor is also responsible to maintain completed confined space entry permits.

**4.02 MAINTAINING CRITICAL OPERATIONS**

- A. During the Work the South Custer Booster Pumping Station is to remain in service, with the exception of scheduled shutdowns that are limited in time to a maximum of four hours.
- B. All shutdowns are to be scheduled a minimum of one week in advance.



#### 4.03 SEQUENCE OF CONSTRUCTION

- A. Install temporary wiring and relocate the existing generator near the booster station transformer, so that the existing generator pad can be removed for the new Work. The generator may only be out of service for one day.
- B. Construct the new building addition and complete the pump installation, building piping, electrical and plumbing.
- C. Construct the new generator pad, place the generator and its associated equipment, and make a temporary connection to the existing MCC. This generator will be used to provide temporary power, during loss of utility power, to the booster station.
- D. Replace the existing transformer and complete the electrical installation and commissioning.
- E. Complete the underground piping, testing and connections to existing piping.
- F. Commission the new pump and SCADA improvements.
- G. Once the new pump is placed into service, complete the connections of the existing pump station piping to the new piping.

#### 4.04 COORDINATION WITH ELECTRICAL UTILITY

- A. The Contractor to contact DTE to coordinate the transformer replacement and service improvements. DTE will require a work order with them for the project the project STE contact is:

Chris Schassberger  
Service Planner, SW Region  
DTE Energy  
(734) 347-4156

END OF SECTION

**SECTION 01090**  
**REFERENCE STANDARDS**

**PART 1 GENERAL**

**1.01 SCOPE**

- A. This Section includes reference standards.

**1.02 DESIGNATION OF ASSOCIATIONS, INSTITUTIONS, SOCIETIES AND STANDARDS**

- A. Whenever in these Specifications reference is made to Associations, Institutions, Societies, or Standards, they will be designated as follows:

AA	-	Aluminum Association
AAMA	-	Architectural Aluminum Manufacturers Association
AASHTO	-	American Association of State Highway and Transportation Officials
ACI	-	American Concrete Institute
ADAAG	-	Americans with Disabilities Act Accessibility Guidelines
AFBMA	-	Anti-Friction Bearing Manufacturers Association
AFI	-	Air Filter Institute
AGA	-	American Gas Association
AGMA	-	American Gear Manufacturers Association
AIHA	-	American Industrial Hygiene Association
AISC	-	American Institute of Steel Construction
AISI	-	American Iron & Steel Institute
AITC	-	American Institute of Timber Construction
AMCA	-	Air Moving and Conditioning Association
ANSI	-	American National Standards Institute
API	-	American Petroleum Institute
ARI	-	Air Conditioning and Refrigeration Institute
ASA	-	American Standards Association
ASHRAE	-	American Society of Heating, Refrigerating, and Air Conditioning Engineers
ASME	-	American Society of Mechanical Engineers
ASTM	-	American Society for Testing Materials
AWPB	-	American Wood Preservers Bureau
AWS	-	American Welding Society
AWWA	-	American Water Works Association
BLS	-	Bureau of Labor Standards
CISPI	-	Cast Iron Soil Pipe Institute
FM	-	Factory Mutual
FS	-	Federal Specifications
IBR	-	Institute of Boiler and Radiator Manufacturers
IEEE	-	Institute of Electrical and Electronic Engineers
INETA	-	International Electrical Testing Association
ISA	-	Instrument Society of America
JIC	-	Joint Industrial Council
MDOT	-	Michigan Department of Transportation

NBS	-	National Bureau of Standards
NEC	-	National Electrical Code
NEMA	-	National Electrical Manufacturers Association
NFPA	-	National Fire Protection Association
NICET	-	National Institute for Certification in Engineering Technologies
NSF	-	National Sanitation Foundation
NRTL	-	Nationally Recognized Testing Laboratory
OSHA	-	Occupational Safety and Health Act
SMACNA	-	Sheet Metal and Air Conditioning Contractors National Association, Inc.
SSPC	-	Steel Structures Painting Council
MBC	-	Michigan Building Code
IBC	-	International Building Code
UBC	-	Uniform Building Code
UL	-	Underwriters Laboratories, Inc.
USBM	-	United States Bureau of Mines

- B. Wherever specific standard numbers are indicated, i.e., ASTM C150, it shall be understood to mean the latest revision thereof.

**PART 2 PRODUCTS**

Not used.

**PART 3 EXECUTION**

Not used.

**PART 4 SPECIAL PROVISIONS**

Not used.

END OF SECTION

**SECTION 01300  
SUBMITTALS**

**PART 1 GENERAL**

**1.01 SCOPE**

- A. This Section includes requirements for submittals.
- B. Contractor shall adhere to the submittal schedule as submitted under the provisions of the General Conditions. Contractor shall modify the schedule as required to allow sufficient time for submittal review based on current construction schedule.

**1.02 COORDINATION OF SUBMITTALS**

- A. The Contractor shall be responsible for the coordination of submittals and field verifications as required for the various parts of the Work.
- B. All submittals to the Engineer, unless otherwise specified, shall be made only by the Contractor. Direct submittals from subcontractors or suppliers will not be accepted.
- C. All submittals shall reference the Specification item that it covers, the Contractor's name, the Contract title and location, and the date of submission. Submittal shall also indicate whether the information is for the Engineer's review and approval, for record purposes, or for the fulfillment of the operation and maintenance requirements.

**PART 2 PRODUCTS**

**2.01 GENERAL**

- A. Two categories of information are normally required:
  - 1. Shop Drawings for review.
  - 2. Information for Record:
    - a. Operation and maintenance manuals.

**2.02 SHOP DRAWINGS FOR REVIEW**

- A. Shop Drawings:
  - 1. The Contractor shall submit Shop Drawings in accordance with the General Conditions, as required by individual Sections, shown on the Drawings or as directed.
  - 2. The Contractor shall indicate all variances from the requirements of the Contract Documents in accordance with the General Conditions.
  - 3. The Contractor shall clearly indicate quantities and the exact intended use of the equipment or material contained in the submittal.
  - 4. All Submittals shall be tailored to the project by high-lighting appropriate information and deleting or crossing out nonapplicable information or where

applicable the Contractor shall provide a data sheet with all necessary information to correctly identify the applicable Sections of the manuals for the actual material or equipment furnished. All options furnished shall be indicated.

5. Color charts or samples shall be included for all submittals where a color selection by the Owner is required. Original Color Charts (not Color Copies) and samples shall be delivered to the Site, Engineer's RPR or Owner as required. The Engineer shall be copied on the transmittal letter for record purposes.
- B. Samples shall be provided as required in the individual Sections. Samples shall be of the precise material proposed to be furnished. The number of samples and sample size shall be the industry standard unless otherwise stated in the individual Sections.

### **2.03 INFORMATION FOR RECORD**

- A. Material certificates shall be submitted for materials as indicated in the individual Sections. The certificate shall state that the products have been sampled and tested in accordance with the proper industrial and governmental standards and meet the requirements of the Specifications. Certificates shall be signed by an authorized agent of the manufacturer.
- B. Licenses and Permits - The Contractor shall submit copies of all licenses and permits required by Local, State, and Federal laws.
- C. Installation and calibration certificates shall be submitted for equipment as indicated in the individual Sections. These certificates shall indicate manufacturer's satisfaction with the installation, the accuracy of calibration and alignment, and the operation of the equipment. Such certificates must be signed by an authorized agent of the manufacturer.
- D. Progress Schedules shall be submitted in accordance with the General Conditions and Section 01310.
- E. Schedule of Shop Drawings and Sample Submittals shall be submitted in accordance with the General Conditions.
- F. Schedule of Values shall be submitted in accordance with the General Conditions.
- G. Copy of programming for all PLC's and computers on the project.

### **2.04 OPERATION AND MAINTENANCE INFORMATION**

- A. Operation and maintenance manuals shall be submitted as information for the record.
- B. Operation and maintenance manuals shall be submitted as electronic documents prior to the printing of the record copy.
  1. The Contractor shall provide one electronic copy of the manuals for preliminary review.
  2. The final accepted manuals shall be provided as one electronic copy of the manual and one printed copy as specified below.

- C. Electronic manuals shall be in Portable Document Format (PDF) as generated by Adobe Professional Version 7.0 or newer. The PDF file shall be fully indexed using the table of contents, searchable with thumbnails generated. PDF documents shall have bookmark created in the navigation frame for each major entry (Section, Chapter, Tab) in the table of contents. PDF images shall be at a readable resolution typically 300 dpi or higher. Optical Character Recognition (OCR) capture shall be performed on these images text can be searched, selected and copied from the PDF file.
1. The opening view of each PDF document shall be the bookmarks to the left and cover page or table of contents.
  2. The PDF file name shall include the Name of Owner, Project title, Contract Number, and Specification Section. Commonly used abbreviations acceptable to the Owner may be used to minimize length of file name.
  3. The Contractors Name shall be the electronic "Author" of the PDF document.
- D. This information will be reviewed only if properly identified with Specification Section numbers and only after revised, where necessary, to conform to the Engineer's notes on previous submittals that have been marked "Make Corrections Noted." Manuals shall be tailored to suit the specific equipment provided.
- E. Submittals shall include but not limited to the following:
1. Descriptive literature, bulletins, or other data covering equipment or system.
  2. Complete list of equipment and appurtenances included with system, complete with manufacturer serial number and model number.
  3. Utility requirements.
  4. General arrangement drawing.
  5. Sectional assembly.
  6. Dimension print.
  7. Materials of construction.
  8. Certified performance curve.
  9. Parts list with assembly drawings.
  10. Recommended spare parts list with part and catalog number.
  11. Lubrication recommendations and instructions.
  12. Schematic wiring diagrams.
  13. Schematic piping diagrams.
  14. Description of associated instrumentation.
  15. Drive dimensions and data.
  16. Operating instructions.

17. Maintenance instructions including trouble-shooting guidelines, lubrication, and preventive maintenance instructions with task schedule.
  18. Special tools and equipment required for operation and maintenance.
  19. Description of equipment controls.
  20. Pump seal data.
  21. Assembly, installation, alignment, adjustment, and checking instructions.
  22. Confirmation of all corrections noted on Shop Drawings marked "Make Corrections Noted."
  23. Manufacturer's name, address, and telephone number along with manufacturers job number and Purchase Order number.
  24. Manufacturer's local sales representative, address, telephone number.
  25. All installation instructions that were provided to Contractor for use to install equipment.
- F. All manuals shall be tailored to the project by high-lighting appropriate information and deleting or crossing out nonapplicable information or the Contractor shall provide a data sheet with all necessary information to correctly identify the applicable Sections of the manuals for the actual equipment furnished. All options furnished shall be indicated.
- G. Manuals shall be printed on 8-1/2 by 11-inch size with standard three-hole punching. Large manuals shall be submitted in three-ring binders. Small manuals shall be submitted in folders with metal fasteners. Index tabs shall be furnished for all manuals containing data for three or more items of equipment. All manuals shall have a title label on the cover stating the specification item number and item name. A table of contents shall be included in all manuals.
- H. Drawings shall be reduced to 8-1/2 by 11 inch or 11 by 17 inch. Where reduction is not possible, larger drawings shall be folded separately and placed in envelopes which are bound into the manual.
- I. Equipment installations shall not be considered substantially complete until all associated operation and maintenance manual submittals are accepted by the Engineer.
- J. Field modifications to equipment during installation shall be included in the manual so that the manual reflects as-built conditions. Revisions to the manual may be submitted for incorporation into the manual where appropriate. However, the Engineer reserves the right to return all six manuals for revision to reflect as-built conditions.

## **PART 3 EXECUTION**

### **3.01 SUBMITTAL SCHEDULE**

- A. The Contractor shall submit a schedule of submittals in accordance with the General Conditions.
- B. The schedule of submittals shall identify, by specification section, the following:

1. Indicate submittals required for each specification section. There may be more than one equipment or product specified in each Specification Section, thus, there may be a need for multiple submittals from each Specification Section.
2. If submittals will be broken down by structure or area they shall be listed separately (i.e., structural reinforcement drawings by building, conduit layout by building).
3. Indicate whether a sample or color selection is required.
4. Indicate manufacturer O&M Manuals and installation certificate is required.
5. Indicate whether a startup and start up report is required.
6. Indicate whether a manufacturer warrant is required.
7. Indicate whether training is required.
8. Indicate whether spare parts required.
9. Include the name of the subcontractor or vendor.

### **3.02 IDENTIFICATION OF SUBMITTALS**

- A. All submittals shall have a Submittal Identification & Approval cover sheet attached. A sample of the submittal cover sheet is attached for reference. The form will be provided by Engineer and coordinated with Contractor.
- B. All submittals shall be given a consecutive number.
- C. Resubmittals shall include a revision suffix such as a number or alphabet signifier.
- D. Submittals to satisfy the operation and maintenance information requirements shall be entered into the EPMS as a submittal. The description shall have the prefix "OM".

### **3.03 PRINTING AND DISTRIBUTION**

- A. The Contractor shall provide printed copies of approved submittals and deliver them to the Owner and Engineers RPR at the Site.
- B. The Contractor shall provide one printed copy of the approved operation and maintenance manual and the electronic copy on portable electronic media device to the Owner.
- C. The Contractor shall provide printed copies of submittals, project information or documents required to satisfy the building permit and inspections as may be required by the governing agency.
  1. The Engineer will provide the stamped/sealed Contract Drawings for the initial filing of the building permit applications.

## **PART 4 SPECIAL PROVISIONS**

Not used.

END OF SECTION



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### Submittal Identification & Approval

<b>Date:</b>	<b>Spec Section</b>
<b>Submittal No.</b>	<b>Drawing Sheet No.</b>
<b>Description:</b>	
<b>Manufacturer(s)</b>	

**Contractor Comments/Deviations/Measurements**

<i>Contractor</i>	<i>Engineer</i>																
<p><b>Contractor Name</b></p> <table border="1" style="margin-left: auto; margin-right: auto;"> <tr><td><input type="checkbox"/></td><td>Approved</td></tr> <tr><td><input type="checkbox"/></td><td>Forwarded</td></tr> <tr><td><input type="checkbox"/></td><td>Checked</td></tr> </table> <p>By: _____ Date: _____</p>	<input type="checkbox"/>	Approved	<input type="checkbox"/>	Forwarded	<input type="checkbox"/>	Checked	<p>SHOP DRAWING REVIEW SUBJECT TO CONTRACT REQUIREMENTS</p> <p><b>Jones &amp; Henry Engineers, Ltd.</b></p> <table border="1" style="margin-left: auto; margin-right: auto;"> <tr><td><input type="checkbox"/></td><td>Approved</td></tr> <tr><td><input type="checkbox"/></td><td>Approved—Make Corrections Noted</td></tr> <tr><td><input type="checkbox"/></td><td>Amend &amp; Resubmit</td></tr> <tr><td><input type="checkbox"/></td><td>Rejected—See Remarks</td></tr> <tr><td><input type="checkbox"/></td><td>Distribute for Information</td></tr> </table> <p style="color: red; font-size: small;">REVIEW IS FOR GENERAL COMPLIANCE WITH CONTRACT DOCUMENTS. NO RESPONSIBILITY IS ASSUMED FOR CORRECTNESS OF DIMENSIONS OR DETAILS</p> <p style="color: red; font-size: x-small;">Approval in no way relieves the Contractor of any responsibility for capacities, performance, functions, compliance with Federal, State, and Local Codes; accuracy of dimensions and details; or continuity and completeness of the Project nor does approval constitute or imply any increase in Contract Price.</p> <p>By: _____</p>	<input type="checkbox"/>	Approved	<input type="checkbox"/>	Approved—Make Corrections Noted	<input type="checkbox"/>	Amend & Resubmit	<input type="checkbox"/>	Rejected—See Remarks	<input type="checkbox"/>	Distribute for Information
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**Review Comments**

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**SECTION 01350  
COMMON PRODUCT REQUIREMENTS**

**PART 1 GENERAL**

**1.01 SCOPE**

- A. This Section includes general requirements for all materials, equipment and systems furnished or installed under this project.
- B. Additional specific requirements included under a particular Section shall take precedence.
- C. This Section includes, but is not limited to, the following procedural and administrative requirements:
  - 1. Product Delivery Storage and Handling.
  - 2. Warranties.
  - 3. Quality Assurance and Control.

**1.02 SUBMITTALS**

- A. Submittals shall be in accordance with the requirements of Section 01300 and related specification sections.
- B. The specification sections and Drawings contain the specific submittal requirements.

**1.03 QUALITY ASSURANCE**

- A. Where Contractor is required to provide design services or certification of the design, the specified product, equipment, or system shall comply with the specified criteria.
  - 1. Contractor shall submit a written request for clarification when specified criteria is incomplete or insufficient.
- B. Manufacturer's name, make, model number and other designations provided in the contract documents are to establish the significant characteristics, including but not limited to, type, function, dimensions and physical properties, performance, and appearance for the purpose of evaluating comparable products. Contractor shall verify product, equipment or system proposed meets or exceeds the requirements as specified or shown on the Drawings.

**1.04 PROJECT HANDLING**

- A. Schedule delivery to minimize the time goods are kept in storage.
- B. Deliver goods to Site in manufacturer's original packaging.
- C. Inspect the goods to determine if there is visible damage to the packaging.
  - 1. The packaging shall be removed in a manner that will allow resealing for storage.

2. If packaging cannot be removed and reused, the goods shall be repackaged per the manufacturer's recommendations.
- D. Goods that are susceptible to damage by the environmental or project conditions, including but not limited to, switchgear, motor control centers, panelboards, instrument control panels, fixtures shall be stored in a controlled environment per the manufacturer's recommendations. If no such area is available at the time such equipment is received, such space shall be provided by the Contractor at no expense to the Owner.
- E. Where construction is in roads or streets, that portion of the right-of-way not required for public travel may be used for temporary storage purposes unless otherwise prohibited. Materials shall not be stored in areas where such storage creates a hazard. Any other additional space required for construction or storage of materials and equipment shall be obtained by the Contractor at his expense.
- F. The Contractor shall confine his equipment, the storage of materials and equipment, and the operations of his workers to areas permitted by law, ordinances, permits, and the requirements of the Contract Documents, and shall not unreasonably encumber the premises with materials or equipment.

#### **1.05 GUARANTEE**

- A. Manufacturer's warranty, extending beyond one-year after substantial completion for the specified product, equipment or system shall be provided to the Owner and endorsed by the manufacturer.
- B. Requirements for warranties extending beyond one-year after substantial completion are described in individual Sections of these specifications.
- C. Manufacturer's limitations and disclaimers shall not relieve the Contractor from warranty obligations under the Contract Documents.

### **PART 2 PRODUCTS**

#### **2.01 SHOP PAINTING**

- A. Non-galvanized ferrous surface shall be painted.
- B. Shop painting of ferrous surfaces shall be as follows:
  1. Surfaces shall be thoroughly cleaned of dirt, grease, oil, rust, scale, or other foreign substances. All metal surfaces shall, as a minimum, be abrasive blasted in accordance with SSPC-SP6, Commercial Blast Cleaning. More stringent surface preparation shall be provided where required by Section 09900.
  2. Surfaces shall receive a shop coat of a primer compatible with the finish coating to be used by the Contractor and specified in Section 09900.

**2.02 GALVANIZING**

- A. Where galvanized metal is indicated, unless otherwise specified, galvanizing shall conform to ASTM A123 (Hot Dip Galvanized). Threaded parts and hardware shall be galvanized in conformance with ASTM A153.

**2.03 REGULATORY REQUIREMENTS**

- A. Materials, equipment, coatings, and chemicals in contact with potable water or water being treated for potable water use shall comply with the applicable NSF Standards.

**PART 3 EXECUTION**

**3.01 INSTALLATION**

- A. Products shall be installed in accordance with the manufacturer's instructions and Contract Documents.
- B. Required appurtenances including but not limited to, anchors, grout, and leveling shims, shall be provided.

**PART 4 SPECIAL PROVISIONS**

Not used.

END OF SECTION

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**SECTION 01610**  
**DISINFECTION OF POTABLE WATER STRUCTURES**

**PART 1 GENERAL**

**1.01 SCOPE**

- A. Under this Section, the Contractor shall furnish all materials, labor, equipment, and supervision necessary to clean and disinfect potable water structures. Disinfection shall comply with latest revision of ANSI/AWWA C652 Disinfection of Water-Storage Facilities and C653 Disinfection of Water Treatment Plants. The disinfection of the following structures shall conform to the requirements of this Section:
  - 1. Pump Suction Wells (see Part 3).
  - 2. New Piping and Appurtenances (see Part 4).
- B. All Work performed under this Section shall comply and be in accordance with all approved trade practices and federal, state, and local regulatory requirements.

**PART 2 PRODUCTS**

Not used.

**PART 3 EXECUTION**

**3.01 CLEANSING**

- A. Prior to disinfecting the structure(s), the Contractor shall remove all items not permanently part of the structure's interior and thoroughly clean and flush all interior surfaces with a high-pressure stream of potable water. All debris and water from the flushing operation shall then be removed and disposed. Disposal shall meet federal, state, and local requirements.

**3.02 DISINFECTION AND TESTING**

- A. After cleansing operations, the Contractor shall perform disinfection and bacteriological sampling and testing in accordance with ANSI/AWWA C652/C653.
- B. When bacteriological tests performed after chlorination are not satisfactory, the Contractor shall reclean tank and repeat disinfection process.
- C. When the disinfection operation is completed, potable chlorinated water furnished by Owner shall be used for initial filling. Water for initial disinfection shall be furnished by Owner. Water for subsequent tests or disinfections shall be furnished by the Contractor.

**3.03 DECHLORINATION**

- A. The Contractor shall dechlorinate any chlorinated water used for cleansing or disinfection prior to its release to the environment or storm sewer by using a reducing agent per ANSI/AWWA C652/C653. The Contractor shall confirm no chlorine residual is present prior to disposal. Disposal shall meet federal, state, and local requirements.

**3.04 RESERVED**



## PART 4 SPECIAL PROVISIONS

### 4.01 CITY REQUIREMENTS

- A. Follow City of Monroe standards in Division G Water main Construction Specifications Part 16, for disinfection of potable water structures. In general, this includes:
1. Disinfection of Completed Pipe Line - Before being placed in service and before certification of completion by the Engineer, all new water systems, or extensions to existing systems or valved section of such extension, or any replacement in the existing water system, or any exposed section of the existing system shall be flushed and disinfected in accordance with the current State of Michigan procedures and or AWWA C651. Water mains shall be thoroughly flushed prior to disinfection at a velocity of not less than 2.5 feet per second.
    - a. Chlorination - The Contractor will perform all necessary work to chlorinate the water mains and its appurtenances. A chlorine solution (Chlorine used shall conform to the NSF Standard 60 or 61) shall be injected into the water main of sufficient strength to create a minimum 50 ppm chlorine solution (maximum 500 ppm) in the main. The type of chlorine used, mixing rates and application rate shall be approved by the Engineer. The strong chlorine solution shall remain in the water main at least 24 hours and maximum of 72 hours prior to flushing. Immediately at the time of flushing the chlorinated water from the main, a water sample for testing the strong chlorine solution shall be taken by the City Water Department. After the main has been thoroughly flushed at a velocity of not less than 2.5 feet per second, another sample shall be taken to test for residual chlorine. Sufficient notification shall be given to the City Water Department by the Contractor as to the date and time such samples are to be taken. The Contractor shall rechlorinate the water main if test conducted on the samples taken do not meet current City Water Department standards. At the time of chlorination, all hydrant valves and intermediate main line valves shall be operated. All cost of chlorination, installation of corporations and related materials and labor shall be at the Contractor's expense.
    - b. Chemical and Bacteriological Test - Immediately following chlorination, all treated water shall be thoroughly flushed from the main at a velocity of not less than 2.5 feet per second until the replacement water through its length shall, upon test by the City Water Department, both chemically and bacteriologically, be proven equal in quality to the water in the source supply system.
- B. Schedule all disinfection activities, testing, water flushing and other applicable requirements with the City of Monroe.

END OF SECTION

**SECTION 01800  
CONSTRUCTION SURVEY WORK**

**PART 1 GENERAL**

**1.01 SCOPE**

- A. This Section includes the furnishing of all labor, materials, equipment, and services necessary for the completion of Construction Survey Work in accordance with the Contract Documents.
- B. This Work consists of the layout of all lines and grades shown on the Drawings or as altered or modified by the Engineer, control survey and of miscellaneous survey work related to construction of the project.

**1.02 PROTECTION**

- A. The Contractor shall protect and preserve the established reference points and monuments.
- B. Whenever monuments are encountered in the line of Work, whether shown on the Drawings or not, the Contractor shall notify the Engineer in writing at least 24 hours in advance of moving same, and under no circumstances is such a stone or other monument to be removed or disturbed by the Contractor or by any of his men without a written order of the Engineer and only when a registered surveyor representative of the Owner is present.

**1.03 REPLACEMENT OF LOST SURVEY POINTS**

- A. Whenever a reference point or monument is lost or destroyed or requires relocation, the Contractor shall, at his own expense, accurately relocate and replace all such points so lost, destroyed, and moved.

**1.04 SUBMITTALS**

- A. Submittals shall be in accordance with the requirements of Section 01300 and shall include:
  - 1. Information for the Record:
    - a. Layout Sheets including, but not limited to, Benchmarks both temporary and permanent and Pipeline layout staking.
- B. Contractor shall provide the Engineer and Resident Project Representative, no later than five working days prior to installation, all Logs, reports, field notes, drawings and documentation as specified shown on the Drawings or directed.
- C. No pipeline or related Work shall be considered for payment until all logs, reports field notes drawings and documentation as specified, shown on the Drawings or directed has been submitted to the Engineer or Engineers representative.

## **PART 2 PRODUCTS**

### **2.01 CONSTRUCTION STAKING**

- A. All construction points shall be marked with a wooden hub and nail or a PK nails in concrete and asphalt pavements and walks.
- B. All points located in areas of heavy underbrush, inaccessible or limited site distance shall be identified with a wood lath extending a minimum of 3 feet above the ground.
- C. All points located in paved surfaces shall be clearly marked with paint. Contractor shall obtain written permission from owner to use paint for marking.

## **PART 3 EXECUTION**

### **3.01 COORDINATION**

- A. The Contractor shall provide field forces necessary to lay out the location, alignment, elevation, and grade of the Work shown on the Drawings and in conformance with the control points and benchmarks shown on the Drawings.
- B. The Contractor shall use competent personnel and suitable equipment for the layout of the Work required. If the layout Work involves more than a few simple distance and elevations from established reference points, the Contractor shall employ a Registered Surveyor to supervise the layout Work.
- C. Contractor shall furnish the necessary labor to assist the Engineer in checking the installation, if required.

### **3.02 EXISTING CONNECTION POINTS**

- A. The Contractor shall verify critical elevation points of the existing utilities prior to commencing installation of Work. Critical points shall include all points where new Work connects to existing utilities and existing utilities that could be conflicts with Work. All data shall be provided to the Engineer before commencing Work.

### **3.03 RIGHTS-OF-WAY AND EASEMENTS**

- A. Rights-of-way or easement(s) shall be staked at points along the boundaries so that at least two stakes can be seen distinctly from any point along the boundary line. The staking shall not exceed 200-feet in any direction. All points of change in width or direction of the rights-of-way or easement(s) boundary line shall be staked.
- B. When the Contractor performs construction and the zone of influence is within 10-feet of a rights-of-way or easement(s) boundary line, they shall place stakes properly identifying points of change in width or direction of the boundary line and at points along the boundary line not to exceed 25-feet.

### **3.04 PAVEMENT**

- A. The Contractor shall establish a layout for location and grade on both sides of the road and 5-feet off the edge of the pavement or back of curb. Layout line shall consist of

stakes set at station intervals necessary for the topography and environment to assure conformance to planned line and grade. Stakes shall be set at a minimum every 50-feet, at all vertical and horizontal points of curvature and points of tangent, and at all vertical high or low points.

- B. Stakes for line and grade of pavement and curb shall be set at station intervals necessary for the topography and environment, not to exceed 50-feet, and at low and high points of vertical curves to assure conformance to planned line and grade.

### 3.05 PIPE IN OPEN CUT

- A. The Contractor shall utilize a laser beam for establishing line and grade when installing pipeline in open-cut construction. In order to maintain control during pipeline installation and to obtain the required field data for the record documents (G.C. 6.19) the Contractor shall establish construction and layout stakes. These stakes shall be based on the contract documents and the survey control data as provided by the Engineer.
- B. The construction staking shall be placed along the pipeline route at and at location of new manholes, valves, deflections both vertical and horizontal and as specified, shown on the Drawings or as directed. All construction layout stakes shall be offset at a minimum of 10-feet and at a right angle to the pipe line route. Layout shall be referenced to the downstream manhole or valve, in addition it may reference survey of baseline stationing.
- C. Contractor shall provide to the Engineer, no later than five working days prior to the installation of the pipeline, all information of the completed construction layout staking. This information shall include but not be limited to stationing, elevations, control points, project coordinates, offset direction and distance for all deflections both horizontal and vertical, manholes and all other points as specified, shown on the Drawings and directed by the Engineer.
- D. The grade of pipe in open-cut, whether placed by laser beam or other approved methods, shall be checked using surveying equipment. The Contractor shall have a surveyor's level and level rod on the Site at all times when pipeline and appurtenances are being installed. The level rod shall be equipped with an attached "shoe" extension on the bottom for placing on the pipe invert. The pipe invert elevation shall be checked at a maximum of 50-feet intervals or more often as directed by the Engineer. Checks will be performed by the Contractor and results, including but not limited to layout station shall be recorded in contractor's field log.
- E. The Contractor shall furnish all equipment and labor and check his alignment from the offset stakes. Contractor shall record all information in the log.
- F. Any inspection or checking of the Contractor's layout by the Engineer shall not relieve the Contractor of his responsibility to secure the proper dimensions, grades, and elevations of the Work.

### 3.06 RESERVED

**3.07 RESERVED**

**3.08 LOCATION OF STRUCTURES AND UNDERGROUND PIPING**

- A. The location of new structures and underground utilities shall be based on the dimensions, coordinates, and requirements shown on the Drawings or specified.
- B. If it is stated on the Drawings or specified that the location and/or elevation of the new structure or underground piping shall depend on the location of existing underground or otherwise hidden facilities, those existing underground or hidden facilities shall be located by the Contractor prior to his determination of the location and/or elevation of the new facilities. This requirement shall override any other specific location dimensions or coordinates shown on the Drawings for that structure or piping.
- C. If the location or elevation determined by the Contractor, in accordance with the above requirements, appears to cause conflicts with existing structures or utilities or appears to potentially cause functional issues with either the existing or new structures or utilities, the Contractor shall notify the Engineer immediately.
- D. In no case, shall coordinates or other location information be extracted or interpolated from the electronic CAD files that may be provided to the Contractor by the Owner or Engineer without the specific approval of the Engineer.

**3.09 RESERVED**

**3.10 BENCHMARKS/VERTICAL CONTROL**

- A. Benchmarks have been set for survey and construction reference purposes.
- B. The Contractor shall protect and transfer these benchmarks as needed to complete the Work.

**3.11 HORIZONTAL CONTROL**

- A. The centerline stationing provided is not based upon physical control points found or established as part of the design.
- B. The Contractor shall establish horizontal control as necessary.

**PART 4 SPECIAL PROVISIONS**

**4.01 REGISTERED SURVEYOR**

- A. The Contractor shall employ the services of a registered surveyor for the initial layout and staking of the project. The Registered Surveyor shall be utilized at any time when reestablishing control points, elevations and on any redesign or extension of the Work. All survey Work shall be as specified, shown on the drawings or as directed.

END OF SECTION

**SECTION 01810  
AUDIO-VIDEO RECORDING**

**PART 1 GENERAL**

**1.01 SCOPE**

- A. Under this Section, the Contractor shall furnish all personnel, transportation, recording equipment, power, and materials to produce color audio-video records of existing topography along all pipeline routes and designated haul roads, in designated residences, and as directed.

**1.02 SCHEDULE OF WORK**

- A. Unless otherwise directed in writing by the Engineer, video recording shall be scheduled in conformance with the following:
  - 1. No recording shall be started on any portion of the Work until that portion of the Work is under Contract unless otherwise directed by the Owner.
  - 2. Recording shall not precede excavation for construction by more than three months.
  - 3. Video recording shall be performed only when foliage is visible on trees, except as authorized by the Engineer.
  - 4. Video recording shall not be performed when more than 10% of the ground is covered with snow or leaves, unless authorized by the Owner.
- B. Before proceeding with the Work, the audio-video recording Contractor shall consult with the Engineer concerning the following:
  - 1. Scheduling recording to precede construction.
- C. All recording shall be completed on a section of Contract before the Contractor starts excavation or places material or equipment in that section.
- D. In areas where public utilities are to be relocated or replaced, a second audio-video recording shall be made after the public utility has concluded their work but before the Contractor commences operations.
- E. The Owner shall obtain permission for the recording crew to enter private property not included in an easement. The Contractor shall give the Owner sufficient prior notice to obtain the permission.

**1.03 DEFINITIONS**

- A. Audio-Video Recording - Zone of Influence - Shall include producing audio-video records as specified herein for the zone of influence. The zone of influence shall be defined as all surface area within street rights-of-way or easements in which project is to be installed or within areas 50 feet on each side of a proposed utility centerline, whichever is greater, and additional features in contiguous areas as specified or directed.

- B. Audio-Video Recording of Buildings - Entering - Shall include moving audio-video equipment into buildings or residences (including attached or separate garages) designated by the Engineer for the purpose of recording existing conditions therein.
- C. Audio-Video Recording of Building - Panels - Shall include audio-video recording of designated panels of buildings. Panel as used herein shall mean the full surface of a room wall, ceiling, or floor or the outer side of a building not viewable in any zone of influence recording.

#### **1.04 SUBMITTALS**

- A. Submittals shall be in accordance with the requirements of Section 01300 and shall include:
  - 1. Shop Drawings for Review:
    - a. Provide a minimum of four copies of the video.

### **PART 2 PRODUCTS**

#### **2.01 AUDIO-VIDEO RECORDING**

- A. Displays - All video shall, by electronic means, display (visible on the playback viewer) continuously and simultaneously generated transparent digital information which shall include the date and time of recording, as well as the corresponding planned station numbers. The date information shall contain the month, day, and year. The time information shall consist of hours, minutes, and seconds, separated by punctuation marks. Below the stationing, periodic transparent alpha/numeric information shall appear. The information shall consist of the name of the project, name of area covered, direction of travel, viewing side, and any other pertinent data.

#### **2.02 AUDIO-VIDEO OUTPUTTING**

- A. Audio-video recording shall be a digital file format such as MPEG, MP3, MP4, Wave or WMV or other current standard file formats as approved by Engineer.
- B. The electronic file organization shall reasonably match the project stationing with file names including the station number and street names.
- C. The electronic files shall be stored on a single solid-state memory device, such as a DVD disc or jump/thumb drive, external hard drive. Solid state memory devices shall have a USB for connection to a computer. The memory volume on the storage device shall be adequate to store the electronic video files in an unzipped capacity along with any associated or embedded data files.

#### **2.03 AUXILIARY LIGHTING**

- A. Auxiliary lighting shall be used wherever necessary to ensure clarity of picture.

### **PART 3 EXECUTION**

#### **3.01 PERSONNEL**

- A. The Work shall be performed by competent personnel with knowledge of the procedures and methods to produce satisfactory records as specified herein.

#### **3.02 PRODUCTION**

- A. Recording shall be composed in such a manner that Filming shall, in general, proceed in the direction of the project stationing.
- B. Recorded Contents:
  - 1. Video recordings shall be supported by appropriate audio description simultaneous with the visual coverage.
  - 2. All houses or buildings and other readily recognizable objects as required shall be identified visually and audibly in such a manner that they can be referenced to the stationing of the project. Objects selected shall be at intervals not exceeding 100 lineal feet and shall include all houses and buildings identified by house numbers.
  - 3. Within the zone of influence, the recording shall include but not be limited to all sidewalks, driveways, ditches, parkways, lawns, inlets, culvert pipe ends, trees, shrubs, fences, houses, and buildings that could conceivably be affected by the Contractor's operations. The audio shall call attention to existing cracks or uneven areas in walks and driveways, damaged lawns, trees, or shrubbery, broken or missing inlet castings, deteriorated fences, and, where feasible, broken or plugged culvert pipes.
  - 4. Within street rights-of-way, the recording shall include but not be limited to all pavement, curbs and inlets, mailboxes, traffic signs, and street signs. The audio shall call attention to damaged mailboxes, signs, curbs, and inlet castings. Damaged areas in pavements over proposed project or in pavements scheduled for resurfacing need not be referred to in the audio.
  - 5. Audio-video recording for designated residences shall include documentation of surface conditions inside and outside of the building prior to starting project construction.
- C. Control of Picture Quality - The camera carrier shall travel at a low speed to ensure against blur or distortion of the recorded pictures. A maximum rate of 48-feet per minute is recommended.

#### **3.03 OWNER REVIEW**

- A. As the audio-video recording work progresses, the Contractor shall deliver completed sections to the Owner and Engineer. The Owner and Engineer will review the recordings and determine if they are acceptable for clarity and coverage. The recording may be rejected if the picture is of poor quality (i.e., blurred, distorted, too light, too dark,



improper color), insufficient coverage, poor audio, or does not meet specified requirements.

- B. The area of rejected recording shall be rerecorded by the Contractor and reinserted in the electronic file in the proper sequence.

**PART 4 SPECIAL PROVISIONS**

Not used.

END OF SECTION

**SECTION 02110**  
**REMOVAL OF STRUCTURES AND OBSTRUCTIONS**

**PART 1 GENERAL**

**1.01 SCOPE**

- A. This Section includes demolition of existing structures and removal of pavement, piping, and equipment necessary to clear space for new construction and/or to rehabilitate existing construction.

**1.02 SUBMITTALS**

- A. Submittals shall be in accordance with the requirements of Section 01300 and shall include:
1. Information for the Record:
    - a. The Contractor shall submit, as specified, a copy of a signed permit from the owner of the property upon which the debris, removed under this Section, will be disposed.
    - b. Dust and noise control measures.
    - c. Record documents, in accordance with the General Conditions, and photograph or video recording indicates the location of, but not limited to, the following existing, new, and abandoned:
      - 1) Utilities.
      - 2) Mechanical.
      - 3) Electrical.
      - 4) Structural.
      - 5) Any embedded items.
    - d. Inventory and documentation list for removed and salvaged materials for the Owner.

**1.03 QUALITY ASSURANCE**

- A. Contractor shall execute the Work in compliance with all federal, state, and local codes. Any removal or demolition shall not leave the Owner in violation of any such regulations or codes unless approved by the Owner and Engineer.

**1.04 PROTECTION**

- A. Structures shall be removed in such a manner as not to damage any portions of the existing structure which are to remain in place.

## **PART 2 PRODUCTS**

### **2.01 FILL MATERIAL**

- A. Fill material shall be in accordance with Section 02200.
- B. Temporary installations shall allow the plant to operate without impeding the operations of the plant and shall be approved by the Owner prior to use.

## **PART 3 EXECUTION**

### **3.01 COORDINATION**

- A. Demolition work extending beyond the limits as specified, shown on the Drawings, or as required, will be considered unauthorized. The Contractor, at no additional cost to the Owner, shall repair said damage to a condition equal to or better than existed prior to commencement of the Work.
- B. Existing structures and equipment which are damaged in appearance or function by performance of demolition work shall be replaced or repaired, at Owner's discretion and to an approved condition, by the Contractor at no increase in Contract Price.

### **3.02 PAVEMENTS, SIDEWALKS, CURBING, AND SIMILAR STRUCTURES**

- A. Removal of existing pavements, sidewalks, curbing, and similar structures shall end at an existing joint or a sawed joint. Sawed joints shall be straight, neat, and free from chipped or damaged edges.
- B. For removal of non-reinforced concrete, the minimum depth of saw cut shall be 3 inches.
- C. For removal of reinforced concrete, the depth of saw cut shall be sufficient to cut the steel unless specified otherwise.
- D. If the concrete is coated with a bituminous surface or other material, the depth shall be sufficient to cut into the concrete, not including the coating depth, as specified above.

### **3.03 EXCAVATION OF RIGID PAVEMENT**

- A. The Contractor shall excavate rigid pavement, consisting of concrete or concrete base with a wearing surface of brick or bituminous concrete, wherever such excavation is required for the purposes of this Contract.
- B. Pavement shall be excavated to neat lines and, unless otherwise specified in Part 4 of this Section, only to widths required for trenches for pipe laying and for construction of structures. Adequate provision shall be made to prevent settlement and breakage of pavement beyond the approved limits of excavation. Concrete pavement and sub-base shall be cut with a concrete saw in conformance with Subsection 3.02.

**3.04 MANHOLES, CATCH BASINS, INLETS, AND SIMILAR STRUCTURES**

- A. Existing manholes, catch basins, inlets, and similar structures designated to be removed shall be completely removed.
- B. Manholes, catch basins, inlets, and similar structures designated to be abandoned shall be removed to an elevation of at least 3 feet below the finished subgrade or ground surface. The remaining void shall be filled with special backfill material compacted to 100% optimum density per ASTM D698 or controlled density fill, CDF if permitted by the Engineer. All sewer openings in manholes located on sewer lines that are not to be filled, shall be plugged with 8-inch minimum thickness masonry plug.
- C. Sewers designated to remain in service and connected to structures indicated to be removed or abandoned shall be rebuilt through the area with new pipe. Sewer flow shall be maintained between removal and replacement operations. Abandoned sewers shall be sealed and made watertight with approved precast stoppers or masonry bulkheads.
- D. All castings or hydrants salvaged from abandoned or removed structures shall remain the property of the Owner, if requested by the Owner, and shall be cleaned and transported by the Contractor to a site designated by the Owner or incorporated in the Work where called for on the Drawings, scheduled, or so directed. If Owner decides salvaged materials are not wanted, the Contractor shall dispose of them at no additional cost to the Owner.

**3.05 GROUT-FILLED ABANDONMENT OF PIPE, CONDUIT, AND SIMILAR STRUCTURES**

- A. Ends of sewer designated to be abandoned shall be sealed with approved masonry bulkheads or factory caps and plugs.
- B. Contractor shall determine and modify, as necessary, the mix of the flowable fill material to satisfactorily fill the entire abandoned sewers and structures. ACI 229R-99 Table 5.1 provides examples of acceptable mix designs.
- C. Contractor may need to include fill holes and vent pipes to assure thorough filling. The locations of grout tubes, vents, and inspection ports for grout filling pipes to be abandoned shown on the Drawing shall be considered the minimum number. The Contractor may choose to provide more grout tubes, vents, and inspection ports at no additional cost.
- D. Quantities of flowable fill material used to fill the conduits shall be monitored continuously during the placement.
- E. Bulkheads shall be installed as shown on plans and as needed by the Contractor's method to completely fill the abandoned sewers.
- F. Sites disturbed by the grout-filled abandonment work shall be restored as part of this Work.

**3.06 GUARDRAIL AND FENCE**

- A. Where so required by the Drawings, existing guardrail and fence shall be carefully dismantled and stored for reuse or for salvage by the Owner.
- B. Wood posts and other materials not considered salvageable by the Owner shall be disposed of by the Contractor.

**3.07 SUPERSTRUCTURES, TANKS, CHAMBERS, AND SIMILAR STRUCTURES**

- A. Care shall be used in demolishing structural elements which are continuous with structural elements remaining in service. Unless otherwise permitted by the Owner, concrete and masonry shall be cut through entirely with a masonry or concrete saw before removing the unwanted portions.
- B. Methods and equipment used in demolition work shall be chosen so the structural integrity and water tightness of both new construction and existing plant structures remain unimpaired by the performance of the demolition work.
- C. Portions of underground structures which are in the way of new sewers, piping, and structures shall be removed from the area of conflict to a distance not less than 6 inches from any point of the new construction.
- D. Care shall be used when removing existing concrete from around reinforcing steel which must be used for securing new concrete. If this reinforcing steel is damaged, the Contractor shall remove additional existing concrete until sufficient existing reinforcing steel is exposed to provide adequate embedment length in the new concrete, as approved by the Engineer.

**3.08 EQUIPMENT REMOVAL**

- A. All equipment, valves, piping, fittings, and miscellaneous steel structures that are removed shall remain the property of the Owner and shall be stored at a site selected by the Owner. The Owner reserves the right to require the Contractor to dispose of certain unwanted portions of removed equipment and materials. The Owner shall have the right to reject any or all materials removed during construction, and the Contractor shall haul away and dispose of these materials in a suitable manner at no additional cost to the Owner.
- B. See Section 16010 for removal of electrical equipment and appurtenances.
- C. The Contractor shall replace, at no cost to the Owner, equipment designated to be turned over to the Owner that is lost or damaged.

**3.09 PRIVATE SIGNS**

- A. Private and commercial signs shall be carefully removed and relocated as directed by the Owner.

**3.10 DISPOSAL OF DEBRIS**

- A. All debris resulting from demolition operations; i.e., broken concrete, masonry, pipe, miscellaneous metal, trees and brush, equipment, etc., shall be trucked from the Work site by the Contractor and disposed of at spoil sites in a legal manner, in full compliance with applicable codes and ordinances.
- B. The Contractor shall police the hauling of debris to ensure that all spillage from haul trucks is promptly and completely cleaned up.

**3.11 BACKFILLING**

- A. All trenches, holes, and pits resulting from the removal and abandonment of any structure or obstruction shall be backfilled and compacted in accordance with the requirements of Section 02200.

**3.12 MAINTAINING OF PLANT OPERATIONS**

- A. Demolition shall be scheduled and performed in strict conformance with these Specifications and in a manner which results in no interruption of treatment operations beyond that provided for and approved by the Owner and regulatory agencies. The date and time of commencing the separate items of demolition work shall be submitted to the Engineer for review, and no demolition work shall commence until the Engineer's approval of date and time is given.
- B. All equipment, labor, and material costs which are made necessary by the requirements of the Sequence Plan, shall be borne by the Contractor.

**3.13 USE OF EXPLOSIVES**

- A. The use of explosives for the Work of removal of structures and obstructions is PROHIBITED.

**3.14 PIPING REMOVAL**

- A. At the location where pipe removal stops, the remaining pipe end shall be capped. The cap must be pressure tight and restrained from movement due to pressures inside the pipe.
- B. Piping removal includes, but not limited to, all hangers, stands, and anchoring devices.

**3.15 OPENINGS AND PATCHING**

- A. The Contractor shall fill all openings created by equipment, piping, and conduit removals.
- B. The Contractor shall patch any marred surfaces created by equipment and piping removals.
- C. All filling and patching work shall be performed in accordance with the specifications.
- D. All anchor bolts shall be removed and holes filled or cut off flush.

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Monroe, MI  
South Custer Booster Pump Station Expansion

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**PART 4 SPECIAL PROVISIONS**

Not Used

END OF SECTION

**SECTION 02200  
EXCAVATION AND BACKFILL**

**PART 1 GENERAL**

**1.01 SCOPE**

- A. This Section includes all excavations and related Work for the construction of the designated structures, pipelines, and other incidental Work.
- B. Excavation includes the Work of making all necessary excavations for the construction of all Contract Work; of furnishing, placing, and use of sheeting, shoring, and sheet piling necessary in excavating for and protecting the Work and workers; of doing all pumping and fluming necessary to keep the excavation free from water; of providing for uninterrupted flow of existing streams, treatment plant processes, drains and sewers; of damming and cofferdamming where necessary; of supporting and protecting existing structures, pipes, conduits, sewers, culverts of all types of materials of construction, of supporting and protecting railroad tracks, posts, poles, wires, fences, buildings, and other public and private property adjacent to the Work; of removing and replacing existing sewers, culverts, pipelines, and bulkheads where necessary; of removing after completion of the Work all sheeting and shoring not necessary to support the sides of excavations; of removing and disposing of all surplus excavated material or material under structures that does not meet the soil design bearing capacities; of doing all backfilling, of compacting backfill to limits specified or ordered by the Engineer; and restoring all property damaged as a result of the Work involved in this Contract.
- C. The Work includes obtaining and transporting suitable fill material from off-site when on-site material is not available.
- D. The Work includes transporting surplus excavated material not needed for backfill at the location where the excavation is made, to other parts of the Work where filling is required, or disposal of all surplus on other sites selected by the Owner.

**1.02 SUBMITTALS**

- A. Submittals shall be in accordance with the requirements of Section 01300 and shall include:
  - 1. Shop Drawings for Review:
    - a. Sieve Analysis (ASTM C136) - One test for each material source.
    - b. Submit a moisture density curve (ASTM D698) for each type of material used for backfill. Test shall be referenced to appropriate sieve analysis test. The maximum dry weight and optimum moisture content shall be indicated.
    - c. Controlled Density Fill Material - Design Mix and Certified Test Results.
    - d. Test results for conformance with specified "Compaction Requirements":



- 1) Retests shall be referenced to the corresponding failing test.
- e. Stripped soil and topsoil test per MDOT Table 816.
2. Information for the Record:
  - a. When excess excavated material is disposed at locations off the Site, the Contractor shall obtain and submit written permission from the Owner of the property upon which the material is to be placed.
  - b. Dimensional drawings of shaft and shaft liner construction, layout and related appurtenances and description of shaft construction and removal sequence.
  - c. Design certifications and calculations for shaft and shaft liner systems sealed by a Professional Engineer in the State where the project is located.
  - d. Manufacturer's product literature and details of shaft construction and shaft liners and accessories.
  - e. Shaft information provided as indicated in this Section shall be provided.
  - f. Details of the proposed method of installation and construction of dewatering wells.
  - g. Schedule of the proposed sequence of dewatering well construction.
  - h. Dewatering logs.
  - i. Submit method for abandoning dewatering well.

## **PART 2 PRODUCTS**

### **2.01 TOPSOIL**

- A. Soil stripped from the Site shall consist of loose, friable, loamy topsoil without admixture of subsoil or refuse. It shall be reasonably free from peat, muck, roots, hard clay, coarse gravel, stones, weeds, tall grass, brush, sticks, litter, ground debris and wood products. The stockpiled soil shall be subject to the approval of the Engineer.
- B. Topsoil provided shall be in accordance with MDOT Table 816 and be loose, friable, loamy soil without admixture of subsoil or refuse. In order for the topsoil to be considered loamy the fraction of topsoil, passing a No. 10 sieve, shall contain not more than 40% clay. Topsoil shall contain not less than 4% nor more than 20% organic matter as determined by loss on ignition of oven-dried samples to constant weight at 212 degrees F.
- C. Excess material shall be removed from Site, unless directed otherwise by Owner or Engineer.

**2.02 SELECTED BACKFILL**

- A. Selected backfill shall be clean excavated soil. It shall be free of rock and foreign debris of any kind and shall be tested in accordance with ASTM C136 sieve screen analysis and ASTM D2487 soil classification. The material's use as selected backfill shall be approved by the Engineer.
- B. Engineer may waive material testing of selected backfill. Such waiver shall apply only to the designated location and the source of the selected backfill. Such waiver shall not apply to excavated soil from locations not so designated.

**2.03 SPECIAL BACKFILL MATERIAL**

- A. Special backfill material shall conform to MDOT 902.07 and shall meet the grading requirements Table 902-3, Class II.

**2.04 AGGREGATE BEDDING MATERIAL**

- A. Aggregate bedding material shall be well-graded durable crushed gravel, crushed stone or meeting the gradation requirements of MDOT Table 902-1, Class 26A.
- B. Aggregate bedding material shall be as follows:
  - 1. For PVC, HDPE, or plastic pipe diameters 10 inches and less, bedding material shall be No. 8 (nominal size 3/8-inch to sieve No. 8).
  - 2. For PVC, HDPE, or plastic pipe diameters over 10 inches, bedding material shall be No. 67 (nominal size 3/4-inch to sieve No. 4) or No. 8 (nominal size 3/8-inch to sieve No. 8).
  - 3. All other aggregate bedding shall be No. 8, No. 67 or No. 57 stone. No. 57 (nominal size 1-inch to sieve No. 4) shall not be used for bedding PVC, HDPE, or plastic pipes.
- C. Fine aggregate bedding material shall be natural sand or manufactured sand bedding material meeting the requirements of MDOT Table 902.08 and MDOT Table 902-8.
  - 1. Fine aggregate bedding material shall be No. 9 (2ns to 2ss) or 2ms (nominal size sieve 4 to sieve 100) or Table 902.4.
  - 2. Natural sand material excavated from Site may be utilized for pipe bedding provided it meets the requirements specified herein and is approved by both the independent laboratory and the Engineer.

**2.05 CONTROLLED DENSITY FILL (CDF) MATERIAL**

- A. Controlled density fill material shall be a cement base fill material that can be deposited in a fluid state. It shall be composed of portland cement and approved filler material, sand, and water. The mixture shall have a compressive strength of 100 psi minimum and 500 psi maximum:
- B. Filler material shall consist of mineral aggregates, slag, or fly ash. Metals, soil, or organic material will not be permitted.

## 2.06 SLOPE AND CHANNEL PROTECTION

- A. Riprap, plain or heavy, shall be in accordance with MDOT 813.

## PART 3 EXECUTION

### 3.01 COORDINATION

- A. Construction Through Highways:
1. Permits - The Owner will obtain permits required for open cut construction through highways. Contractor shall be responsible for compliance with and furnishing any item required by permit such as Bond Security.
  2. Notification - The Contractor shall give written notice to appropriate officials of the affected Department of Transportation, City, or County at least five days, not including weekends and holidays, before starting construction under highways and as required under other roadways.
  3. Contractor shall comply with standard permit conditions of controlling authority and special provisions noted in Part 4 of this Section.
- B. Test Pits:
1. The Contractor shall perform exploratory test pits as may be necessary or ordered by Engineer in advance of excavation to determine the exact location and elevation of subsurface structures, pipelines, and conduits which are likely to be encountered and shall make acceptable provision for their protection, support, and maintenance in operation. Vacuum excavation (pot hole) may be used if adequate information can be obtained by such method. No additional payment shall be made for test pits.
  2. Conflicts with existing utilities not located, as specified, far enough in advance of construction, shall not be considered as a basis for delay claims or additional payment.

### 3.02 REMOVING AND REPLACING TOPSOIL

- A. Removal:
1. Excavation for trenches in which pipelines, sewers, conduits, and other utilities are to be installed: The Contractor may elect to strip soil and stockpile unless the Contract Documents direct stripping and stockpiling prior to excavation.
  2. General excavation, other than trench excavation: The Contractor shall remove, and stockpile the top 12 inches of the existing soils from all areas of construction including, but not limited to, excavation and embankment areas, stockpile sites, construction yard, storage areas, etc.
- B. Replacing Stockpiled Soil and Topsoil:
1. Trench excavation areas disturbed as a result of trenching operations and which are to be restored with grass or other plantings shall be free of peat, muck,

roots, hard clay, coarse gravel, stones, weeds, tall grass, brush, sticks, litter, ground debris and wood products. The surface shall be mechanically conditioned after removal of debris. After surface is prepared, it shall be covered with topsoil or stockpiled soil material to a minimum depth of 4 inches. Topsoils and stockpiled soil material shall meet the requirements specified herein and be tested.

2. General excavation areas which are to be restored with grass or other plantings shall be free of peak, muck, roots, hard clay, coarse gravel, stones, weeds, tall grass, brush, sticks, litter, ground debris, wood products and construction debris including loose stone. The surface shall be mechanically conditioned after removal of debris. After surface is prepared it shall be covered with stockpiled soil and then have a minimum of 4 inches of topsoil placed.
- C. The Work shall be in accordance with applicable portions of MDOT Sections 205.03A.1 and 816.03A.

### **3.03 GENERAL EXCAVATION**

- A. All necessary excavation shall be performed to accommodate the completion of all Contract Work.
- B. The Drawings show the horizontal and the lower limits of structures, pipelines, sewers, and other utilities. The methods and equipment used by the Contractor when approaching the bottom limits of excavation and when trimming the bottom of the excavation to a smooth surface shall be selected to prevent disturbing the soil below the bottom limits of excavation.
- C. Excavation which is carried below the bottom limits shall be classified as Unauthorized Excavation, unless said excavation has been authorized by the Engineer prior to each occurrence.
- D. Unauthorized excavation shall be filled with CDF material to the bottom limits. Under circumstances where structural integrity is not a factor, the Engineer may allow the filling of unauthorized excavation with pipe bedding material or special backfill material compacted to 100% density, as specified under compaction requirements.
- E. Sheeting, Shoring, and Bracing:
  1. The Contractor shall furnish and install adequate sheeting, shoring, and bracing to maintain safe working conditions, and to protect newly built work and all existing adjacent and neighboring structures and utilities from damage by settlement.
  2. Sheeting, shoring, and bracing shall be arranged so as not to place a strain on portions of completed Work until the construction has proceeded far enough to provide ample strength. Sheeting and bracing may be withdrawn and removed at the time of backfilling, but the Contractor shall be responsible for all damage to newly built Work and adjacent and neighboring structures and utilities.

3. Sheeting, shoring, and bracing shall be removed or cut-off at the time of backfilling to avoid problems with finish grade or future excavation.

F. Construction Sheeting Left in Place:

1. The Contractor shall furnish, install, and leave in place, construction sheeting and bracing when specified or when indicated or shown on the Drawings.
2. Construction sheeting and bracing, placed by the Contractor to protect adjacent and neighboring structures and utilities, may be left in place if desired by the Contractor. All such sheeting and bracing left in place, shall be included in the cost for excavation.
3. Any construction sheeting and bracing which the Contractor has placed to facilitate his work may be ordered, in writing by the Engineer, to be left in place. The right of the Engineer to order sheeting and bracing left in place shall not be construed as creating an obligation on his part to issue such orders. Failure of the Engineer to order sheeting and bracing left in place shall not relieve the Contractor of his responsibility under the Contract.

G. Removal of Water:

1. The Contractor shall at all times during construction provide and maintain ample means and devices with which to remove promptly and dispose of properly all water entering the excavations or other parts of the Work and shall keep said excavations dry until the structures to be built or pipelines to be placed therein are completed. No water shall be allowed to rise over or come in contact with concrete or masonry until the concrete and mortar has attained a satisfactory set, except in cases where the concrete has been tremied into place with the approval of the Engineer. Water shall not be allowed to rise above the bottom of the bedding stone prior to placing pipe. In waterbearing sand, well points and/or sheeting shall be supplied, together with pumps and other appurtenances of ample capacity to keep the excavation free of water and in compliance with government regulations.
2. The Contractor shall dispose of water from the Work in a suitable manner without damage to adjacent property or structures and in compliance with all regulations.

### 3.04 TRENCH EXCAVATION

- A. Excavation for trenches in which pipelines, sewers, conduits, and other utilities are to be installed shall provide adequate space for workers to place and joint the pipe properly. The trench shall be kept to a minimum width. The width of trench at the top of the pipe shall comply with the limits specified or shown on the Drawings.
- B. Excavation shall be to the depth necessary for placing aggregate bedding material under the pipeline, sewer, conduits, and other utilities as shown on the Drawings. If over excavation occurs, the trench bottom shall be filled to grade with compacted aggregate bedding material.

- C. The amount of trench open at any one time in advance of completed Work shall be limited to the minimum necessary for conducting laying operations.
- D. In general, backfilling shall begin as soon as the pipeline, sewer, conduits, and other utilities are in a condition to receive it and shall be carried to completion as rapidly as possible. New trenching shall not be started when earlier trenches need backfilling or the surfaces of streets or other areas need to be restored to a safe condition.

### **3.05 EXCAVATION OF UNSUITABLE MATERIAL**

- A. Unsuitable materials existing below the Contract bottom limits for excavation shall be removed as required by the Engineer. The Engineer may rely upon the independent laboratory retained on this Project when determining unsuitable soil conditions, removal and backfill. Such excavation shall be conducted at a time when the Engineer and independent laboratory are present and shall not exceed the vertical and lateral limits prescribed by both.
- B. The voids left by removal of unsuitable material shall be filled with special backfill, pipe bedding material, or CDF material as listed in Part 4 or as prescribed by the independent laboratory and as approved and ordered by the Engineer. Special backfill or pipe bedding shall be installed as described in this Section and in general shall be compacted to 100% density as specified under compaction requirements.

### **3.06 DISPOSAL OF UNSUITABLE AND SURPLUS MATERIAL**

- A. All excavated materials which are unsuitable for use in backfilling trenches or around structures, and materials excavated that are in excess of that required for backfilling and for constructing fills and embankments as shown on the Drawings, shall be disposed of by the Contractor at his expense and at sites provided by him as may be required, except that the Owner reserves the right to require the Contractor to deposit such surplus at locations designated by the Owner within a five-mile radius of the Work.
- B. No surplus excavated material of any class shall be deposited in any stream or watercourse or be dumped on public property without the consent of the Owner. All spoil areas shall be left smooth, level, with drainage to a water course and proper erosion and runoff control shall be used.

### **3.07 BACKFILL AND COMPACTION**

- A. Pipe and Conduit Bedding - Unless otherwise directed, pipe, conduits and other utilities shall be installed in specified aggregate bedding material as shown on the Drawings and as specified.
- B. Backfilling Under Existing Pipeline, Sewer, Conduits and Other Utilities - Where it is necessary to undercut or replace existing utility conduits and/or service lines, the excavation beneath such lines shall be backfilled the entire length with aggregate bedding material tamped in place in 6-inch layers to the required density. The aggregate bedding shall extend outward from the spring line of the conduit a distance of 2-feet on all sides and thence downward at its natural slope.

- C. Backfilling with Selected Backfill - Unless otherwise specified or directed, material excavated in connection with the Work may be used for backfilling and other filling purposes, if it meets all requirements given elsewhere in this specification for selected backfill. No material shall be used for backfilling that contains stones, rock, or pieces of masonry greater than 12 inches, frozen earth, debris, earth with an exceptionally high void content, organic material, or marl. No large pieces of rock or masonry shall be deposited closer than 24 inches from the completed outside surface of any structure or pipe.
- D. Backfill Immediately - All trenches and excavations shall be backfilled immediately after completion of construction therein, unless otherwise directed by the Engineer. Under no circumstances shall water be permitted to rise in unbackfilled excavation during construction or after pipe has been placed.
- E. Backfilling around and over structures, pipelines, conduits, and other utilities comprising the Work shall be carefully done by hand and tamped with suitable tools of approved weight when within 2 feet of structures, pipeline, conduit, and other utilities. Selected backfill or, where specified, shown on Drawings, or ordered by the Engineer, special backfill material shall be used in this area. The material shall be placed in uniform layers not exceeding 6 inches in depth up each side. Each layer shall be placed, then carefully and uniformly tamped to the specified density so as to eliminate the possibility of lateral displacement of pipe or structure.
- F. Backfilling may be done by machinery after the backfill has been placed and compacted beyond 2 feet horizontally of structures, pipelines, conduits, and other utilities and to a minimum depth of 1 foot above the tops of any buried structures, pipelines, conduits, and other utilities. The backfill material shall be deposited in horizontal layers, not thicker than one foot, and each layer shall be thoroughly compacted to the specified density by approved methods before a succeeding layer is placed. In no case, will backfill material from a bucket be allowed to fall directly on a structure or pipe and in all cases the bucket must be lowered so that the shock of the falling material will not cause damage.
- G. Backfilling Under Pavement and Walks - Where existing or new pavement, driveway, parking lot, curb and gutter, or walk is over an excavation, special backfill material shall be used to backfill the entire excavation from the bedding to surface. The material shall be placed and compacted to the required density in accordance with one of the following methods:
  - 1. The backfill material shall be deposited in 6-inch horizontal layers and each layer shall be thoroughly compacted to the proper density by approved compaction method before a succeeding layer is placed.
  - 2. No method of compaction which alters the gradation of the special backfill material or prevents compaction testing by standard testing methods shall be used.

- H. Backfilling with Controlled Density Fill Material (CDF) - Where called for on the Drawings, specified, or ordered, CDF material shall be used in lieu of special backfill or bedding material specified herein. Before placing CDF material, the Contractor shall take required measures to protect the Work against flotation.
- I. Backfilling Under Structures - Where structural slabs, mats or footings are to be placed on a backfilled area, special backfill material shall be used unless otherwise noted on the Drawings. The backfill material shall be placed in 6-inch horizontal layers and each layer shall be thoroughly compacted to the specified density by approved methods before a succeeding layer is placed. Where backfill is to be placed on undisturbed side slopes steeper than one vertical to six horizontal, steps shall be formed into the slope before each layer of the backfill is placed. These steps shall be cut vertically at no more than 2-foot intervals and shall have a horizontal dimension of not less than 3-feet.
- J. Prior to backfilling under structures the natural subgrade shall be evaluated at regular intervals in each direction by the independent testing laboratory to determine that the subgrade can obtain the design bearing capacity given by the "Structural Design Data" table on the Drawings. If the subgrade cannot obtain the design bearing capacity then the testing laboratory shall submit a remedy to the Engineer for approval and for the Contractor to perform.

### **3.08 COMPACTION REQUIREMENTS**

- A. In areas to be filled, after the top 12-inches of soil is stripped, then the undisturbed subgrade shall be compacted to not less than 100% of maximum dry density per ASTM D698 (Standard Proctor) prior to placing of fill.
- B. Backfill placed under areas receiving concrete slabs, mats, footings, or within the interior of buildings shall be compacted to not less than 100% of maximum dry density per ASTM D698.
- C. Backfill placed around structures where other structures, pipelines, or slabs are to be constructed shall be compacted to not less than 100% of maximum dry density per ASTM D698.
- D. The material used to construct embankments and fills in locations other than under pavements, walks, structures, or slabs and around and over pipelines, shall be compacted to not less than 95% of maximum dry density per ASTM D698.
- E. All other backfill, including backfill around and over pipelines, and backfill around structures not covered in Paragraphs B. and C. above, shall be compacted to not less than 95% of maximum dry density per ASTM D698.
- F. The bottom of excavations upon which concrete slabs or structures are to be placed shall be compacted to obtain 100% maximum dry density per ASTM D698 in the top 12 inches.
- G. All soil subgrade which will provide bearing support for pavements or curbs, shall be compacted to a width of 6 inches beyond the back of curb and to a depth of 12 inches below the bottom of excavation to a density of not less than 100% of maximum dry



density per ASTM D698. All fill below the subgrade shall be compacted to not less than 98% of maximum dry density, unless specified otherwise.

- H. Subgrade under the driveways and walks shall be compacted to a depth of 6 inches below the subgrade surface to density of not less than 100% of the maximum dry density determined by ASTM D698.
- I. Subgrade under structures shall be compacted to a depth of 12 inches below bottom of excavation surface to a density of not less than 100% of the maximum dry density determined by ASTM D698.

### **3.09 COMPACTION TESTS**

- A. Trenches and excavation around structures shall be backfilled and consolidated in layers, as specified, to the existing ground surface. Initial test series for each type of backfill material shall be continued until the method of consolidation employed has proven to attain the required compaction. Any change in the proven method of consolidations will require additional testing and field verification of compaction.
- B. Subgrade below pavements, curbs, sidewalks, and structures shall be consolidated as specified. Compaction tests shall be performed to verify specified consolidation.
- C. Subsequent tests or series of tests shall be in locations and at depths ordered by the Engineer.

### **3.10 RESERVED**

### **3.11 RESERVED**

### **3.12 RESERVED**

## **PART 4 SPECIAL PROVISIONS**

### **4.01 FIELD TESTING (MINIMUM REQUIREMENTS)**

- A. The laboratory shall perform the following field tests:
  - 1. Trench Backfill - One test for every 200 cubic yards of backfill material.
  - 2. Subgrade Compaction - One test for every 300 square yards of subgrade.
  - 3. If directed by the Engineer, additional tests shall be performed for any of the above.

END OF SECTION

**SECTION 02600  
PAVEMENTS, CURBING, AND WALKS**

**PART 1 GENERAL**

**1.01 SCOPE**

- A. This Section includes the construction of sidewalks, curbing pavements, and berms of various designated types as shown or scheduled on the Drawings, specified, or directed.
- B. This Section includes preparation of the base and subgrade construction of walks, curbs, pavements and base courses, adjustment of manhole castings, and valve boxes to conform to new pavement courses, and other work and materials incidental to the construction of pavements, curbing and walks.
- C. Existing curbs and walks of stone or concrete shall be replaced using concrete.
- D. This Section includes temporary and restoration of permanent pavement markings as they exist at the time of bidding unless otherwise shown on the Drawings, specified, or directed.

**1.02 OWNER'S STANDARDS AND SPECIFICATIONS**

- A. Sidewalks, curbs, driveways, parking areas, and street pavement and berms disturbed by construction shall be restored in accordance with the Owner's present standards and specifications.

**1.03 SUBMITTALS**

- A. Submittals shall be in accordance with the requirements of Section 01300 and shall include:
  - 1. Shop Drawings for Review:
    - a. Manufacturers' and suppliers' material certificates.
    - b. A sieve analysis (ASTM C136) shall be furnished for each material source.
  - 2. Information for the Record:
    - a. Delivery tickets from the asphalt and aggregate suppliers shall be given to the inspector at the unloading site. Tickets shall include (as a minimum) name of source, date, type of material, and weight.
    - b. Test results and certificates.

## PART 2 PRODUCTS

### 2.01 AGGREGATE BASE AND SURFACE

- A. The aggregate shall be crushed limestone meeting the requirements of MDOT Table 902-1, Class 21AA or 22A.

### 2.02 CHIP SEAL

- A. Chip seal shall meet the requirements of MDOT Section 505.
- B. Chip seal shall be placed in two applications with materials and rates of application in accordance with MDOT 505.03E. The initial application shall use Class 25A aggregate and the second application, Class 29A aggregate. Asphaltic material used with each application shall be HFRS-2 or CRS-2 meeting the requirements of MDOT Table 904-4 or 904-5.

### 2.03 ASPHALT EMULSIONS

- A. The bond coat material shall be SS-1h or CSS-1h, and shall meet the requirements of MDOT Table 904-4 and 904-5.
- B. The prime coat material, if required, shall be MS-Op and shall meet the requirements of MDOT Table 903-4.

### 2.04 BITUMINOUS AGGREGATE BASE AND ASPHALT CONCRETE

- A. Bituminous Material - The asphalt cement shall be PG 58-28 performance grade (Design Temperature) and shall meet the requirements of MDOT Table 904-2.
- B. Design Mix - Refer to MDOT Section 501:
  - 1. The base course shall meet the requirements of MDOT Mixture No. 2.
  - 2. The leveling course shall meet the requirements of MDOT Mixture No. 3.
  - 3. The wearing course shall meet the requirements of MDOT Mixture No. 5.

### 2.05 CONCRETE (CAST-IN-PLACE)

- A. All concrete used shall be grade P1 as specified in MDOT Table 601-2.
- B. Reinforcing steel and dowel bars shall be as specified in MDOT Section 905 and 906.
- A. Other materials required for placing concrete shall be as follows:
  - 1. Joint Sealer:
    - a. Hot Applied Sealer - MDOT Section 914.04A.
    - b. Backer Rod - MDOT Section 914.04B.
  - 2. Preformed Fiber Joint Filler - MDOT Section 914.03.
  - 3. Curing Materials:

- a. Burlap Cloth - AASHTO M182, Class 2.
- b. Sheet Materials - ASTM C171.
- c. White Membrane Curing Compound - MDOT Section 903.06A
- d. Transparent Membrane Curing Compound - MDOT Section 903.06B.

## **2.06 PAVEMENT MARKING**

- A. Contractor shall provide temporary and permanent pavement markings equal to those markings that are removed from existing paved surfaces prior to commencement of the Work unless scheduled on the drawings, specified, or as directed. See Ohio edit
- B. Pavement markings shall be in accordance with the requirements of MDOT Item 811.
- C. Pavement markings shall match existing or adjoining pavement markings.
- D. Pavement markings partially disturbed by construction shall be replaced entirely.

## **PART 3 EXECUTION**

### **3.01 COORDINATION**

- A. All soil subgrade under pavements, driveways, curbs, curb and gutter, and walks shall be compacted in accordance with Section 02200.
- B. All service boxes, manholes, inlets, and other structures shall be adjusted or reconstructed to the required grades in both new and resurfacing pavement areas.

### **3.02 PAVEMENT INSTALLATION**

- A. All construction shall be in conformance with applicable portions of MDOT Specifications, except as otherwise specified or called for herein.
- B. Unless otherwise directed by Engineer all aggregate bases which are to receive bituminous courses shall be primed as specified.
- C. A tack coat at a rate as specified shall be applied to all existing pavements which are to be overlaid, and between subsequent courses when directed by the Engineer.

### **3.03 TRANSITION JOINTS FOR BITUMINOUS CONCRETE PAVEMENT OVERLAY**

- A. Types of Transition Joints:
  1. Transition joints shall be either butt type or feathered type as directed by the Engineer.
  2. Butt joints shall be used on State and Federal roads and main thoroughfares and feathered joints used elsewhere unless otherwise specified.
  3. Butt Joints:

- a. When a butt joint is called for on the Drawings or specified, the old surface shall be cut back for at least 3 feet to a depth of at least 1 inch for the full width of the joint and pavement installed.
  - b. A bituminous seal shall be placed on the finished surface at the junction of the new and old pavements.
4. Feathered Joint:
- a. Feathered joints shall be constructed by manually raking the paving material to a smooth transition from the full depth material to the existing pavement surface.
  - b. Existing pavement surface shall be bond-coated to include the transition area.
  - c. Feathering shall be done by a workman skilled in the operation and shall be approved by the Resident Project Representative.

### **3.04 CURBING**

- A. Curbing shall be constructed in conformance with applicable portions of MDOT Section 802 and the MDOT Standard Construction Drawings.
- B. Place 1-inch dowelled expansion joints at inlets and at spring lines of street and driveway returns. If intersecting streets and driveways are more than 300-feet apart, place expansion joints at 300-foot intervals.
- C. Contraction joints shall be placed at approximately 10-foot intervals.

### **3.05 CONCRETE SIDEWALK**

- A. Sidewalk shall be constructed in conformance with applicable portions of MDOT Section 803.
- B. Unless otherwise indicated on the Drawings, concrete sidewalks shall be a minimum of 4-feet-0-inch wide and 4-inch thickness of concrete. Concrete walk removed and replaced shall be equal to the section removed.
- C. The surface of the walks shall be divided into equally spaced blocks at approximately 5-foot intervals. Expansion joint filler 1/2-inch thick shall be installed between the walk and any fixed structure, at all changes in direction or shape and at intervals of 20-foot maximum. The expansion joint filler shall be 1-inch thick where the walk is installed against the back of curb. The filler shall be recessed 1/2-inch from top of finished surface.
- D. Surface of new sidewalks shall be broomed to slightly roughen surface. On sections of sidewalk to be replaced, the surface texture shall match the adjoining.

### **3.06 CONCRETE DRIVEWAYS**

- A. Dowelled contraction joints shall be placed at a maximum spacing of 20-feet. Lesser spacing shall be used on irregular areas as directed by the Engineer.

- B. Expansion joint filler 1/2-inch thick shall be installed at intervals of 24-feet maximum. One-inch expansion joint filler shall be installed between the driveway and any fixed structure.

### **3.07 BITUMINOUS AND AGGREGATE DRIVEWAYS**

- A. Bituminous driveways and parking lots shall be constructed as shown on the Drawings and indicated in Part 4 using materials specified for asphalt concrete pavements. Placement shall be in accordance with MDOT Section 501.
- B. Aggregate driveways and parking lots shall be constructed as shown on the Drawings using base aggregate meeting the requirements of MDOT Item 302.
- C. Replacement of bituminous or aggregate driveways and parking lots shall conform to Section 01565 and this Section but in no case, be inferior to that being replaced.

### **3.08 MILLED ASPHALT BASE**

- A. Where shown on the Drawings, existing asphalt concrete pavement shall be milled or pulverized, then spread, graded, and compacted as the base for a new paved roadway surface. All such Work shall be performed in accordance with MDOT Item 305-HMA Base Crushing and Shaping.

### **3.09 INSPECTION**

- A. Laboratory services shall be in accordance with the requirements of Section 01410 and shall include:
  - 1. A compaction test on the subgrade, aggregate base, and each layer of asphalt shall be performed for every 300 square yards of material placed.
  - 2. Asphalt Concrete:
    - a. Plant Certification - The laboratory shall certify or furnish recent certification (within one year) from 2021 that the plant meets State requirements.
    - b. Plant Inspection - For the first day of production and for every day when more than 100 cubic yards of material is being delivered to the project, the laboratory shall provide a representative at the plant who will inspect the plant, make mix design adjustments, check the temperature, and take the required samples.
    - c. Quality Control Testing - A sample of the mix shall be taken for each 200-cubic yard of bituminous material or fraction thereof delivered to the project. An extraction test AASHTO T164-70 and a mechanical analysis AASHTO T30-70 shall be performed on the mix samples.
    - d. Bituminous Material - Provide a satisfactory certificate furnished by the manufacturer stating that the materials conform to MDOT Specifications, Table 904-2, 904-3, or 904-4 as required.

- e. Aggregate - A sieve analysis (ASTM C136) shall be performed on each aggregate to be used in the plant mix design.
  - f. Mix Designs - The supplier shall design the plant mixes in accordance with the Marshall Method of Mix Design (ASTM D1559) and shall make all mix design adjustments.
3. Cast-in-Place Concrete:
- a. Concrete shall be tested in accordance with Section 03300, Cast-in-Place Concrete.

### 3.10 PROTECTION

- A. No heavy construction vehicle shall operate on any pavement, curbing, or walk after it has been installed.
- B. Traffic shall be prohibited on newly installed asphalt pavement until it has cooled sufficiently to avoid marking.
- C. Asphalt Pavements:
  - 1. Bituminous mixtures shall be transported and placed in accordance with MDOT Section 501.03.
- D. Concrete Pavements, Curbing, and Walks:
  - 1. Concrete shall be mixed, transported, placed, and finished only within the temperature limitations specified in MDOT Sections 601.03F and 602.03T.
  - 2. No concrete shall be mixed, transported, placed, or finished when the temperature of the base, subgrade, or air is below 40 degrees F or whenever, in the opinion of the Engineer, the temperature may fall below 40 degrees F within 24 hours after the concrete has been placed.
  - 3. The Contractor shall take such precautions as are necessary to protect the concrete from rain.
  - 4. The Contractor shall protect the concrete from freezing for no less than seven days or until such time that specimen beams have attained a modulus of rupture of at least 600 psi.

### PART 4 SPECIAL PROVISIONS

Not used.

**END OF SECTION**

**SECTION 02800  
SODDING, SEEDING, AND MULCHING**

**PART 1 GENERAL**

**1.01 SCOPE**

- A. This Section includes fine grading, placing sod, and seeding and mulching areas designated on the Drawings, specified, or ordered.
- B. The Work consists of fine grading, furnishing, and placing topsoil; sod; seed; mulching material; and fertilizer; and watering seeded or sodded areas until growth is established.
- C. The Contractor shall restore all grass areas damaged by his operations.
- D. Unless otherwise specified herein or directed, Work shall be in conformance with MDOT Section 816, Turf Establishment.

**1.02 SUBMITTALS**

- A. Submittals shall be in accordance with the requirements of Section 01300 and shall include:
  - 1. Shop Drawings for Review:
    - a. Manufacturer's project information for materials.
  - 2. Information for the Record:
    - a. Submit to Resident Project Representative:
      - 1) Invoices indicating the weight, brand, and composite analysis of fertilizer used on the project.
      - 2) Bag tickets indicating weight and composition of all seed used on the project.

**PART 2 PRODUCTS**

**2.01 SOD**

- A. Sod shall conform to MDOT 917.13, unless otherwise specified in Part 4.

**2.02 SEED**

- A. Seed mixtures shall be in conformance with the requirements of MDOT Tables 816-1 and 917-1, Mixture TUF, unless otherwise specified in Part 4.

**2.03 FERTILIZER**

- A. Commercial fertilizers shall be from a dealer or manufacturer whose brands and grades are registered or licensed by the State of Michigan, Department of Agriculture. The content of nutrients shall be 12-12-12, unless otherwise approved by Engineer.



**2.04 MULCHING MATERIAL**

- A. Mulching material shall be straw, wood fiber or compost reasonably free of weed seed, and other foreign materials, conforming to MDOT Section 917.15A.

**2.05 MATTING MATERIAL**

- A. Matting material shall be in conformance with the requirements of MDOT Section 917.14B, unless otherwise specified in the Special Provisions.

**2.06 TOPSOIL**

- A. Topsoil furnished by the Contractor shall be as specified in Section 02200.

**PART 3 EXECUTION**

**3.01 FURNISHING AND PLACING TOPSOIL**

- A. Areas from which the top layer of soil has been removed or disturbed shall be recovered with a minimum of 4 inches of recompact topsoil placed in conformance with Section 02200 or MDOT Section 816.03A.

**3.02 PREPARATION**

- A. The operating of finish grading and sowing shall not be performed when the ground is frozen or muddy.
- B. Areas to be Sodded:
  - 1. Preparation of areas to be sodded shall be in conformance with MDOT Section 816.03D.
- C. Areas to be Seeded:
  - 1. Unless otherwise shown on the Drawings or specified in Part 4, all areas of disturbed soil on the Site shall be seeded.
  - 2. The area to be seeded shall be prepared in accordance with Section 02200.
  - 3. Fertilizer shall be applied at a rate which will provide 240 pounds per acre of chemical fertilizer nutrients in equal proportions of Nitrogen, Phosphoric Acid, and Potash. Either dry or liquid fertilizer may be used and shall be distributed in an even pattern over the specified area, then thoroughly disked, harrowed, or raked into the soil to a depth of not less than 1 inch.

**3.03 INSTALLATION**

- A. Sodding:
  - 1. Sod shall be placed in conformance with MDOT Section 816.03D.
  - 2. No sod shall be placed when the temperature is below 32 degrees F. No frozen sod shall be placed nor shall any sod be placed upon frozen soil. When sod is

placed between the dates of June 1 and October 15, it shall be covered immediately with a straw mulch 1-inch-thick, loose measurement.

B. Seeding:

1. The seed shall be mixed thoroughly and sown evenly at a rate specified by MDOT. The seed mixture may be sown dry or hydraulically unless directed otherwise in Part 4 of this Section.
2. The seed mixture shall be applied when the soil is in a workable condition and shall be raked into a depth of approximately 1/4 inch.
3. Seed shall be sown only between the dates of May 1 and October 15, unless otherwise permitted by the Engineer.

C. Mulching:

1. Within 24 hours after an area has been seeded it shall be mulched in conformance with one of the following specified methods as designated in Part 4:
2. Mulch:
  - a. Mulching with hay or straw shall be in conformance with mulching requirements of MDOT Sections 816.03E, F, and G except that in front of residences the mulching material shall be kept in place by an approved non-tracking adhesive or other approved method in lieu of the specified asphalt emulsion.
  - b. Matting shall be used on all slopes greater than 10:1. Matting used for mulching shall be placed in conformance with MDOT Section 816.03H.

D. Seeded and sodded areas shall be watered and maintained as specified below until they are established.

1. The seed bed shall be thoroughly watered, as soon as the seed is covered.
2. Water shall be applied by a hydro-seeder or water tank under pressure with a nozzle producing a spray that will not dislodge the mulching material.
3. Water applications shall be made at least once a week, provided significant rainfall has not occurred within the weekly period.
4. The rate of application shall be 240 gallons per 1,000 square feet
5. The Contractor shall keep all sodded areas, including the subgrade, thoroughly moist for two weeks after sodding. After the two-week period, the Contractor shall water the sod as specified above.
6. Mulch and matting areas shall be maintained until all Work on the Contract has been completed and accepted.
7. The seeded area shall be mowed once at an approximate height of 6 inch as directed by the Engineer to control excess growth, including weeds.

8. Maintenance shall consist of the repair of areas damaged by erosion, wind, fire, or other causes. The soil in these damaged seeded areas shall be restored to the condition and grade existing prior to application of mulch or matting, and restored areas shall be relimed, refertilized, and reseeded. Where necessary, the mulch or matting shall be completely replaced. Damaged sod shall be replaced with new sod.

**PART 4 SPECIAL PROVISIONS**

Not used.

END OF SECTION

**SECTION 02900  
SITE PLANTINGS**

**PART 1 GENERAL**

**1.01 SCOPE**

- A. This Section includes furnishing and planting trees, shrubs, vines and other woody or herbaceous plants, and shrub bed preparation, in accordance with the Drawings and as specified herein.
- B. This Work also includes backfilling the planting holes with prepared soil, watering and cultivating, and furnishing all incidental materials and labor required to complete the Work.

**1.02 SUBMITTALS**

- A. Submittals shall be in accordance with the requirements of Section 01300 and shall include:
  - 1. Information for the Record:
    - a. Name and location of nursery furnishing the plants.
    - b. Certificates in accordance with State and Federal laws with respect to inspection for plant diseases and insect infestation.
    - c. Two-year warranty from nursery providing the plantings.

**1.03 PRODUCT HANDLING**

- A. When temporary storage or heeling-in of plants is required, the Contractor, prior to shipping of planting stock, shall provide and prepare a suitable heeling-in ground or a well-ventilated and cool storage shed, located near the planting site.
  - 1. All acceptable planting stock, if not planted immediately, shall be heeled-in or properly stored.
- B. Balled and burlapped plants which are not planted immediately, shall be temporarily stored in a protected area with balls 6 inches apart and voids filled with moist mulch to and including the top of the ball.
- C. Prior to heeling-in, all bare-rooted plants shall be puddled. The heeling-in operation will then consist of placing the plants, properly spread, in a trench and covering the roots with moist topsoil.
- D. Bare root plants shall be adequately protected at all times. Plants left out of the ground unprotected overnight, left with roots exposed to the sun, improperly protected during transit, unloading, heeling-in or during the planting operation will be rejected.
- E. Plants stored in a shed shall have their roots protected at all times with moist straw or other approved material and watered as required.

## PART 2 PRODUCTS

### 2.01 MATERIALS

- A. The plants shall meet the requirements of Division 8, MDOT Standard Specifications for Construction.
- B. Plant Stock - All plants shall be true to type and name in accordance with the current edition of Standardized Plant Names, American Joint Committee on Horticultural Nomenclature and each bundle, or each plant if not bundled shall be labeled with scientific name and size.
  - 1. All plants shall be typical of the species or variety and shall, unless otherwise specified, conform to the current edition of "American Standard for Nursery Stock" of the American Association of Nurserymen (AAN) for type and grade. Plants shall be dormant, free from disease, injurious infections, mechanical wounds, broken branches, decay, or any other defect. Unless otherwise noted, all plants shall be nursery grown as hereinafter specified.
- C. Balled and Burlapped Plants - Unless otherwise shown on the plans or specified, all plants shall be balled, balled and burlapped, or platformed prior to shipment. The diameter and depths of balls on B & B plants shall be in accordance with the current edition of the "American Standard for Nursery Stock" of the American Association of Nurserymen.
  - 1. All balled and burlapped plants shall be furnished with a firm ball of earth from the original and undisturbed soil in which the plant was growing. The ball shall be wrapped with burlap or similar approved material and tightly laced to hold the ball firm and intact. Any B & B plant material arriving at the plant site with broken or loose balls or of manufactured earth will be rejected.
- D. Fertilizer - Fertilizer shall meet the approval of the Engineer and shall meet the requirements of MDOT 6.50.02 (c), Fertilizer.
- E. Mulch - This material as specified shall meet the requirements of MDOT 6.50.02.
- F. Prepared Soil - This material as specified shall meet the requirements of MDOT 6.50.02.
- G. Tree Wrapping Paper - This material shall be as specified in MDOT 8.21.03, except the paper shall be 4 inches in width.
- H. Tree Wound Dressing - The tree wound dressing shall be Bartless Tree Paint, Cabot's Tree Wound Dressing, Tanglefoot Tree Wound Dressing, DuPont Tree Wound Dressing, or equal.
- I. Twine - The twine used for wrapping shall be composed of a minimum of a 2-ply jute material.
- J. Wire - Wire used for guying trees shall meet the specifications of MDOT 8.21.06.
- K. Hose - Hose used with wire for guying trees shall be 1/2-inch rubber garden hose or stream hose, MDOT 8.21.07.

- L. Stakes - Stakes used for guying trees shall meet the specifications of MDOT 8.21.08.

## 2.02 SUBSTITUTIONS

- A. No substitutions will be permitted without the written approval of the Engineer.

## PART 3 EXECUTION

### 3.01 PREPARATION

- A. The Contractor shall furnish stakes and stake out the locations of all plant pits. No excavation or cultivation shall be started until the locations have been approved by the Engineer.
- B. Should rocks or other obstructions prevent planting at indicated locations in accordance with the Drawings, alternate locations shall be determined by the Engineer. Deletions may be considered by mutual consent of the Contractor and the Engineer.

### 3.02 EXCAVATION

- A. Work shall consist of the excavation of individual holes for plant materials in accordance with MDOT 6.50.03 except that holes for large plants, such as deciduous shade and flowering trees, evergreen, large shrubs, and other material designated as B & B shall be wide enough to allow a minimum of 12 inches beyond the periphery of the roots system or ball. When soil conditions unfavorable to plant growth are encountered, the Engineer may direct the Contractor to dig three times the width of the root spread or ball.

### 3.03 SHRUB BED PREPARATION

- A. Planting beds shall be excavated to a depth of 8 inches below finish grade and shall be made smooth and uniform and parallel to the finished grade and cross section. The tops and bottoms of all slopes shall be rounded to blend into the natural ground or adjacent slopes by vertical curves as shown on the Plans and as specified under Tolerance for Trimming and Finishing Earth Grade, 2.08.18 MDOT. Topsoil shall then be placed on the prepared bed to a depth of 4 inches as specified under Topsoil Surface 6.53.03 MDOT. Following the placement of the topsoil a single layer of plastic sheeting shall be spread evenly over the surface. This is to be followed by a layer of wood chips of sufficient depth to allow for settlement. All shrub beds shall be edged with steel edging 4 inches by 1/8 inch in size. These shall be placed adjacent to all lawn areas and shall be considered incidental.

### 3.04 PRUNING

- A. Branches - Work shall consist of the pruning of branches in accordance with MDOT 6.50.08.
- B. Roots - Work shall be performed in accordance with MDOT 6.50.07 - (d), Bare Root Stock.

### 3.05 BACKFILLING

- A. Backfill mix shall be as specified in MDOT 6.50.02 Materials for Prepared Soil. This mixture shall be worked around the roots and firmly tamped as it is filled into the holes in order to eliminate air pockets. Care should be taken to avoid bruising or breaking the roots while tamping or firming the backfill mix around them. Upright plants shall be held plum during the backfilling operation. When the backfilling is 2/3 completed, the exposed burlap shall be loosened and laid back from the ball or cut off if excessive and removed. After thorough watering the backfilling shall be completed. Sticks, sod, clods, or other material which tend to form air pockets shall be removed during backfilling. Except areas for shrub beds, a shallow basin, approximately 3 inches in depth and the diameter of the hole, shall be constructed of backfill mix round each plant. On steep slopes, sufficient soil shall be pulled to the lower side of the plants to form shallow basins to catch and hold water.

### 3.06 MULCHING

- A. Following completion of the backfilling, all plant basins, plant beds or other specified areas shall be uniformly mulched to a loose depth of 3 inches or as indicated on the Plans. The mulch shall meet the specifications of MDOT 8.21.02.

### 3.07 PROTECTION

- A. Unless otherwise specified, the trunks of all deciduous shade and flowering trees shall be wrapped with 4-inch-wide waterproof paper overlapping 1-1/2 inches, between the lowest main branches to the ground line. Wrapping shall be tied in at least five places, including top, middle, and bottom. These protective measures shall be taken within four days after planting. Wrapping shall meet the specifications of MDOT 6.50.09, Wrapping Deciduous Trees.
- B. Watering and cultivating of plant materials shall be as directed in MDOT 6.50.11.
- C. Deciduous and evergreen trees as required shall be braced or guyed according to MDOT 6.50.12.
- D. The period of establishment, inspection for the acceptance of plant materials, the replacement of dead or unhealthy plants, care of plant materials during the period of establishment shall be as described in MDOT 6.50.13.

## PART 4 SPECIAL PROVISIONS

Not used.

END OF SECTION

**SECTION 03100  
CONCRETE FORMWORK**

**PART 1 GENERAL**

**1.01 SCOPE**

- A. This Section includes formwork for cast-in-place concrete.

**1.02 SUBMITTALS**

- A. None required.

**1.03 QUALITY ASSURANCE**

- A. Design, engineering, erection, bracing, and shoring of formwork shall be the responsibility of the Contractor.
- B. Formwork shall comply with pertinent provisions of the following codes, standards, and specifications:
1. "Guide to Formwork for Concrete (ACI 347R)," American Concrete Institute.
  2. "Standard Tolerances for Concrete Construction and Materials (ACI 117)," American Concrete Institute.
  3. "Formwork for Concrete, SP-4". "American Concrete Institute."
- C. Formwork shall be designed in accordance with requirements of governmental agencies having jurisdiction, pertinent requirements of local building codes, "Building Code Requirements for Structural Concrete (ACI 318) and Commentary (ACI 318R)," and "Specifications for Structural Concrete (ACI-301)," American Concrete Institute.
- D. Formwork for liquid retaining structures shall also satisfy the requirements of "Environmental Engineering Concrete Structures (ACI-350)," American Concrete Institute.
- E. Formwork shall be constructed to tolerances specified in ACI 117.
- F. Regardless of specified tolerances, no portion of a structure shall extend beyond legal boundary of project.

**PART 2 PRODUCTS**

**2.01 MATERIALS**

- A. Form facing material shall be "new or undamaged" condition and may be plyform, tempered concrete-form-grade hardboard, metal, plastic, or other material capable of producing the specified finish. Select the grade or class of material to satisfy the requirements of strength, stiffness, and surface smoothness to produce the specified finish.
- B. Form Release shall be manufactured from Dayton Superior "Clean Strip J1EF", W.R. Meadows, Inc. "Duogard or Duogard II", L&M Construction Chemicals "Debond Form Coating", or equal.



- C. Arrangement of facing material shall be orderly and symmetrical, with number of seams kept to practical minimum.
- D. Facing material shall be supported by studs or other backing capable of preventing excessive deflection. Maximum deflection of facing material shall be  $1/240$  of span between supports but shall not exceed specified tolerances.
- E. Material with raised grain, torn surfaces, worn edges, patches, dents, or other defects shall not be used.

## 2.02 PERFORMANCE REQUIREMENTS

- A. Formwork shall be designed to safely support vertical and lateral loads, until such loads can be safely supported by concrete structure. Loads shall be carried to ground by formwork and in-place construction of adequate strength.
- B. Formwork shall be designed for dead and live loads, weight of concrete, wind, construction loads including impact, and other loads which act or might act on formwork together with appropriate safety factors and load multipliers as recommended by ACI-347.
- C. Formwork shall be designed for pressure of concrete giving due consideration to rate of concrete placement, method of placement, method of consolidation, concrete mix design, temperature, and other factors pertinent to formwork design.
- D. Forms shall have sufficient strength and rigidity to maintain specified tolerances.

## PART 3 EXECUTION

### 3.01 COORDINATION

- A. Forms shall be used to confine concrete and shape it to required dimensions, alignment, elevation, and position.
- B. Earth cuts shall not be used as forms for vertical surfaces unless specifically shown on the Drawings.
- C. Runways for moving equipment and materials shall be supported directly on formwork or structural member, and shall not rest on reinforcing steel.
- D. Openings shall be provided in formwork to accommodate Work of other trades. Openings shall be accurately located and cut.

### 3.02 PREPARATION OF FORM SURFACE

- A. Surfaces of forms and embedded materials shall be cleaned of accumulated concrete or mortar from previous concreting. Foreign material and contaminants shall be removed before concrete is placed.
- B. Before placing reinforcement or concrete, surfaces of forms shall be covered with acceptable coating material that prevents bond with concrete, VOC compliant, and does not stain concrete surface. No coating material shall be used if form liner is used.
- C. Form coating material shall not stand in puddles in forms, and shall not come in contact with reinforcement or hardened concrete against which fresh concrete is to be placed.

### 3.03 ERECTION

- A. Forms shall be sufficiently tight to prevent loss of mortar from concrete.
- B. Formwork shall be cambered to compensate for anticipated deflections from weight of fresh concrete and construction loads.
- C. Shores and struts shall be provided with positive means of adjustment capable of taking-up formwork settlement during concrete placement, using wedges or jacks.
- D. Formwork shall be securely braced and anchored against deflection and displacement.
- E. Wedges used for final adjustment of formwork shall be fastened in position prior to beginning concrete placement.
- F. Temporary openings shall be provided at base of column forms and wall forms and at other points where necessary to facilitate cleaning and observation immediately before concrete is placed.
- G. Wood forms for wall openings shall be constructed to facilitate loosening, if necessary, to counteract swelling of forms. Wood inserts for keyways, reglets, recesses, and similar uses shall be kerfed to counteract swelling.
- H. At construction joints, form facing material shall overlap hardened concrete of previous placement by not more than 1 inch. Forms shall be held tight against hardened concrete to prevent offsets or loss of mortar, and to maintain true surface.
- I. Insert vibrator as needed to properly consolidate concrete. Provide openings in forms as needed to insert vibrators.
- J. Form Ties and Accessories:
  - 1. Form ties and accessories to be partially or wholly embedded in concrete shall be of commercially manufactured type. Nonfabricated wire is not permitted.
  - 2. Form ties shall be constructed so that ends can be removed to minimum depth of 1-1/2 inch without significant spalling of concrete. Form tie assemblies shall provide cone-shaped depressions 1-1/2-inch-deep and at least 1 inch in diameter at concrete surface to permit filling and patching.
  - 3. Ties shall be tight fitting or tie holes in forms shall be sealed to prevent leakage.
  - 4. Single rod ties shall be furnished with tightly fitted washer at midpoint to prevent leakage along tie. Multiple rod ties do not require washers.
  - 5. When tapered, ties are used, large end shall be placed on liquid side of tanks and water-retaining structures. Tapered ties shall be completely removed. The Contractor shall submit the methods and materials to be used to fill the voids thus formed for Engineer's review and approval.
- K. Chamfer strips shall be placed in corners of forms and at all exposed edges to produce a beveled edge on permanently exposed surfaces. Chamfers shall be 3/4 inch or as noted on Drawings. Chamfer strips shall be wood, metal, PVC, or rubber and shall be fabricated and installed to produce uniformly smooth and straight lines. Chamfer strips shall be mitered at changes in direction.

- L. Control joints shall be located and constructed as shown on Drawings.

### 3.04 REMOVAL OF FORMS GENERAL

- A. When repair of surface defects or finishing is required at early age, forms shall be removed as soon as concrete has hardened sufficiently to resist damage from removal operations.
- B. Top forms on sloping concrete surfaces shall be removed as soon as concrete has attained sufficient stiffness to prevent sagging.
- C. Wood forms for wall openings shall be loosened as soon as can be accomplished without damage to concrete.
- D. Ties shall be removed.

### 3.05 MINIMUM CONCRETE STRENGTH REQUIREMENTS FOR REMOVAL OF FORMS AND SHORING

- A. Formwork for columns, walls, sides of beams and other elements not supporting the weight of concrete may be removed after curing for 24 hours.
- B. Formwork for columns, walls, sides of beams and other elements supporting the weight of concrete joists, elevated slabs and other elements may be removed after curing for seven days. These forms may be removed after three days of curing if concrete has attained 80% of the specified design compressive strength.
- C. Formwork and shoring used to support the weight of concrete beams, elevated slabs or other similar horizontal elements may be removed after 14 days of curing if concrete has attained 90% of the specified design compressive strength. Otherwise, these forms shall remain in place until either this strength is attained or 21 days have elapsed.
- D. Removal strength shall be determined by testing specimens field cured along with concrete they represent. Testing laboratory shall perform strength tests as specified in Section 03300. All concrete testing performed for the purpose determining the timing of formwork removal shall be accomplished at the Contractor's expense.
- E. Contractor is responsible for maintaining stability of the structure during construction when it is subjected to construction loads, wind loads and other loads after the forms have been removed.
- F. Concrete structures shall not be filled with water, backfilled against or subjected to their design loads until 28 days after the commencement of curing or until field cured test cylinder specimens have reached the specified design compression strength. In no case shall concrete structures be loaded prior to curing for their specified minimum curing periods.

### PART 4 SPECIAL PROVISIONS

Not used.

END OF SECTION

**SECTION 03150  
WATERSTOP**

**PART 1 GENERAL**

**1.01 SCOPE**

- A. This Section includes waterstop for cast-in-place concrete construction.
- B. Additional product requirements are specified in Section 01350.

**1.02 SUBMITTALS**

- A. Submittals shall be in accordance with the requirements of Section 01300 and shall include:
  - 1. Shop Drawings for Review:
    - a. Product literature.
  - 2. Information for the Record:
    - a. Manufacturer's installation instructions.

**1.03 PRODUCT HANDLING**

- A. Store waterstops under tarps to protect from oil, dirt, sunlight, and premature exposure to water.

**PART 2 PRODUCTS**

**2.01 PLASTIC WATERSTOP (TYPES A AND B)**

- A. Plastic waterstop shall be constructed of highest-grade virgin Polyvinyl Chloride (PVC) and shall conform to US Army Corps of Engineers specification CRD-C 572. Minimum tensile strength shall be 2000 psi.
- B. Waterstop shall have factory-installed hog rings along both edges at minimum 12-inch spacing.
- C. Type A waterstop shall be 9 inches wide by 3/8-inch nominal thickness ribbed waterstop with a 1/2 inch inside diameter center bulb, Greenstreak, Inc. No. 735, or equal. Type A waterstop with split flange shall be Greenstreak No. 727, or equal.
- D. Type B waterstop shall be 6 inches wide by 3/8-inch nominal thickness ribbed waterstop without center bulb, Greenstreak No. 679 or equal. Type B waterstop with split flange shall be Greenstreak No. 724, or equal.

**2.02 TYPE C WATERSTOP**

- A. Type C waterstop shall be a hydrophilic rubber waterstop made from a combination of chloroprene rubber and chloroprene rubber modified to impart hydrophilic properties.

- B. The waterstop shall have a delay coating to inhibit initial expansion due to moisture present in fresh concrete.
- C. Performance requirements of chloroprene rubber:
  - 1. Tensile Strength (ASTM D412):
    - a. 1,300 psi minimum.
  - 2. Ultimate Elongation (ASTM D412):
    - a. 400% minimum.
  - 3. Hardness, Shore A (ASTM D2240):
    - a. 50 plus or minus 5.
  - 4. Tear Resistance (ASTM D624):
    - a. 100 pound per inch minimum.
- D. Performance requirements of chloroprene hydrophilic rubber:
  - 1. Tensile Strength (ASTM D412):
    - a. 350 psi minimum.
  - 2. Ultimate Elongation (ASTM D412):
    - a. 600% minimum.
  - 3. Hardness, Shore A (ASTM D2240):
    - a. 52 plus or minus 5.
  - 4. Tear Resistance (ASTM D624):
    - a. 50 pound per inch minimum.
  - 5. Expansion Ratio (Volumetric Change - Distilled Water at 70 degrees F):
    - a. 3 to 1 minimum.
- E. Waterstop shall be Hydrotite manufactured by Greenstreak, or equal.
- F. Nominal size of waterstops for construction joints shall be 10 mm high by 30 mm wide (Hydrotite CJ-1030-4M or equal) and nominal size of waterstops around pipes that penetrate concrete shall be 4 mm high by 20 mm wide (Hydrotite DSS0420 or equal), unless specified or noted otherwise.
- G. Hydrotite adhesive by Greenstreak, or equal.
- H. Leakmaster sealant by Greenstreak, or equal.
- I. Cyanoacrylate adhesive by Greenstreak, or equal.

### PART 3 EXECUTION

#### 3.01 PREPARATION

- A. Concrete shall be carefully and thoroughly consolidated with vibrator machine around Type A and B waterstops.
- B. New cast-in-place concrete surfaces shall be cast or troweled smooth. New and existing surfaces shall be cleaned of all oil, dirt, and lattice under type C waterstops. Where existing surfaces are rough apply a swellable sealant (as specified in 2.02.H) base under the Type C waterstops.

#### 3.02 INSTALLING

- A. Waterstop shall be installed in accordance with manufacturer's recommendations.
- B. Types A and B Waterstops:
  - 1. Waterstop shall extend entire length of joint and shall be centered so that half of waterstop is embedded on each side of joint, unless shown otherwise on Drawings.
  - 2. Waterstop shall be continuous around corners and intersections to provide a continuous seal and to make a watertight structure.
  - 3. Field splices shall be limited to straight butt splices. Intersections and transitions shall be made with fabricated and tested junction sections.
  - 4. Splices shall be made with splicing iron in accordance with manufacturer's recommendations. Use of torch or direct flame is prohibited.
  - 5. Dirt, grease, and splattered concrete shall be cleaned from waterstop and wire loops.
- C. Type C Waterstops:
  - 1. Waterstop shall extend entire length of joint and shall be continuous around corners and intersections to provide a continuous seal and to make a watertight structure.
  - 2. Secure waterstop to concrete or penetrating pipes with a chloroprene rubber compatible adhesive approved by manufacturer. Apply the adhesive to both the concrete or pipe surface, and to the waterstop, and allow to dry to a tacky consistency, then place the waterstop into position.
  - 3. Cut square and Glue spliced ends together with cyanoacrylate adhesive per manufacturer's recommendations.
  - 4. Concrete shall be placed over the waterstop within 4 hours of placement. Prevent rain water, curing water and other sources of water from prematurely activating the waterstop prior to concrete placement. Remove, clean surface, and replace any waterstops that have been damaged or prematurely activated.

### 3.03 SCHEDULE

- A. Waterstop shall be placed in following locations:
  - 1. Joints in walls and slab below grade which separate occupiable space or equipment rooms from earth or water.
  - 2. Joints at and below 100-year flood elevation indicated on the Drawings or as otherwise specified.
  - 3. Joints in walls and slabs of liquid-retaining, conveying and secondary containment structures.
  - 4. Other locations shown on Drawings or specified elsewhere.
- B. Waterstop shall be Type B unless otherwise shown on the Drawings or specified elsewhere.
- C. Waterstop shall be Type A in expansion joints unless otherwise shown on the Drawings or specified elsewhere.

### PART 4 SPECIAL PROVISIONS

Not used.

END OF SECTION

**SECTION 03200  
CONCRETE REINFORCEMENT**

**PART 1 GENERAL**

**1.01 SCOPE**

- A. This Section includes reinforcing steel, load transfer dowels, and accessories.
- B. Additional product requirements are specified in Section 01350.

**1.02 SUBMITTALS**

- A. Submittals shall be in accordance with the requirements of Section 01300 and shall include:
  - 1. Shop Drawings for Review:
    - a. Placing drawings shall indicate:
      - 1) Construction joints, splice locations, and splice lengths.
      - 2) Bending schedules.
      - 3) Accessories.
    - b. Product literature for mechanical splices and adhesives.
  - 2. Information for the Record:
    - a. Mill certificates.

**1.03 QUALITY ASSURANCE**

- A. Reinforcement shall be detailed, fabricated, and placed in accordance with following codes, standards, and specifications.
  - 1. "Details and Detailing of Concrete Reinforcement (ACI 315)", American Concrete Institute, and "Reinforcing Bar Detailing," Concrete Reinforcing Steel Institute (CRSI).
  - 2. "Manual of Standard Practice", Concrete Reinforcing Steel Institute.
  - 3. "Standard Tolerances for Concrete Construction and Materials (ACI 117)", American Concrete Institute.
- B. Concrete reinforcement shall be in accordance with "Building Code Requirements for Structure Concrete (ACI 318) and Commentary (ACI 318R)", American Concrete Institute, and "Specifications for Structural Concrete for Buildings" (ACI-301).
- C. All placing of reinforcing bars in the form shall follow the CRSI "Placing Reinforcing Bars."
- D. Concrete reinforcement for environmental engineering concrete structures (liquid retaining structures) shall also be in accordance with "Environmental Engineering Concrete Structures (ACI-350)," American Concrete Institute.



#### 1.04 DETAILING

- A. When splices are not indicated on Drawings, reinforcement shall be furnished so as to minimize splices. Horizontal rebar shall be spliced within the limits of adjacent pours to be poured later to allow for unrestrained shrinkage movements. Splice locations shall be subject to Engineer's approval. The Contractor shall give sufficient advance notice satisfactory to Engineer's representative for his inspection upon completion of installation.
- B. When slab or wall reinforcement is interrupted by openings or embedments, additional reinforcement shall be furnished as shown on Drawings.

#### 1.05 DELIVERY, STORAGE, AND HANDLING

- A. Bundles of reinforcing bars shall be tagged with weatherproof tags indicating quantity, grade, size, and Shop Drawing designation.
- B. Bundles of welded wire fabric shall be tagged with weatherproof tags indicating quantity, style designation, width, and length.
- C. Reinforcement shall be stored off ground and shall be protected from oil, mud, and other deleterious substances.

### PART 2 PRODUCTS

#### 2.01 MATERIALS

- A. Reinforcing bars shall be grade 60 deformed bars conforming to ASTM A615 or ASTM A996.
- B. Reinforcement to be welded shall be grade 60 bars conforming to ASTM A706.
- C. Welded wire fabric shall be fabricated from underformed wire and shall conform to ASTM A185, except welded intersections shall be spaced not farther apart than 12-inch welded wire fabric shall be furnished in flat sheets.
- D. Load-transfer dowels shall conform to ASTM A36 and shall be fitted with expansion sleeve. Dowel size shall be as indicated on Drawings.

#### 2.02 BAR SUPPORTS

- A. Bar supports in contact with forms shall be Class 1, maximum-protection, plastic-coated wire supports. Other bar supports may be Class 3, no-protection, wire supports.
- B. Bar supports on grade shall be precast concrete blocks not less than 4 inches by 4 inches wired in place. Blocks shall have compressive strength not less than the specified compressive strength of concrete being placed.
- C. Form spacers shall be all-plastic, snap-on devices, specifically designed to position reinforcing bars in concrete.

### 2.03 MECHANICAL SPLICE

- A. Threaded mechanical splices and dowel bar replacements (DBR) shall be furnished where shown or otherwise permitted.
- B. Mechanical splice and dowel bar replacement shall develop 125% of the specified reinforcement yield strength. The next larger size coupler shall be furnished at no additional cost to Owner when required to develop specified strength.
- C. When dowel bar replacements are provided to facilitate future expansion, epoxy coated rebar couplers shall be used. Rebar couplers shall be greased and capped with threaded plastic plugs to make a watertight seal.
- D. Mechanical splices and dowel bar replacements shall be as manufactured by Dayton Superior, Lenton, Bar Splice Products, Inc., or equal.

### 2.04 ADHESIVE

- A. Adhesive for embedding reinforcement in existing structures shall be 100% solids, 100% reactive, epoxy conforming to ASTM C881, Type IV, Grade 3, Classes B and C. The adhesive shall be formulated to withstand the maximum allowable published loads permanently without creep or failure.
- B. Bond strength to concrete per ASTM C882 shall be 1800 psi minimum at 7 days.
- C. Adhesive shall be mixed in accordance with manufacturer's instructions.
- D. The adhesive shall be type "HIT-RE-500-V3" manufactured by Hilti or equal. The "fast set" formulation of the "Power-Fast Epoxy" as manufactured by Powers/Rawl shall not be used.

### 2.05 FABRICATION

- A. Reinforcement shall be accurately fabricated to dimensions shown on approved Shop Drawings. Bend dimensions shall conform to CRSI Manual of Standard Practice.
- B. Bends shall be shop formed unless otherwise indicated. Radial fabrication (Type 9 Bars) may be furnished straight and sprung to fit when permitted by CRSI Manual of Standard Practice.
- C. Reinforcement shall be cold bent, and shall not be bent or straightened in injurious manner.

## PART 3 EXECUTION

### 3.01 COORDINATION

- A. Reinforcement shall be accurately placed, supported, and tied prior to concrete placement. Reinforcement shall be subject to review of Resident Project Representative prior to placing concrete.

### 3.02 PREPARATION

- A. Grade shall be leveled such that specified concrete cover is maintained.

- B. When ground is too soft to support reinforcement, the Contractor shall over excavate and construct concrete mud mat at no additional cost to Owner. Mud mat shall be minimum of 3 inches thick, unless noted otherwise.

### 3.03 ERECTION AND INSTALLATION

- A. Reinforcement shall be placed in accordance with approved Shop Drawings.
- B. Reinforcement and dowels shall be adequately supported and fastened before concrete is placed and shall be secured against displacement. Supports shall be placed at minimum of 4-foot centers.
- C. Concrete cover for wall and column reinforcement shall be accurately maintained by use of form spacers or Class 1 bar supports.
- D. Templates shall be furnished for placement of column dowels.
- E. Load-transfer dowels shall be accurately aligned perpendicular to joint. Placing cages shall be used to ensure proper alignment.
- F. Reinforcement shall be placed within the tolerances specified in ACI 117, but the required number of bars shall not be reduced. When it is necessary to move reinforcement to avoid interference with other reinforcement, conduits, or embedded items exceeding specified tolerances, the resulting arrangement of bars shall be subject to Engineer's approval.
- G. Driving or forcing reinforcement into concrete is prohibited.
- H. Field bending or straightening of reinforcement is prohibited, except as specifically shown on Drawings. Bars with kinks or bends not shown on Shop Drawings are not permitted.
- I. Welding of reinforcement is prohibited except as specifically shown on Drawings.
- J. Unless specifically noted otherwise, welded wire fabric shall be installed near the top in slabs on grade (2 inches from the top of slab). Fabric should extend to within 2 inches of the joints and the edges of the slab. When used for temperature reinforcement in structurally reinforced elevated slabs, welded wire fabric shall be placed 3/4 inches down from the top surface of the slab, unless otherwise shown, and shall extend into supporting beams and walls for anchorage unless an expansion joint is called for.

### 3.04 CONCRETE COVER

- A. Concrete cover shall be as indicated on Drawings. If drawings do not specify concrete cover for reinforcement, it shall be in accordance with the requirements of ACI-301 and/or ACI-350 as applicable.
- B. Allowable Tolerances in Concrete Cover shall be:
  - 1. To formed surfaces: plus 1/4 inch.
  - 2. To unformed top surface: minus 1/4, plus 1/2 inch.

**3.05 LAP SPLICES**

- A. Splices shall be located as shown on approved Shop Drawings.
- B. Bar lap splice shall be Class B splices and their lengths shall be as shown on Drawings.
- C. Welded wire fabric shall be lapped a minimum of 2 cross wire spacings, but not less than 8 inches.

**3.06 MECHANICAL SPLICES**

- A. Mechanical splices and dowel bar replacements shall be installed in accordance with the manufacturer's instructions.

**3.07 WELDING**

- A. When welding of reinforcement is shown on Drawings, welding shall conform to "Structural Welding Code - Reinforcing Steel", (AWS D1.4), American Welding Society.
- B. Tack welding and other welding not specifically shown on Drawings is prohibited.

**3.08 FIELD BENDING**

- A. When bending or straightening of reinforcement partially embedded in concrete is shown:
  - 1. Inside bend diameter shall be minimum of 6 bar diameters.
  - 2. Beginning of bend shall not be closer to concrete surface than 6 bar diameters.
  - 3. No. 5 bars and smaller may be cold bent the first time only when temperature is above 32 degrees F. Bars shall be preheated for subsequent bending or straightening.
  - 4. Bars larger than No. 5 shall be preheated.
- B. Preheating of Reinforcement shall be as follows:
  - 1. Preheat shall be applied to length of bar equal to a minimum of 5 bar diameters each way from center of bend. Preheat shall not extend below surface of concrete. The temperature of the bar at concrete interface shall not exceed 500 degrees F.
  - 2. Preheat temperature shall be 1,100 degrees to 1,200 degrees F. Temperature shall be maintained until bending or straightening is completed. Preheat temperature shall be measured by temperature measurement crayons or other acceptable method.
  - 3. Reinforcement shall not be artificially cooled, until the material temperature is less than 600 degrees F.
- C. Bending or straightening of bars other than specifically shown on Drawings is prohibited.

**3.09 DOWELING TO EXISTING STRUCTURE**

- A. Dowels shall be embedded into existing concrete where shown on Drawings. Unsound concrete shall be reported to Engineer.
- B. Adhesive dowels shall be placed in holes larger than the reinforcement diameter using a rotary percussion hammer and carbide bit. Hole diameters shall be as recommended by manufacturer for each specific reinforcing diameter.
  - 1. Unless indicated otherwise, adhesive dowels shall be embedded as follows:

Stud Diameter	Minimum Embedment
#3	3-1/4 inches
#4	4-3/8 inches
#5	5-3/4 inches
#6	6 inches
#7	7-1/4 inches
#8	8-7/8 inches

- C. Hole shall be cleaned of dust and residue by blowing the hole with dry and oil-free compressed air. Air nozzle shall be inserted to bottom of hole. The holes should also be brushed using a nylon brush to remove dust and other debris which may have been pressed into the walls of the hole.
- D. Standing water and frost shall be removed immediately prior to injecting adhesive.
- E. Adhesive shall be injected from bulk-loading caulking gun, disposable caulking tubes, or pneumatic dispenser. Adhesive shall be injected using extension on nozzle to reach bottom of hole. Adhesive shall be injected to pre-determined depth which will cause hole to be completely filled after bar is inserted.
- F. Bar shall be inserted and slightly rotated to ensure adhesive completely surrounds bar.
- G. Adhesive displaced from hole shall be removed immediately.
- H. The manufacturer's installation guidelines for the specific adhesive chosen shall be strictly followed.

**3.10 CLEANING**

- A. Reinforcement, at time concrete is placed, shall be free of mud, oil, or other materials that may adversely affect or reduce bond.
- B. Reinforcement with rust, mill scale, or combination of both shall be considered satisfactory provided minimum dimensions, weight, and height of deformations of hand-wire-brushed test specimen are not less than applicable ASTM specification requirement.

**PART 4 SPECIAL PROVISIONS**

Not used.

END OF SECTION

**SECTION 03300  
CAST-IN-PLACE CONCRETE**

**PART 1 GENERAL**

**1.01 SCOPE**

- A. This Section includes furnishing, placing, finishing, and curing cast-in-place concrete. Miscellaneous materials required for concrete construction are included.
- B. Anchor bolts and other cast-in items are furnished under other Sections.
- C. The Contractor, before commencing Work, shall examine all adjoining Work on which this Work is dependent for proper installation and workmanship according to the intent of this specification, and shall report to the Engineer any condition which prevents this Contractor from performing first class work.
- D. Laboratory services for quality control shall be furnished in accordance with requirements of Section 01410.
- E. Additional product requirements are specified in Section 01350.

**1.02 SUBMITTALS**

- A. Submittals shall be in accordance with the requirements of Section 01300 and shall include:
  - 1. Shop Drawings for Review:
    - a. Concrete mix designs including substantiating data and test records. Concrete Mix Design, Proportioning.
    - b. Product literature for admixtures, curing compounds, and miscellaneous materials.
    - c. Locations of construction and control joints not shown on Drawings, and proposed changes in locations.
    - d. Material certifications.
    - e. Aggregate gradation and percentages of deleterious substances.
    - f. Batch plant certification.
  - 2. Information for the Record:
    - a. Manufacturer's application instructions for miscellaneous materials.
    - b. Quality control test reports.
    - c. Slab profile report.
- B. Copy of concrete delivery ticket shall be presented to Resident Project Representative for each batch. Delivery ticket shall indicate:
  - 1. Name of ready-mixed company and plant designation.

2. Truck number.
3. Concrete class.
4. Quantity of concrete.
5. Date.
6. Time when batch was loaded.
7. Type and name of admixtures.
8. Actual batch weights of cement, fly ash, aggregates, and water.
9. Location of pour and time of unloading shall be added to the ticket at Site.

### 1.03 QUALITY ASSURANCE

- A. Batch Plant:
  1. Batch plant shall be central batch plant with automatic or semi-automatic control. Concrete may be mixed using either central-mixed, shrink-mixed, or truck-mixed methods. If concrete is shrink-mixed or truck-mixed, the truck and concrete shall conform to ASTM C94.
  2. Batch plant shall be certified by the Department of Transportation, National Ready Mixed Concrete Association (NRMCA) or an independent certification using NRMCA "Check list for Certification of Ready Mixed Concrete Production Facilities" executed and certified by independent Professional Engineer registered in state of Site. Evidence of current certification shall be submitted.
- B. Pre-installation Conferences:
  1. Before beginning concrete work, Contractor shall hold a meeting to review detailed requirements for preparing concrete mix designs and to determine proper procedures for concrete construction. A representative of Contractor, testing laboratory, concrete producer, concrete pumping contractor, and Engineer shall be in attendance.
  2. Contractor shall submit for Engineer review a plan showing the locations of all proposed construction and control joints, which are not shown on the construction Drawings, and a schedule that incorporates the alternating pour sequences required to allow for strength gain and control of volumetric shrinkage changes.
  3. When dry-shake floor hardener or metallic topping is specified, manufacturer's representative shall instruct Contractor on proper equipment and application procedures.
- C. Concrete work shall be in accordance with the current edition of the following codes, standards, and specifications:
  1. American Concrete Institute (ACI).

2. "Manual of Standard Practice", Concrete Reinforcing Steel Institute (CRSI).

**1.04 DELIVERY AND HANDLING**

- A. Concrete shall be delivered in accordance with ASTM C94 except the time limit for discharging of concrete during hot weather shall be reduced as specified.
- B. Concrete shall be delivered in agitating trucks or in mixing trucks operating at agitating speed.

**1.05 ENVIRONMENTAL CONDITIONS**

- A. Unless adequate protection is provided, concrete shall not be placed during rain, sleet, or snow, or when inclement weather is imminent.
- B. Cold Weather:
  1. Cold weather concreting procedures per "Cold Weather Concreting," ACI 306R, shall be followed whenever any one of the following conditions occur or are expected to occur:
    - a. The air temperature is below 40 degrees F at the time of concrete placement.
    - b. The average daily air temperature is below 40 degrees F for three consecutive days immediately prior to the day of concrete placement.
    - c. An average daily air temperature below 40 degrees F is foreseen or occurs during any day of the specified concrete curing period.
  2. For purposes of the paragraphs above, the average daily temperature is defined as the arithmetic mean of the highest and lowest temperature during the period from midnight to midnight. All air temperatures are to be measured at the Site.
- C. Hot Weather:
  1. Hot weather concreting procedures per "Hot Weather Concreting," ACI 305R, shall be followed whenever any one of the following conditions occur or are expected to occur:
    - a. The air temperature is above 90 degrees F at the time of concrete placement.
    - b. Whenever conditions of concrete temperature, air temperature, wind velocity, and relative humidity combine to cause flash set, excessively low slump, cold joints, plastic shrinkage cracking, or otherwise impair the quality of concrete.
  2. When the evaporation rate of bleed water exceeds 0.1 pounds per square foot per hour, steps shall be taken to prevent plastic shrinkage cracking. Evaporation rate shall be determined by the method presented in "Hot Weather Concreting," ACI 305R.



## PART 2 PRODUCTS

### 2.01 MATERIALS

- A. Cement - ASTM C150 Type I or II, unless indicated otherwise. All cement shall be from the same mill. Cement for Class A-2 concrete shall contain less than 8% tricalcium-aluminate (C3A).
- B. Coarse Aggregate - Aggregates for normal weight concrete shall be crushed limestone conforming to ASTM C33, Class 4S. Aggregates for lightweight concrete shall meet the requirements of ASTM C330. Aggregates shall satisfy all quality requirements specified therein (i.e., grading, limits on deleterious substances, etc.).
- C. Fine Aggregate - ASTM C33.
- D. Fly Ash - ASTM C618, Class C or Class F, including supplementary chemical requirements and supplementary physical requirements, except loss-on-ignition shall be less than 5%. The use of fly ash shall be in accordance with "Use of Fly Ash in Cement (ACI-232.2R)".
- E. Silica Fume - ASTM C1240.
- F. Ground Granulated Blast Furnace (GGBF) slag shall be in accordance with ASTM C989 Grade 100 or 120. Slag for Class A-1 concrete shall contain less than 12% tricalcium-aluminate (C3A) and slag for Class A-2 concrete shall contain less than 8% tricalcium-aluminate (C3A).
- G. Admixtures - The use of all admixtures shall be in accordance with "Chemical Admixtures for Concrete (ACI 212.3R)", and "Guide for the Use of High Range Water Reducing Admixtures in Concrete (ACI 212.4R)."
  - 1. Air entraining - ASTM C260.
  - 2. Water-reducing - ASTM C494.
  - 3. Accelerator - ASTM C494, Type C or E, admixture shall be non-corrosive as verified by long-term accelerated corrosion testing by an independent laboratory.
  - 4. Anti-washout admixture - Master Builders "Rheomac UW450", or equal.
  - 5. Only those admixtures expressly stated by the manufacturer as being chloride-free shall be used.
  - 6. The maximum water-soluble chloride ion content, expressed as a percentage by weight of the cement, contributed from all concrete ingredients shall not exceed 0.10% for non-prestressed concrete structures. Written certification of chloride ion content shall be submitted. Testing for Chloride Ion content shall conform to ASTM C1218.
  - 7. If more than one admixture is used, the admixtures shall be compatible with each other and shall be incorporated into the concrete mix in correct sequence

and timing so that desired effects of all admixtures are realized and harmful effects are avoided.

8. Air-entraining and chemical admixtures shall be incorporated into the concrete mix in a water solution. The water so included shall be considered to be a portion of the allowed mixing water.
- H. Water shall conform to ASTM C94. Mixing water, including that contributed by aggregates and admixtures, shall be clean, and free from injurious amounts of oils, acids, alkalis, organic materials, chloride ions, or other substances that are deleterious to concrete or reinforcement. Non-potable water shall not be used.

## 2.02 ACCESSORIES

- A. Curing Compound - Compound shall be membrane-forming, liquid applied, non-yellowing, VOC-compliant, water-based acrylic polymer resin conforming to ASTM C309, Type 1 and ASTM C1315, Type 1, Class A. The compound shall include sealing and dustproofing properties. Minimum solids content shall be 25%. Compound shall not permit a moisture loss in excess of 0.40 kilograms per square meter (0.082 pounds per square feet) in 72 hours. Sodium silicate based products are not acceptable. Compound shall be Dayton Superior "Cure & Seal 1315 J22WB", SpecChem, LLC. "Cure & Seal WB 25", L&M Construction Chemicals, Inc. "Lumiseal WB Plus" or equal. Curing compound in potable water treatment plant construction shall be non-toxic and free of taste and odor.
- B. Bonding Adhesive for Cracks, etc. - ASTM C881 100% solids, 100% reactive two component epoxy bonding adhesives. Sika Corporation, "Sikadur 32, Hi-Mod", Dayton Superior "Sure Bond (J-58)", The Euclid Co. "Dural 452 Gel", Master Builders "MasterEmaco ADH326", or equal.
- C. Bonding Adhesive for Vertical Joints - Non-vapor barrier forming, solvent-free, moisture insensitive, epoxy modified cementitious product Sika Corporation "Sika Armatec 110 Epocem", Euclid Co. "Duralprep A.C.", or equal.
- D. Bonding Grout - Identical concrete mix as approved for each concrete Class, except that an identical quantity of the fine aggregate shall be substituted for all coarse aggregate.
- E. Liquid Floor Hardener – A VOC compliant, Non-yellowing, dust proofing, liquid applied hardener with non-slip properties that dries to a clear finish. L&M Construction Chemicals "Seal Hard", W.R. Meadows "Liqui-Hard", ChemMasters "Chemisil Plus", or equal. Apply after concrete has cured as recommended by the manufacturer.
- F. Bond Breaker - Bond breaker shall be non-staining type which will provide a positive bond prevention, such as SpecChem "SpecTilt 100", Nox-crete "Silcoseal Classic", or equal.
- G. Premolded Expansion Joint Fillers:

1. Exterior Walks and Pavements - Asphalt impregnated cellular fibers securely bonded together, in conformance with ASTM D1751. W. R. Meadows "Fibre Expansion Joint", J D Russell Company "Fiberflex", or equal.
  2. Other Locations - Self expanding cork type in conformance with ASTM D1752, Type III. W.R. Meadows, Inc. "Sealtight - Self-Expanding Cork Joint Filler", Masco "Self-Expanding Cork", or equal.
- H. Isolation Joints - Flexible foam expansion joint filler, W.R. Meadows "Sealtight - Ceramar", or equal.
- I. Compressible Material - Rigid extruded polystyrene from Board Foamular 150 (15psi) by Owens Corning Company or compressible fill material by Plasti-Fab or equal. Provide foam board, unless noted otherwise.
- J. Epoxy Joint Filler - Two component, 100% solids, flexible epoxy filler with minimum Shore D hardness of 50. The Euclid Chemical Company "Euco 700", Sika Corporation "Sikadur 51 SL", W.R. Meadows, Inc "Rezi-Weld Flex", or equal. Only to be used to fill interior non-moving saw cut or tooled construction or control joints and shrinkage cracks. Not suitable for constant immersion.
- K. Non-slip Aggregate Floor Treatment - Aluminum oxide or emery grit. BASF chemical company "Master Top 120SR", Dayton Superior "Emery Non-slip", or equal.
- L. Vapor Barrier - 6 mil polyethylene, ASTM D2103.

**2.03 RESERVED**

**2.04 RESERVED**

**2.05 CONCRETE MIXES**

- A. The Contractor shall design and be responsible for the performance of all concrete mixes. Mixes shall have the required quality, consistency, and workability to permit concrete to be readily worked into forms and around reinforcement without segregation or excessive bleeding. Hardened concrete shall develop all characteristics required by Contract Documents.
- B. Proportioning:
1. Concrete mixes shall be proportioned to maximize durability and water tightness. To this end the total water content shall be reduced to the lowest practical amount that is consistent with placing and consolidation methods. Water reducing and high range water reducing admixtures shall be used as required to maintain workability. Specified water/cementitious ratio shall not be exceeded.
  2. Concrete proportions shall comply with ACI 211.1, ACI 301, ACI 318 and for the environmental components of the Work ACI 350.

- a. Proposed mix designs proportioned by field test data or trail mixes shall be accompanied by a complete standard deviation analysis and calculations for the required average compression strength  $F'_{cr}$ . Test records used for determining standard deviation and average strength shall have been made within the past 12 months. These test records must represent materials, quality control procedures and conditions similar to those expected, and changes in materials and proportions within the test records shall not have been more restricted than those for the proposed Work. A minimum of ten concrete compressive test records are required if field test data is selected as the method to determine the validity of the proposed mix design.
- b. Proportioning by empirical methods on basis of water/cement ratio is not permitted.
- c. Concrete mix proportions are subject to Engineer's approval.

C. Design mixes shall have following requirements:

- 1. Three normal weight concrete mixes are generally required; Class A-1, A-2 and Class B. Concrete mixes shall be as follows:

	Class A-1	Class A-2 (Wastewater)	Class B
28-Day Compressive Strength $f'_{c}$ (psi)	4500	4500	3000
Maximum Water/Cementitious Ratio:	0.44	0.42	.66
Minimum Cementitious Content (Lbs/CY)	600	650	480
Maximum Cementitious Content (Lbs/CY)	800	800	650
Slump (Inches)	See below	See below	See below

For calculating water/cementitious ratio of the mix, the weight of the water shall be that of the total free water in the mix, which includes the mixing water, the water in any admixture solutions, and any water in the aggregates in excess of that needed to reach a saturated surface dry condition.

- 2. Concrete placed under water shall contain an approved anti-washout admixture and shall contain a minimum of 600 pounds of cement per cubic yard. Fly ash or GGBF slag shall not be used in the concrete mix.

D. Slump:

- 1. When superplasticizer is not included in the mix, slump shall be 2 to 4 inches.
- 2. When superplasticizer is included in the mix, the maximum slump measured upon delivery to the construction site shall be 3 inches. Superplasticizer shall be added at the Site after verification of slump to increase slump to the desired amount.
- 3. Tolerance of 1 inch above the maximum specified slump will be permitted for one batch in any five consecutive batches.

- Concrete of lower slump than specified may be used provided it is properly placed and consolidated. Field adjustment of slump by addition of water is not permitted.

E. Air Content:

- All concrete shall be air entrained unless specified or noted otherwise on the Drawings.
- Concrete to be air-entrained shall have an air content as schedule below, unless specified otherwise:

Nominal Maximum Size of Coarse Aggregate (Inch)	ASTM C33 Aggregate Size Number	Total Air Content Percent By Volume
3/8	8	7.5
1/2	7	7.0
3/4	67	6.0
1	57	6.0
1-1/2	467	5.5

- Allowable deviation from specified air content is plus or minus 1%.
- Interior floor slab specified to receive a trowel finish shall not be air entrained. Maximum air content shall be 3%.
- Floors receiving dry-shake hardeners or heavy-duty topping shall not be air-entrained. Maximum air content shall be 3%.
- Air entrainment is not required for Class B concrete.

F. Coarse Aggregate Size:

- Nominal maximum size of aggregate shall not be more than one-fifth of narrowest dimension between side forms, one-third of depth of slabs, nor three-fourths of minimum clear spacing between reinforcing bars.
- Coarse aggregate shall be largest size consistent with placing methods and specified constraints. Minimum coarse aggregate shall be Size Number 57, unless smaller size is required by dimensional or reinforcement spacing constraints.

G. Cementitious Material:

- The cementitious mixture shall contain cement and either fly ash or GGBF slag, but not both.
- When fly ash is used in the concrete mixture, it shall comprise between 15% to 25% of the total cementitious mixture. When slag is used in the concrete mixture, it shall comprise between 25% to 50% of the total cementitious mixture. The percentages are based on weight of the total cementitious mixture.

3. For concrete in contact with wastewater, Class A-2, the cementitious design mixture shall consist of ASTM C150 Type II cement and slag or ASTM C150 Type II cement and Class F fly ash. Alternately, ASTM C150 Type I cement and Class C fly ash may be used provided the design cementitious mixture is tested per ASTM C1012 to have 0.10% or less expansion in 6 months. The test results shall be submitted with the proposed concrete mix design.
4. Air content for concrete containing fly ash shall be closely monitored and the dosage of air-entraining admixture shall be modified as required.

## **2.06 CONCRETE PRODUCTION**

- A. Ready-mixed concrete is to be used unless otherwise specified. It shall be batched, mixed, and transported in accordance with ASTM C94.
- B. Admixtures other than air-entraining admixture shall not be added without Engineer's written approval.
- C. Admixtures shall be charged into mixer as solutions and shall be measured by means of acceptable dispensing device. If two or more admixtures are used, they shall be added separately. Admixtures shall be used in accordance with manufacturer's instructions.
- D. During cold or hot weather conditions, special precautions, as specified in ACI 306R or ACI 305R, respectively, shall be taken during batching, mixing, and curing.

## **2.07 STORAGE OF MATERIALS**

- A. Cement shall be stored in weathertight containers.
- B. Aggregate stockpiles shall be arranged to avoid excessive segregation and to prevent contamination with other materials or with other sizes of like aggregates. Frozen or partially frozen aggregates shall not be used.
- C. Sand stockpiles shall be allowed to drain to ensure a relatively uniform moisture content throughout the stockpile.
- D. Admixtures shall be stored in a manner to prevent contamination, evaporation, freezing, or damage. Admixtures in the form of suspensions or nonstable solutions shall be agitated to assure thorough distribution of ingredients. Liquid admixtures shall be protected from freezing and from temperature changes which would adversely affect their characteristics.

## **PART 3 EXECUTION**

### **3.01 COORDINATION**

- A. Reinforcement, sleeves, inserts, anchors, and embedded items shall be accurately placed, supported, and tied prior to concrete placement. Other trades and contractors required to furnish embedded items shall be given ample notice of concrete placement. Reinforcement and embedded items shall be subject to review of Resident Project Representative prior to placing concrete.

- B. Contractor shall notify Resident Project Representative a minimum of 24 hours before placing concrete, excluding non-working days.
- C. Concrete shall be placed only between hours of 8:00 a.m. and 6:00 p.m. unless otherwise permitted. Concrete shall not be placed after 12:00 noon on last working day of week.

### 3.02 PREPARATION

- A. Hardened concrete and foreign materials shall be removed from inner surfaces of conveying equipment.
- B. Waterstop shall be secured in place to ensure that it cannot bend to form cavities during concreting.
- C. Formwork shall be completed and snow, ice, and water shall be removed from forms. Before placing reinforcing steel or concrete, the surfaces of the forms shall be covered with an acceptable coating material, or form liner may be used.
- D. The space to receive concrete shall be free of laitance, dirt, and other debris. Laitance shall be removed by wire brushing.
- E. Reinforcement and embedded items shall be checked for proper placement and adequate support. All reinforcement at the time concrete is placed, shall be free of mud, oil, or other materials that may adversely affect or reduce the bond. Aluminum conduits or pipes shall not be embedded in concrete unless approved by the Engineer and effectively coated to prevent aluminum-concrete reaction.
- F. Preparation of grade shall be as specified for slabs. Concrete shall not be placed on frozen ground. There shall be no standing water on the subgrade, nor any muddy or soft spots when the concrete is placed.
- G. A final detailed inspection of the foundation, construction joints, forms, waterstops, embedments, reinforcements, and other items of the placement shall be made immediately before the concrete is placed.

### 3.03 PLACING CONCRETE

- A. Conveying:
  - 1. Concrete shall be handled from mixer to place of final deposit as rapidly as practicable by methods which will prevent segregation or loss of ingredients and in a manner which will ensure that required quality of concrete is maintained. Conveying systems shall not impair the strength, slump, or air content of the concrete. Concrete shall be placed and consolidated prior to initial set, and in no case more than 1-1/2 hours after the cement is added to the mix.
  - 2. Chutes shall be metal (except aluminum), or wood with metal lining and shall have a slope not exceeding 1 vertical to 2 horizontal and not less than 1 vertical to 3 horizontal. Chutes more than 20-feet long and chutes not meeting slope

requirements may be used provided they discharge into a hopper before distribution.

3. Pumping or pneumatic conveying equipment shall be of suitable kind with adequate pumping capacity. Pneumatic placement shall be controlled to prevent segregation. Loss of slump in pumping or pneumatic conveying equipment shall not exceed 1-1/2 inch.
4. Concrete shall not be permitted to drop more than 4 feet freely, or through a cage of reinforcing steel, from conveying device. Concrete shall be deposited through drop chutes, elephant-trunks, or tremies as required. Temporary openings in wall or column forms may be used to limit the free fall of concrete to less than four feet. The openings should be spaced no more than six to eight feet apart.
5. Concrete shall not be conveyed through pipes made of aluminum or aluminum alloy.

B. Depositing:

1. Concrete shall be deposited continuously or in layers of such thickness that no concrete will be deposited which has hardened sufficiently to cause planes of weakness within the sections. No interruption in concrete placement shall exceed 30 minutes to avoid cold joints in the structural elements being placed. Alternate placing equipment shall be immediately available for use in the event that the primary placing equipment or system breaks down.
2. Placing shall proceed at such a rate that concrete which is being integrated with fresh concrete is still plastic.
3. Concrete which has partially hardened or has been contaminated shall not be deposited.
4. Placing of concrete for supported elements, such as beams and elevated slabs, shall not begin until supporting elements, such as columns and walls, have cured for a minimum of 7 days, unless the concrete has attained 80% of the specified design compression strength or the shoring for the supporting elements has been designed to carry the weight of the supported elements and their construction load.
5. Concrete shall be placed continuously between construction, isolation, and expansion joints. Where joints are spaced greater than 25 feet apart the placing of concrete adjacent to previously placed concrete shall not begin until 48 hours after completion of previous placement, unless otherwise noted. Concrete shall be deposited as nearly as practical in its final position and shall be carried up evenly in forms to avoid segregation due to rehandling or flowing. Layers shall not exceed 24 inches. Concrete shall not be permitted to flow laterally in forms.



6. The temperature of the concrete mixture immediately before placement shall be between 50 degrees F and 90 degrees F, except as provided under cold weather and hot weather concreting.
- C. Consolidating:
1. Concrete shall be consolidated by vibrating, so that concrete is thoroughly worked around reinforcement and embedded items, and into corners and angles of forms, eliminating air and stone pockets. Vibrators shall extend into underlying layers to bond two layers together. To avoid excessive pressure on the forms, the vibrator should penetrate no more than two feet into the underlying layer.
  2. Vibrators shall be the largest size and most powerful that can be used properly in the Work, as described in "Recommended Practice for Consolidation of Concrete" (ACI 309R). A minimum of one spare operable vibrator shall be available on site. Mechanical high frequency vibrators with a minimum frequency of 8,000 revolutions per minute are preferred for consolidation of concrete within the forms.
  3. Vibrators shall not be used to transport or drag concrete within forms. Vibrators shall be inserted and withdrawn from the concrete slowly.
  4. Vibrators shall be inserted in the fresh concrete at points approximately 18 inches apart or as recommended by the vibrator manufacturer. The vibration shall be of sufficient duration and intensity to thoroughly consolidate the concrete, but shall not be continued so as to cause segregation. Vibration shall not be continued at any one point to the extent that localized areas of grout are formed.
- D. Under Water Concreting:
1. Concrete shall not be placed under water unless otherwise indicated or permitted. The recommendations given for concrete placed under water in Chapter 8 of ACI 304 shall be followed subject to the requirements specified herein.
  2. Concrete shall be deposited by tremie or other acceptable method such that fresh concrete enters mass of previously placed concrete from within, causing water to be displaced with minimum disturbance at the surface of the concrete.
  3. Concrete shall not be disturbed after placement.
- E. Defective Concrete:
1. Defective concrete is defined as concrete in place which does not conform to specified design strength, required percent air, shapes, alignments and elevations, as shown on the Drawings and/or which presents faulty surface areas. Evaluation and acceptance of concrete shall conform to ACI 318 and as determined by Engineer.

2. All defective concrete shall be removed and replaced in a manner meeting with the Engineer's approval. Should surface imperfections occur, they may be patched at the discretion of, and in a manner satisfactory to the Engineer. The Engineer reserves the right to require complete removal and replacement of such defective Work should the patching fail to satisfactorily restore the required quality and appearance of the Work. All such Work shall be performed at the Contractor's expense, without extension of time.
3. If for any reason, in the opinion of the Engineer, the testing of any section of the completed structure is necessary, a superimposed load shall be applied by the Contractor and the test conducted in accordance with the current Building Code at the Contractor's expense irrespective of the results of such tests. In cases where failure is declared, the Engineer shall have the authority to order the defective construction removed. All expense of removing such defective construction and substituting new construction, including expense of removing and replacing the Work of others, or protecting and repairing the Work of others, shall be borne by this Contractor.

#### 3.04 JOINT INSTALLATION

A. Construction Joints:

1. Construction joints shall not be spaced further apart than 60 feet, unless noted otherwise. Where construction joint spacing exceeds 25 feet concrete placement shall be alternated so that adjacent sections are placed a minimum of 48 hours apart to allow for volumetric change of adjacent pours due to shrinkage and to help minimize cracks. Joints shall be located where they will least impair the strength, watertightness, and architectural design of the finished structure. Joint types and locations shall be subject to Engineer's approval. Construction joints shall not be located less than 5 feet from any other joint to which they are parallel.
2. Joints in walls and columns shall be placed at the tops of footings and mat foundations, unless shown otherwise. Joints should be made perpendicular to the main reinforcement where practical.
3. Joints shall be constructed straight by means of a temporary straight edge or rustication strip placed in forms. Joints shall be perpendicular to reinforcement.
4. Reinforcement shall be continuous across construction joints unless otherwise indicated. Unless otherwise specified or shown on Drawings, longitudinal keys at least 1-1/2 inches deep by 3-1/2 inches wide shall be provided in all joints in walls, and between walls and slabs or footings.
5. Surface of concrete shall be thoroughly cleaned and laitance shall be removed by wire brushing prior to placing adjoining concrete.

6. At all vertical joints in new concrete and in new against previously existing concrete, and wherever else called for on the Drawings, bonding adhesive paste shall be applied per the manufacturer's directions.
  7. At all horizontal joints in new concrete and in new against previously existing concrete, and wherever else called for on the Drawings, bonding grout shall be applied in a 2-inch-thick layer.
- B. Expansion and Isolation Joints:
1. Expansion and isolation joints shall be located and constructed as shown. Generally, joints shall be located at the perimeter of slabs-on-grades and other locations shown. These joints shall have filler material and have exposed faces sealed.
  2. Reinforcement and other embedded metal items shall not extend continuously through expansion or isolation joints unless shown otherwise.
  3. Unless polystyrene foam boards are called for on Drawings, premolded type joint fillers shall be installed for expansion joints in accordance with manufacturer's instructions. Joint filler shall be accurately placed and secured. Fillers for each joint shall consist of as few pieces of material as possible. Pourable or non-sag joint sealants per Section 07900 shall be placed in top or face of joints, as applicable, per manufacturer's instructions. All joints in tanks and within buildings shall be sealed unless otherwise shown. Where called for on the Drawings, exterior joints in or around walks and pavement shall be sealed.
- C. Control Joints:
1. Unless indicated otherwise on the Drawings, control joints in slabs shall be located at a maximum spacing of 30 times the slab thickness in both directions with a maximum aspect ratio not to exceed 2 to 1. These joints shall preferably be located on column lines with joints also located between column lines if required to satisfy maximum spacing. Driveways and sidewalks shall have control joints spaced at intervals approximately equal to the slab width. Drives and walks wider than 12-feet shall have longitudinal and transverse joints at 12-foot maximum spacing. All control joints shall be continuous, not staggered or offset. Control joints shall not be located in liquid containing or conveying structures, such as tank, channels and etc.

### 3.05 FINISHING OF FORMED SURFACES

- A. Surface defects shall be patched. Patching procedures shall be as follows:
1. Honeycombed and other defective concrete shall be removed to sound concrete. Cut or chip edges perpendicular to surface or slightly undercut; featheredging is not permitted. Area to be patched and surrounding area within at least 6 inches shall be dampened to prevent absorption of water from patching mortar.

2. Bonding grout consisting of 1-part cement and 1-part fine sand passing a No. 30 mesh sieve mixed to the consistency of a thick cream, shall be thoroughly brushed into surface immediately prior to applying patching mixture.
  3. Patching mixture shall be composed of same proportions as used for concrete except that coarse aggregate shall be omitted and mixture shall not consist of more than 1-part cement to 2-1/2 parts sand by damp loose volume. Mixing water shall be no more than necessary for handling and placing. Patching mixture shall be prepared in advance and allowed to prehydrate with frequent manipulation with trowel, until stiffest consistency that will permit placement is obtained.
  4. Where concrete is exposed to view, color of patching mixture shall be adjusted to match surrounding concrete by substituting appropriate amount of white cement for gray cement. Proper color shall be determined by trial patches.
  5. Patching mixture shall be applied before bond coat begins to lose water sheen. Patching mixture shall be thoroughly consolidated and struck off so as to leave patch slightly higher than surrounding surface. Patch shall be left undisturbed for one hour after which time it shall be finished with metal tools. Patched area shall be moist cured for not less than 7 days.
- B. Tie holes shall be patched as follows:
1. The holes shall be plugged, unless stainless steel noncorrosive or acceptably coated ties are used, as approved by Engineer.
  2. Tie holes shall be cleaned and dampened prior to patching with a non-metallic, non-shrink grout. Patching material shall be packed solid into hole.
  3. The Contractor may substitute alternate materials and procedures subject to the approval of Engineer. These materials shall be applied in accordance with manufacturer's written recommendations wherever applicable.
- C. Stains, rust, efflorescence, and surface deposits on exposed concrete shall be removed by methods acceptable to Engineer.
- D. After removal of forms, the surface of concrete shall be given one or more of the finishes specified below as scheduled in the Finishing Schedule of this specification.
1. Rough Form Finish - Fins exceeding 1/8 inch in height shall be removed. Otherwise, surfaces shall be left with texture imparted by forms.
  2. Smooth Form Finish - The form facing material with or without form-liner shall produce a smooth, hard, uniform texture in the concrete. The type of facing material or form-liner selected is dependent upon the type of smooth finish desired and shall be approved by the Engineer. Tie holes and defects shall be patched. All fins shall be completely removed.
  3. Special Architectural Finishes - This shall be produced in accordance with Section 6 of ACI 301R.

4. Smooth Rubbed Finish - The smooth rubbed finish shall be produced on a concrete with smooth form finish as specified above.
    - a. Forms shall have been removed and patching completed as soon after placement as possible without damaging or jeopardizing structure.
    - b. Finishing shall be performed no later than the day following form removal.
    - c. Surfaces shall be thoroughly wetted and rubbed with abrasive until form marks, fins, and irregularities are removed and uniform color and texture are produced. Cement grout shall not be used.
  5. Grout Cleaned Finish - The grout cleaned finish shall be produced on a concrete with smooth form finish as specified above.
    - a. Cleaning shall not begin until all contiguous surfaces to be finished are completed and accessible. Finishing as the Work progresses is not permitted. Finishing of an area shall be completed on day it is started.
    - b. Finishing grout shall consist of 1-part cement and 1-1/2 parts fine sand with sufficient water to produce consistency of thick paint. Where concrete is exposed to view, color of grout shall be adjusted to match surrounding concrete by substituting appropriate amount of white cement for gray cement. Proper color shall be determined by trial patches.
    - c. Wet surface sufficiently to prevent absorption of water from grout and apply grout uniformly with brushes or spray gun. Scrub surface vigorously with cork float to coat surface and fill air bubbles and holes. While grout is still plastic, remove excess grout with rubber float or burlap. After surface whitens from drying, rub vigorously with clean burlap. Finish shall be kept damp for minimum of 36 hours after final rubbing.
- E. Finishing of Related Unformed Surfaces:
1. Tops of walls, horizontal offsets, and similar unformed surfaces occurring adjacent to formed surfaces shall be struck smooth after placement and shall be floated to texture consistent with that of adjacent formed surface. Where smooth rubbed finish or grout cleaned finish is specified, finish shall continue uniformly across unformed surfaces.

### 3.06 SLAB INSTALLATION

- A. Floor construction shall comply with ACI 302R. Floors shall be Class 5 except floors with heavy-duty topping shall be Class 7.
- B. Preparation - Subgrade supporting slabs shall be well drained and of adequate and uniform load bearing capacity. Subgrade shall be free of frost before concrete is placed.

- Subgrade shall be moist at time of placement. Ground may be dampened with water, but there shall be no standing water on subgrade, nor muddy spots.
- C. Vapor barriers shall be installed in all occupied spaces or where shown on Drawings. A minimum 4-inch layer of granular, self-draining compactable fill, shall be placed under the vapor barrier. Joints shall be lapped 6 inch minimum. Caution shall be taken during construction not to tear or otherwise damage the vapor barrier. Damaged vapor barriers shall be patched or replaced.
  - D. Floors and slabs shall be sloped to drains as shown maintaining thickness shown on Drawings as a minimum. When formwork is cambered, screeds shall be set to like camber to maintain proper concrete thickness.
  - E. A minimum of 1/4 inch per foot slope shall be provided for exterior slabs, driveways, and walks. Driveways and walks can be pitched to one side or crowned along the longitudinal centerline with drainage to both sides as most suitable to surrounding drainage pattern.
  - F. Concrete shall not be deposited more rapidly than it can be spread, straight-edged, and darby or bull-floated. These later operations shall be completed before bleed water collects on surface. Rakes shall not be used for spreading concrete to avoid segregation. Slabs shall be consolidated by internal vibrators of high frequency and low amplitude, or vibrating screeds.
  - G. Placement of large slab areas shall be sequenced to reduce initial shrinkage cracks. Such slabs can be poured in a series of long strips separated by similar long strips poured at another time. The adjacent pours shall be at least 48 hours apart. Placing sequence and number of pours are subject to the approval of Engineer.
  - H. Construction joints shall not be spaced further apart than 60 feet in both directions. Where construction joint spacing exceeds 25 feet concrete placement shall be alternated, in a strip or checkered fashion, so that adjacent sections can be placed a minimum of 48 hours apart to allow for volumetric change of adjacent pours due to shrinkage and to help minimize cracks.
  - I. Control joints in slabs shall be located at a maximum spacing of 30 times the slab thickness, in both directions, with a maximum aspect ratio not to exceed 2 to 1, unless noted otherwise. These joints shall be located on column lines where practical. Driveways and sidewalks shall have control joints spaced at intervals approximately equal to the slab width. Drives and walks wider than 12-feet shall have longitudinal and transverse joints at 12-foot maximum spacing. All control joints shall be continuous, not staggered or offset, where practical. Saw-cutting of control joints shall be performed with "Soff-Cut" saw after final finishing as soon as the concrete surface is firm enough not be torn or damaged by the blades and prior to the application of curing compound. In any case, saw-cutting of joints shall be done within two hours after final finishing. Control joint shall be 1/8-inch-wide by one inch deep. Control joints shall not be located in liquid containing or conveying structures, such as tank, channels and etc.

- J. Finishes:
1. Scratched Finish - After concrete has been placed, consolidated, struck off, and leveled, but prior to final set, surface shall be roughened with rakes.
  2. Floated Finish - After concrete has been placed, consolidated, struck off, and leveled, surface shall not be worked further until ready for floating. Floating shall begin when bleed water sheen disappears and surface has stiffened sufficiently. Floating shall be performed with wood hand float or power float. During first floating, high spots shall be cut down and low spots shall be filled. Slab shall be refloated immediately to uniform sandy texture.
  3. Troweled Finish - Surface shall first be float finished, followed by power trowel, and then hand troweled. Additional trowelings shall be performed after surface has hardened sufficiently. Final troweling shall be done when ringing sound is produced as trowel is moved over surface. Finished surface shall be free of trowel marks and uniformly smooth and hard. Dusting surface with cement is not permitted.
  4. Broom Finish - Surface shall first be float finished and then given coarse texture by drawing broom over surface.
  5. Non-Slip Finish - Non-slip abrasive aggregate shall be applied in accordance with manufacturer's instructions.
- K. Finishing Tolerances:
1. Floor flatness (FF) and floor levelness (FL) tolerance for slabs on grade with trowel finish shall be FF25/FL20. Minimum local tolerance over 2 bay shall be 2/3 of specified tolerance.
  2. Floated finish surfaces shall be constructed to tolerance of FF 20/FL17.
  3. FL shall not apply to slabs where slope is shown or specified.
- L. Liquid hardener shall be applied to interior exposed concrete floors which do not receive paint, dry-shake hardener, or other coating, or floor coverings. Material shall be applied in accordance with manufacturer's instructions. Remove curing, sealer, and dustproofing compounds prior to placing the liquid hardener.
- M. Construction and control joints shall be filled with epoxy joint filler where shown. Joint filler shall be applied not sooner than 3 months after slab construction is completed and shall be installed in accordance with manufacturer's instructions.
- N. Expansion and isolation joints shall be sealed using moisture insensitive and movement tolerating joint sealants per Section 07900.

### 3.07 CURING

- A. Beginning immediately after placement, concrete curing shall be initiated to protect the concrete from moisture loss and premature drying. Concrete shall be continuously cured for a minimum of 7 days. Tanks and other liquid-retaining structures shall be

cured for minimum of 10 days. Elevated slabs, joists, and beams shall be cured for at least 14 days and as many additional days as necessary for tests to verify that the concrete has attained 90% of its specified design strength up to a maximum of 21 days. For the entire duration of the curing period, the concrete shall be protected from detrimental weather conditions as specified elsewhere in this Section.

- B. Curing procedures for each type of concrete section shall be submitted and shall be in accordance with ACI 308, "Standard Practice for Curing Concrete," subject to the additional requirements specified herein.
- C. Concrete surfaces not in contact with forms shall be cured by one of following procedures:
  - 1. Ponding, fog spraying, or continuous sprinkling with water. Care shall be taken to avoid thermal shock from use of cold curing water or excessive evaporation rates. Alternate drying and re-wetting of slabs during curing shall be avoided to avoid hairline cracks at the surface.
  - 2. Application of burlap or absorptive mats kept continuously wet.
    - a. Burlap shall be clean and thoroughly rinsed in water before it is used.
    - b. Burlap and absorptive mats shall be soaked as frequently as required to maintain continuously wet surface.
    - c. Burlap and absorptive mats shall remain in place unwetted for minimum of 3 days after end of curing period to permit concrete to dry slowly.
  - 3. Application of waterproof sheet material conforming to ASTM C171.
    - a. Sheet material shall be placed over the wet surface of fresh concrete as soon as possible without marring surface. Material shall be placed flat without wrinkles.
    - b. Sheet material shall cover all exposed surfaces and shall extend beyond edges of slab a distance of at least twice the thickness of the slab.
    - c. Sheet material shall be lapped a minimum of 6 inches. Windrows of earth or wood shall be placed along edges and laps to seal joints and secure material from displacement by wind.
  - 4. Application of approved curing compound.
    - a. Curing compound shall be used only after receiving approval by the Engineer.
    - b. Curing compound shall not be used on walls to receive smooth rubbed or grout cleaned finishes, prior to the completion of the application of these finishes. Curing compound maybe applied, at contractor discretion, over these finishes to complete the curing processes.
    - c. Curing compound shall not be used on surfaces to receive paint, liquid hardener, coatings, sealers, floor hardeners, tile, adhesives, or other



- materials requiring bond, unless positive measures are taken to remove it completely from the areas to receive bonded application.
- d. Curing compound shall be placed in accordance with manufacturer's instructions after finishing, and immediately after water sheen has disappeared from concrete surface.
  - e. Exposed steel, keyways, or concrete to be surfaced shall be protected from curing compounds, unless the manufacturer of the surfacing material submits written documentation approving the use of their material on concrete on which the specific curing compound was applied.
  - f. Curing compounds shall not be used on surfaces to receive concrete toppings. Refer to Section 03510.
- D. Moisture loss from surfaces placed against wooden forms or metal forms exposed to heating by sun shall be minimized by maintaining forms continuously wet.
- 1. Forms shall be continuously sprinkled or covered with wet burlap.
  - 2. If forms are loosened but not removed, water shall be made to run down inside of form by use of soaker hoses.
  - 3. If forms are removed prior to completion of curing period, concrete shall be cured by one of the methods specified for concrete surfaces not in contact with forms.

### 3.08 COLD WEATHER CONCRETING

- A. Cold weather concreting procedures concerning production, transportation, placement, protection, curing, and temperature monitoring shall be submitted to Engineer for review prior to onset of cold weather.
- B. Concrete Production:
  - 1. Minimum concrete temperatures during mixing shall be as follows:

Air Temp	Least Dimension Less Than 12 Inch	Least Dimension 12 Inch or Greater
30 to 45 degrees F	60 degrees F	55 degrees F
0 to 30 degrees F	65 degrees F	60 degrees F
Below 0 degrees F	70 degrees F	65 degrees F

- 2. The mixing temperatures shall not be more than 15 degrees F above the values given above. When necessary, in order to produce concrete of the specified temperature, the mix water, the aggregates, or both, shall be heated prior to batching. Heating shall be done in a manner which is not detrimental to the mix and does not prevent the entrainment of the required amount of air. The methods used shall heat the materials uniformly. Aggregates shall not be heated directly by gas or oil flame, or on sheet metal over fire. Neither aggregates nor

water shall be heated to over 150 degrees F. If either are heated to over 100 degrees F, they shall be mixed together prior to the addition of the cement so that cement does not come into contact with materials which are in excess of 100 degrees F.

- C. Preparation - All snow, ice, and frost shall be removed from the surfaces, including reinforcement, against which the concrete is to be placed. Concrete shall not be placed around any embedment which is at 32 degrees F or less and is sufficiently massive as to cause the adjacent concrete to freeze.
- D. Placing - Minimum concrete temperatures at the time of placement shall be 55 degrees F for sections with smallest dimension less than 12 inches, and 50 degrees F for larger sections. Maximum concrete temperature shall not exceed 20 degrees F above the minimum required temperatures at the time of placement.
- E. Protection:
  - 1. Protection shall be provided and shall be adequate to prevent the surface temperature of the concrete from falling below 50 degrees F for the duration of the specified curing period. During this period, the concrete surface shall not be exposed to heated air that is more than 20 degrees F above this minimum value. At the end of the protection period, concrete shall be allowed to cool gradually. Maximum decrease in surface temperature shall be 5 degrees F in a one-hour period and 40 degrees F in a 24-hour period.
  - 2. At the time of placement, Contractor shall keep a record of the date, time, outside air temperature, temperature of concrete, and weather conditions (calm, windy, clear, cloudy, etc.). After placement, the Contractor shall keep a record of the date, time, outside air temperature, inside enclosure air temperatures, concrete surface temperatures and weather conditions for the duration of the specified curing period. These conditions shall be recorded at regular intervals, but not less than twice per each 24-hour period, with no period exceeding 16 hours without recorded conditions. The concrete surface temperatures shall be recorded at several locations on the placed section including interior, edge and corner locations and their corresponding enclosure air temperatures at these locations where applicable. These records shall be submitted to the Engineer or resident field representative weekly. The Contractor shall place a sufficient number of thermometers on the concrete surfaces throughout the Work to allow monitoring of concrete surface temperatures representative of all the Work. The Contractor shall place a minimum of two thermometers, each capable of recording the high and low temperature.
  - 3. Materials and equipment required for protection shall be available at Site before cold weather concreting commences.

4. Heated Enclosure:
    - a. Enclosure shall be strong enough to be wind-resistant and weather-tight and ample space shall be provided between concrete and enclosure to permit free circulation of the warmed air.
    - b. Maximum air temperature within enclosure shall be 70 degrees F.
    - c. Heaters shall be indirect fired type and shall be vented outside of enclosure. Combustion products shall not be permitted to come in contact with protected concrete.
    - d. Heaters and ducts shall be arranged so as not to cause areas of overheating or drying of concrete surface.
  5. Insulation:
    - a. Slabs not less than 12 inches thick placed on ground, elevated slabs, and walls may be protected by insulated forms and insulation blankets. Insulation shall be wind resistant and weather-tight.
    - b. Insulation type and thickness shall be selected with due regard for concrete temperature, air temperature, and length of protection period in accordance with "Cold Weather Concreting" (ACI 306R). Special care shall be taken at corners and edges of structure. Insulation type, thickness, and "R" value shall be as indicated in cold weather concreting procedures.
    - c. When minimum concrete temperature is not maintained, insulation shall be removed and immediately replaced by a heated enclosure. A sufficient number of surface thermometers shall be furnished and installed as directed by Resident Project Representative.
- F. Curing - If water curing is used, it shall be terminated at least 24 hours before concrete is exposed to freezing temperatures. Curing period shall be completed by non-water curing methods.

### 3.09 HOT WEATHER CONCRETING

- A. Hot weather concreting procedures including production, transportation, placement, protection, and curing shall be submitted for Engineer's review prior to onset of hot weather.
- B. Concrete Production and Delivery - The temperature of the concrete at time of placement shall be maintained within specified temperature by any combination of the following:
  1. Type III cement is prohibited.
  2. The temperature of the aggregates shall be kept low by shading the aggregate piles or sprinkling the aggregate with water.

3. Concrete ingredients shall be cooled before mixing or flake ice shall be substituted for all or part of mixing water as required to reduce concrete temperature. Mixing shall continue until ice is completely melted.
  4. Delivery of concrete shall be scheduled so that concrete is deposited as soon as practicable. Concrete shall be completely discharged within 1 hour after introduction of mixing water to cement.
  5. Water reducing or retarding admixtures with shrinkage compensating cement shall be used in such quantities as recommended by the manufacturer.
- C. Preparation - Steel forms, reinforcement, and embedments shall be cooled to below 90 degrees F by means of spraying with water or other approved methods immediately prior to concrete placement.
- D. Placing - Concrete shall be placed at lowest practicable temperature. Temperature of concrete as placed shall not cause difficulty from loss of slump, flash set, or cold joints and shall be between 75 degrees F and 90 degrees F and in no case shall exceed 90 degrees F.
- E. Protection:
1. During hot weather conditions prior to the application of curing materials, the concrete being placed and finished shall be protected from damage due to rapid evaporation. Such protection shall be adequate to prevent premature crusting of surface or an increase in drying shrinkage and cracking. Such protection shall be provided by raising the humidity of the surrounding air by fog spraying, the use of wind breaks or sun shades, additionally reducing of the temperature of the concrete, scheduling placement during the cooler times of days or nights, reducing time between placement of concrete and start of curing, or any combination thereof.
  2. Forms shall be covered and kept moist.
- F. Curing:
1. Curing shall be performed by water methods only unless approved otherwise.
  2. When the use of waterproof sheet material is approved for hot weather concreting, the material shall be pigmented white.
  3. Forms shall be loosened as soon as practicable and water curing shall be used as specified.

### **3.10 MASS CONCRETE**

- A. Concrete sections with minimum dimension larger than 36 inches shall be treated as mass concrete.
- B. Concrete Production:
1. Type III cement and accelerating admixtures are prohibited.

2. Cement content shall be reduced by substitution of fly ash within specified limit.
  3. Concrete ingredients shall be cooled before mixing or flake ice shall be substituted for all or part of mixing water as required to reduce concrete temperature. Mixing shall continue until ice is completely melted.
- C. Placing:
1. The temperature of concrete when deposited shall be between 50 degrees F and 70 degrees F.
  2. Concrete shall be placed in layers approximately 18 inches thick. Vibrator shall extend into previously placed layer.
- D. Curing:
1. The curing period for mass concrete shall be a minimum of 14 days.
  2. When the surrounding air temperature exceeds 40 degrees F, forms and exposed concrete shall be kept continuously wet for the first 48 hours after placing. Concrete shall be cured by any acceptable method after the first 48 hours, except when surrounding air temperature exceeds 90 degrees F, water curing methods shall be used exclusively. When cold weather concreting provisions apply, continuous wetting during first 48 hours is not required.
  3. During and at conclusion of the curing period, the temperature of the air immediately adjacent to concrete shall not fall more than 3 degrees F in any 1 hour, nor 30 degrees F in any 24 hours.

### 3.11 TESTING

- A. Concrete materials and operations shall be tested as the Work progresses.
- B. Duties of testing laboratory shall be as follows:
1. Review, check, and test proposed materials for compliance with Specifications before the start of the Work.
  2. Sample aggregates from concrete production stockpiles, at least once a month, during the placement of concrete and test for compliance with the specifications. The moisture content of each sample shall be measured and recorded.
  3. Review and test proposed mixture design when required by Engineer.
  4. Randomly sample concrete during construction in accordance with ASTM C172 and perform scheduled tests.
- C. Test Schedule:
1. Strength:
    - a. One strength test shall be made for each 50 cubic yards, or fraction thereof, of each class of concrete placed on any one day. Frequency of

- testing shall not provide less than 5 strength tests for each class of concrete.
- b. Concrete strength test shall consist of three specimens from each sample molded and cured in accordance with the section of ASTM C31, "Curing Specimens for Checking the Adequacy of Mixture Proportions for Strength or as the Basis for Acceptance or Quality Control".
  - c. Specimens shall be tested in accordance with ASTM C39. Two specimens shall be tested at 28 days for acceptance and one shall be tested at 7 days for information. Strength test result shall be average of strengths of 28-day specimens. If one specimen shows evidence of improper molding, handling, or testing, it shall be discarded and remaining specimen shall be considered as strength test result. Should both specimens in a test show any of the above defects, the entire test shall be discarded.
2. Cold Weather Concreting and Form Removal:
- a. When cold weather concreting procedures apply or when form removal provisions of Section 03100 apply, field cured specimens shall be made to determine when protection procedures may be terminated or when forms may be removed. These field cured specimens shall be in addition to strength tests and shall be made at same time as strength specimens.
  - b. Specimens shall be molded and cured in accordance with the section of ASTM C31, "Curing for Determining Form Removal Time or When a Structure May be Put into Service". The Contractor shall determine number of specimens required, but number of specimens shall not be less than three.
  - c. Specimens shall be tested in accordance with ASTM C39. Age-at-test of specimens shall be selected by Contractor.
3. Slump shall be measured for first batch of each concrete class delivered in morning and afternoon, for each strength test, and whenever consistency of concrete appears to vary. Slump shall be measured in accordance with ASTM C143. In the event that a batch fails to comply with specified requirements, the slump shall be measured on each successive batch until three batches meet the specified requirements.
4. Air content shall be determined for first batch of each concrete class delivered in morning and afternoon, for each strength test, and as required by field representative. Air content shall be measured in accordance with ASTM C231, ASTM C173, or ASTM C138. When concrete is placed by pumping, air content and slump shall be measured before pump and also at pump discharge. In the event that a batch fails to comply with specified requirements, the air content shall be measured on each successive batch until three batches meet the specified requirements.

5. Temperature of concrete sample shall be measured for each strength test.
6. If the measured slump or air content falls outside the specified limits, make additional tests immediately. Test all succeeding trucks for both slump and air until three in succession pass the slump and air tests.

### 3.12 EVALUATION OF STRENGTH

- A. The Contractor shall perform concrete mix work and produce concrete structures in full compliance with Specifications.
- B. Concrete strength will be considered satisfactory if the average of three consecutive strength test results equals or exceeds the specified strength, and no individual strength test result falls below specified strength by more than 500 psi.

### 3.13 CONCRETE SCHEDULE

- A. Unless indicated otherwise on the Drawings or specified, concrete shall be furnished as follows:
  - Class A-1: For all structures not defined under Class A-2 or Class B concrete.
  - Class A-2: For structures that cover, convey or store wastewater such as channels and tanks, and their attached auxiliary structures, and all other concrete that will be submerged or exposed to wastewater.
  - Class B: For pipe saddle supports, pipe pier supports, buried electrical duck banks, equipment pads, housekeeping pads and mudmats, unless noted otherwise. The above items shall not be exposed to weather and shall not be submerged in liquids; otherwise, they shall be of Class A concrete as specified above.

### 3.14 CONCRETE FINISHING SCHEDULE

- A. Concrete shall be finished as follows unless indicated otherwise:
  1. Building Interior:

Floors intended as walking surfaces or to receive a floor covering, bases, and curbs:	Troweled finish*.
Other slabs intended to receive roofing, water-proofing membrane or sand bed terrazzo:	Float finish*.
Exposed formed surfaces:	Smooth-rubbed finish*.
Other formed surfaces:	Smooth-rubbed finish*.
  2. Building Exterior:

Slabs, drives, and walks:	Broom finish*.
Exposed formed surfaces:	Grout-cleaned finish to 6-in below grade*.
Other formed surfaces:	Smooth form finish*.
  3. Pedestrian Ramps and Exterior Stairs: Non-slip finish\*.

4. Tanks and Other Liquid Retaining Structures:

Slabs:	Float finish*.
Interior formed surfaces to 6-inches below low water level:	Grout-cleaned finish*.
Interior formed surfaces lower than 6-inches below low water level:	Smooth form finish*.
Exterior formed surfaces:	Grout-cleaned finish to 6-in below grade*.
Other formed surfaces:	Rough form finish*.

\* Concrete surface finish shall be coordinated and acceptable surface finishes to be applied to concrete.

**3.15 ELECTRICAL CONDUITS AND LIQUID PIPE EMBEDMENTS**

- A. Prior to placing concrete with embedded conduits and pipes the contractor shall submit a layout plan drawing that includes the locations, quantity, and size of these items. The layout plan shall be submitted to the Engineer at least 14 days prior to placement for approval.
- B. Conduits, pipes, and sleeves passing through slabs, walls or beams shall not impair significantly the strength of construction. Conduits and pipes shall not be embedded in columns or beams without the approval of the engineer.
- C. Conduits and pipes embedded within slabs and walls shall not be larger in outside dimension than one-third the overall thickness of the slab or wall that they are embedded in.
- D. Conduits and pipes embedded within slabs and walls shall not be spaced closer than 3 diameters on center.
- E. Concrete cover over conduits, pipes and fittings shall not be less than 2 inches.

**3.16 HOUSEKEEPING PADS**

- A. Unreinforced concrete pads shall be installed under all floor-mounted items such as motor control centers, electrical panels, control panels, transformers, and HVAC equipment that do not produce vibration. The pads shall be 4 inches high with chamfered edges and a troweled finish, unless noted otherwise on the drawings.

**3.17 EQUIPMENT PADS**

- A. Reinforced concrete pads shall be installed under all generators, pumps, motors, blowers, drives or other pieces of equipment with internal moving parts that may produce vibration. The pads shall be a minimum of 4 inches high. Refer to standard pad details given on the drawings.



**PART 4 SPECIAL PROVISIONS**

**4.01 ADDITIONAL TESTING**

- A. Preparation and testing of field cured specimens required for cold weather concreting and for form removal requirements shall be furnished by Contractor at no additional cost to Owner.

END OF SECTION

**SECTION 03310  
GROUT**

**PART 1 GENERAL**

**1.01 SCOPE**

- A. This Section includes non-shrink cementitious and epoxy grouts.
- B. Masonry grout and bonding grout are specified in other Sections.
- C. Additional product requirements are specified in Section 01350.

**1.02 SUBMITTALS**

- A. Submittals shall be in accordance with the requirements of Section 01300 and shall include:
  - 1. Shop Drawings for Review:
    - a. Contractor shall indicate variances from requirements of Contract Documents.
    - b. Product literature.
    - c. Material certifications of ASTM standard and grade.
    - d. Laboratory test reports for grout compressive strength tests.
  - 2. Information for the Record:
    - a. Manufacturer's mixing, placing, and curing instructions.

**1.03 PRODUCT HANDLING**

- A. Environmental limitations specified by manufacturer shall be observed. Heated enclosures shall be provided as required.

**PART 2 PRODUCTS**

**2.01 NON-SHRINK GROUT**

- A. Grout shall be prepackaged, nonmetallic, noncorrosive, non-staining cementitious grout. Grout shall remain volume stable in both dry and wet conditions and provide a minimum of 95% effective bearing area.
- B. Grout shall conform to ASTM C1107 Grade C when tested at fluid consistency of 25 seconds or more per ASTM C939 at temperature extremes of 45 degrees F and 90 degrees F and a working time of 30 minutes. Metallic grouts are prohibited.
- C. Non-shrink property shall not be based on any gas generating additives such as aluminum oxide.
- D. Minimum compressive strength:           1 day   3,500 psi

(2-inch cube cured at 70 degrees F)    7-day    5,500 psi  
28-day    7,500 psi

- E. Non-shrink grout shall be Five Star "Fluid Grout 100", Master Builders "Masterflow 928 Grout", or equal.

## 2.02 EPOXY GROUT

- A. Grout shall be non-shrink prepackaged epoxy grout which will achieve a minimum effective bearing area of 95%.
- B. Max unrestrained linear shrinkage:    0.0005 inch per inch (ASTM C531)  
Max coefficient of expansion:    27 x 10<sup>-6</sup> inch/inch/degree F  
Minimum compressive strength:    7-day 11,500 psi  
(2-inch cube cured at 70 degrees F)
- C. Epoxy grout shall be Five Star "HP Epoxy Grout", Master Builders "Masterflow 648", or equal.

## 2.03 MIXING

- A. Grout shall be mixed with mechanical mixers in accordance with manufacturer's written instructions. A mortar mixer with moving blades shall be used to thoroughly blend the potable water into the mix.
- B. Water used to mix non-shrink cementitious grout shall be potable. Water shall be added in just sufficient quantity to obtain desired consistency, but shall not exceed manufacturer's maximum recommendations. Grout shall be used in as stiff a consistency as possible. Grout shall not be re-tempered by addition of water. Grout manufacturer shall be consulted when additional flowability is required.
- C. Materials other than those supplied by grout manufacturer shall not be added to grout.
- D. Cementitious grout shall be mixed close to its placement site, and transportation and placement time shall be limited to less than 15 minutes. Mixed grout temperature shall be held between 45 degrees F and 70 degrees F using ice or hot water as required.
- E. Epoxy Grouts - Ingredients are prepackaged and pre-measured and shall be completely mixed in accordance with the manufacturer's instructions.

## PART 3 EXECUTION

### 3.01 PREPARATION

- A. Concrete to receive grout shall have minimum compressive strength of 3,000 psi. New concrete shall be cured as specified prior to placing grout.
- B. Defective or deteriorated concrete shall be removed. Laitance, grease, oil, and other substances which prevent bond shall be removed. Concrete shall be roughened by

chipping, sand-blasting, or other mechanical means to assure the bond of the grout to the existing concrete.

- C. Oil, grease, and dirt shall be removed from the underside of base plates and bearing plates. Air relief holes shall be provided in base plates to eliminate air entrapment.
- D. Concrete to receive non-shrink cementitious grout shall be saturated with water for 24 hours prior to grout placement. Concrete to receive epoxy grout shall be dry.
- E. Forms shall be constructed of coated wood or steel. Forms shall be constructed and anchored to resist hydraulic head of grout and shall be leak-tight when fluid grouts are used.
- F. Unless otherwise specified, non-shrink, cementitious grout shall be used under column and equipment bases. Equipment such as stamping machines, compressors, crushers, etc., involving high impact or vibration, and applications requiring chemical resistance, shall use non-shrink epoxy grouts.
- G. When placing more than 5.0 cubic feet of epoxy grout, contact the manufacturer for recommendations.

### **3.02 PLACING**

- A. Grout shall be placed in accordance with manufacturer's instructions.
- B. Grout shall be placed from only one side of form to avoid air entrapment. Grout shall be placed in a continuous operation to avoid cold joints under base plates. Spaces and cavities below top of baseplate shall be completely filled without voids or air pockets.
- C. Grout shall be rodded or vibrated to remove entrapped air.
- D. Grout exposed to view shall be finished smooth after initial set.
- E. Unless otherwise shown, cementitious grouts shall be placed in minimum 1 inch thickness and epoxy grouts shall be placed in minimum 2-inch thickness. Manufacturer's recommendations for minimum thicknesses required for specific situations shall override these specified minimum values.
- F. If the grout extends up the side of a baseplate, it must be cut back to the lower level of the baseplate to avoid cracking of the grout due to possible movement of the baseplate caused by temperature changes, vibrations, etc.

### **3.03 CURING**

- A. Grout shall be cured and protected in accordance with manufacturer's instructions.
- B. Non-shrink cementitious grout shall be wet cured for minimum of 7 days.

### **PART 4 SPECIAL PROVISIONS**

Not used.

END OF SECTION

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**SECTION 03400  
STRUCTURAL PRECAST CONCRETE**

**PART 1 GENERAL**

**1.01 SCOPE**

- A. Section includes furnishing and installing factory precast/prestressed structural concrete including hollow core slab units.
- B. Additional product requirements are specified in Section 01350.

**1.02 PERFORMANCE REQUIREMENTS**

- A. Structural members shall be designed to support attached or supported material, equipment loads, snow, and superimposed dead and live loads shown or specified.
- B. Superimposed Uniform Design Loads Shall be:
  - 1. Roof: Dead load: 10 psf  
Snow load: 22 psf + Drift loads

**1.03 SUBMITTALS**

- A. Submittals shall be in accordance with the requirements of Section 01300 and shall include:
  - 1. Shop Drawings for Review:
    - a. Shop Drawings shall indicate:
      - 1) Location of each member in plan.
      - 2) Cross sectional dimensions.
      - 3) Size and location of reinforcement.
      - 4) Minimum bearing length.
      - 5) Details of connections, and embedded items.
      - 6) Description of materials and hardware.
      - 7) Size and location of openings.
      - 8) Design loads and location of concentrated loads.
      - 9) Manufacturer's literature.
    - b. Shop Drawings shall bear seal of professional engineer responsible for the structural design.
  - 2. Information for the Record:
    - a. Material certifications.
    - b. Precast manufacturing plant certification.

- c. Design Mix for each concrete mix to be used in the manufacture of the precast/pre-stressed units.
- d. Design certification. This document shall include all pertinent design values and shall bear the seal and signature of the professional engineer responsible for the structural design of the units as installed.

#### **1.04 QUALITY ASSURANCE**

- A. Manufacturer - Precast concrete manufacturing plant shall be certified by Prestressed/Precast Concrete Institute, Plant Certification Program.
- B. Precast concrete elements shall be designed, manufactured, and erected in accordance with following standards:
  - 1. "Manual for Quality Control for Plants and Production of Precast and Prestressed Concrete Products (MNL-116)," Precast/Prestressed Concrete Institute.
  - 2. "PCI Design Handbook - Precast and Prestressed Concrete" - Precast/Prestressed Concrete Institute.
  - 3. "Building Code Requirements for Structural Concrete (ACI 318) and Commentary (ACI 318R)," American Concrete Institute.
  - 4. "Structural Welding Code," American Welding Society.
  - 5. "Specifications for Structural Concrete for Buildings (ACI-301)" American Concrete Institute.
  - 6. "ITG-7 Specification for Tolerances of Precast Concrete", American Concrete Institute.
- C. Design shall be performed by a professional engineer registered in state of the projects location. Professional engineer shall be experienced in precast/prestressed concrete design.
- D. Welders shall be qualified by tests as prescribed in AWS Structural Welding Code.
- E. When fire-resistance rated assemblies are indicated, provide structural precast units whose calculated fire resistance has been determined according to ASTM E119 and PCI MNL-124 "Design for Fire Resistance of Precast/Prestressed Concrete" and is acceptable to authorities having jurisdiction.

#### **1.05 DELIVERY, STORAGE, AND HANDLING**

- A. Members shall be handled and stored in accordance with manufacturer's instructions.
- B. Members shall be stored off the ground. Stacked members shall be separated by battens across full-width of each bearing point.
- C. Members shall be lifted with suitable lifting devices at points provided by manufacturer.

## **PART 2 PRODUCTS**

### **2.01 MATERIALS**

- A. Cement - ASTM C150, Type I, II or III.
- B. Aggregates - ASTM C33, (Normal Weight) Class 5S.
- C. Admixtures - All admixtures to be used shall be chloride ion-free and a certification of compliance signed by the manufacturer of the admixture shall be submitted.
  - 1. Air Entraining - ASTM C260.
  - 2. Water Reducing - ASTM C494, Type A.
- D. Fly Ash - ASTM C618, Class F.
- E. Water shall conform to ASTM C94. Mixing water, including that contributed by aggregates and admixtures, shall not contain deleterious concentration of chloride ion.
- F. Reinforcement:
  - 1. Bar reinforcement shall be grade 60 deformed bars conforming to ASTM A615 or ASTM A616 including supplementary requirement S1.
  - 2. Welded Wire Fabric - ASTM A185.
  - 3. Strand shall be uncoated, 7-wire, stress relieved strand conforming to ASTM A416 including supplement with tensile strength of 250 or 270 ksi.
- G. Anchors and Inserts:
  - 1. Structural Steel (Structural shapes and plates) - ASTM A36, shop primed.
  - 2. Stainless Steel - ASTM A666 Type 304.
- H. High strength bolts and nuts - ASTM A325, Type I, heavy hex steel structural bolts heavy hex carbon-steel nuts, and hardened carbon steel washers.

### **2.02 BEARING PADS**

- A. Plastic - Multipolymer plastic strip with minimum thickness of 1/8 inch.
- B. Fiber Reinforced - Random oriented fiber reinforced pad. Pad shall support compressive stress of 3000 psi with no cracking, splitting, or delaminating in internal portion of pad. One specimen shall be tested for each 200 pads used.
- C. Bearing pads shall have a minimum width of 2 inches when bearing on concrete or steel, and 3 inches when bearing on masonry. The pad shall be set back a half inch from bearing support edge when not bearing on steel.

### **2.03 MIXES**

- A. Concrete:



1. 28-day Compressive Strength – 5,000 psi minimum with maximum water cement ratio 0.45 at point of placement.
  2. Release Strength – 3,500 psi minimum.
  3. Use water-reducing admixtures according to manufacturer's directions.
  4. Concrete which will be subject to freezing and thawing in moist condition shall be air entrained for severe exposure.
- B. Cement grout shall be mixture of one-part cement (ASTM C150 Type I), three parts sand (clean natural sand per ASTM C33) and just sufficient water for placement and hydration.

#### **2.04 FABRICATION**

- A. Fabrication procedures and tolerances shall be in conformance with PCI MNL-116.
- B. Concrete shall be thoroughly consolidated to remove air bubbles and to eliminate imperfections. Major or unsightly imperfections, honeycomb, and other defects will not be permitted.
- C. Concrete cover over reinforcement shall be 2 inches for members used in sewage retaining structures.
- D. Finishes:
1. Underside - Finish resulting from casting against smooth, clean forms.
  2. Top - Finish resulting from vibrating screed with additional hand finishing at projections. Where concrete topping is indicated, top surface shall be intentionally roughened to increase bond.
  3. Vertical Ends - Strands shall be recessed and ends of member shall receive sacked finish.
- E. Identify pickup points of precast concrete units and orientation in structure with permanent markings, complying with markings indicated on Shop Drawings. Imprint casting date on each precast unit on a surface that will not show in the finished structure.
- F. Openings shall be included in the design of the structural precast whether installed at the manufacturers' facility or in the field. Openings, whether factory installed or field cut shall be certified by the manufacturers' design engineer as part of the design certification Shop Drawing.
1. Openings larger than 8 inches in least dimension shall be provided by precast manufacturer as a part of fabrication, prior to shipment to the Site. Such openings shall be cast, saw cut, cored, or otherwise made to prevent rough or uneven edges.
  2. Smaller openings may be field cut in a manner so as not to affect structural integrity of member and to result in smooth and even edges.
- G. Structural inserts, anchors, and plates shall be cast-in as shown on Drawings.

- H. Minor patching will be permitted providing structural integrity of product and appearance are not impaired. Determination of patching versus replacement shall be determined by the Owner and Engineer.
- I. Provide UL Fire Resistance Classification Marking for fire rating in hours.

#### **2.05 HOLLOW-CORE SLAB UNITS**

- A. Type - Precast, prestressed concrete units with open, hollow cores running the full length of the slab units.
- B. Furnish units free of voids or honeycombs.
- C. Provide standard finish to precast units.
- D. Reinforce units to resist transportation and erection stresses.
- E. Include cast-in weld plates where required.
- F. Coordinate with other trades for installation of cast-in items.
- G. Provide headers of cast-in-place concrete or structural steel shapes for openings larger than one slab width according to hollow-core slab unit fabricator's recommendations.

#### **2.06 SOURCE QUALITY CONTROL**

- A. When precast members are manufactured in established casting yards, the manufacturer shall be responsible for the continuous monitoring of the quality of all materials and concrete strengths. Tests shall be performed in accordance with appropriate ASTM methods. The Engineer should be allowed to observe all sampling and testing and the results of all tests shall be made available to the Engineer.
- B. The Owner or Contractor may employ an independent testing agency to evaluate precast fabricator's quality control and testing methods.
  - 1. Allow the testing agency access to material storage areas, concrete production equipment, concrete placement, and curing facilities. Cooperate with Owner's testing agency and provide samples of materials and concrete mixes as may be requested for additional testing and evaluation.
- C. Quality-Control Testing - Test and inspect precast concrete according to PCI MNL-116 requirements.
- D. Precast concrete units will be considered deficient when precast concrete units exhibit any of the following deficiencies.
  - 1. Failure of concrete to meet compressive-strength test requirements.
  - 2. Reinforcement, and pre-tensioning and detensioning tendons of prestressed concrete do not conform to fabrication requirements.
  - 3. Insufficient concrete curing and/or protection of precast units against extremes in temperature.

4. Precast units are damaged during handling and erecting.
- E. Testing - When there is evidence that the strength of precast concrete units may be deficient or may not meet requirements, the Contractor shall employ an independent test agency to obtain, prepare, and test cores drilled from hardened concrete to determine compressive strength according to ASTM C42.
1. A minimum of three representative cores shall be taken from precast concrete units of suspect strength, from locations directed by the Engineer.
  2. Cores shall be tested, following immersion in water, in a wet condition per ACI 301 when precast concrete units will be wet under service conditions.
  3. Cores shall be tested in an air-dry condition per ACI 301 when precast concrete units will be dry under service conditions.
  4. Strength of concrete for each series of three cores will be considered satisfactory if the average compressive strength is at least equal to the 28-day design compressive strength.
  5. Test results shall be reported in writing on the same day that tests are made, with copies to Owner, Engineer, Contractor, and precast fabricator. Test reports shall include the Project identification name and number, date, name of precast concrete fabricator, name of concrete testing agency; identification letter, name, and type of precast concrete unit or units represented by core tests; design compressive strength, compressive strength at break and type of break, corrected for length-diameter ratio, and direction of applied load to core with respect to horizontal plane of concrete as placed.
- F. Patching - Where core test results are satisfactory and precast concrete units meet requirements, solidly fill core holes with patching mortar and finish to match adjacent concrete surfaces.
- G. Dimensional Tolerances - Units having dimensions smaller or greater than required and not meeting tolerance limits may be subject to additional testing.
1. Precast units having dimensions greater than required will be rejected if the appearance or function of the structure is adversely affected or if larger dimensions interfere with other construction. Repair or remove and replace rejected units, as required, to meet construction conditions.
- H. Defective Work - Precast concrete units that do not conform to requirements, including strength, manufacturing tolerances, and finishes, are unacceptable. Replace with precast concrete units that meet requirements.

## **2.07 FABRICATOR APPROVAL**

- A. The fabricator of structural load bearing members and assemblies furnished under this Section, shall be registered and approved to fabricate these products without special inspections per the requirements of the current Building Code Section 1704. The approved fabricator shall submit evidence of such registration at the time that Shop

Drawings are submitted. At the completion of production, the approved fabricator shall submit a certificate of compliance to the local building code official stating that the fabrication was performed in accordance with the Contract Documents and the approved Shop Drawings.

### **PART 3 EXECUTION**

#### **3.01 ERECTION**

- A. Members shall be erected in accordance with manufacturer's recommendations.
- B. Hollow core plank shall bear on plastic bearing strips. Bearing length shall be in accordance with manufacturer's instructions.
- C. Members shall be aligned and leveled as shown. Variations between adjacent members shall be leveled out by jacking, banding, loading, or other method recommended by manufacturer. Cutting or otherwise modifying precast member is prohibited.
- D. Debris shall be removed from grout keys and keys shall be completely filled after members are aligned and leveled. Excess grout shall be removed.
- E. Exposed cores of hollow core plank shall be dammed and grouted. Cores shall be dammed and grouted in other locations when shown.
- F. When shown, metal hangers shall be placed in joints between adjacent members as members are installed. Hangers shall be recessed into members so that joint width is not increased by hanger.

#### **3.02 FIELD WELDING**

- A. Field welding of connections shall be performed where shown. Welded connections shall not be made until members are aligned and leveled.
- B. Weld materials shall be compatible with base material.

#### **3.03 CAULKING**

- A. Joints in members which serve as finished ceiling shall be sealed in accordance with Section 07900. Sealant shall be tooled to slightly concave surface. Sealant shall match finish ceiling color, if required by Engineer.

### **PART 4 SPECIAL PROVISIONS**

Not used.

END OF SECTION

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**SECTION 04200  
UNIT MASONRY**

**PART 1 GENERAL**

**1.01 SCOPE**

- A. This Section includes furnishing, all labor, materials, equipment, and appliances required to complete the masonry work, including the following:
  - 1. Furnishing and placing masonry units, grout, mortar, masonry lintels, sills, copings, through-wall flashing, and connectors.
  - 2. Furnishing and setting of the steel reinforcement as indicated on the Drawings and as herein specified or necessary.
  - 3. Furnishing, erecting, and maintaining bracing, forming, scaffolding, rigging, and shoring.
  - 4. Furnishing and installing other equipment for constructing masonry.
  - 5. Cleaning masonry and removing surplus material and waste.
  - 6. Installing steel lintels, nailing blocks, all bolts, anchors, inserts, window and door frames, connectors, and construction items to be built into the masonry, and building in vent pipes, conduits, and other items furnished and located by other trades.
  - 7. The removal and repair of sections of the masonry for inspection as directed by the Engineer.
- B. Products Furnished but not Installed in this Section:
  - 1. Dovetail anchor slots shall be installed under Section 03100.
- C. Products installed but not furnished under this Section include the following:
  - 1. Steel lintels for unit masonry specified in Section 05500.
  - 2. Frames for masonry openings specified in Division 8.
- D. Laboratory services shall be furnished in accordance with requirements of Section 01410.

**1.02 SUBMITTALS**

- A. Submittals shall be in accordance with the requirements of Section 01300 and shall include:
  - 1. Shop Drawings for Review:
    - a. Reinforcement placing drawings. The drawings shall show the location of reinforcement in plan, elevation, and section views, and include bending schedules.

- b. Product literature for joint reinforcement, anchors and ties, premolded joint fillers, and accessory materials.
  - c. Mortar and grout mix proportions.
  - d. Manufacturer's color selection kit for each type of masonry and mortar.
  - e. Samples of each type of facing brick and architectural concrete masonry units showing range of colors, textures, finishes and dimensions.
  - f. Six-inch-long sample of each premolded joint material.
  - g. Product Certifications - Results of tests of mortar, grout mixes, and masonry units attesting compliance with applicable ASTM Standards.
  - h. Certification of compliance for each type and size of anchors, ties, metal accessories, and reinforcement to be used in construction, demonstrating compliance with applicable ASTM Standards.
  - i. Show locations of the wall expansion joints with the corresponding vertical reinforcement.
2. Information for the Record:
    - a. Manufacturer's installation instructions.
    - b. Results of tests on components of mortar, grout, and masonry units to provide evidence that they conform to applicable ASTM specification requirements.

### 1.03 QUALITY

- A. Preconstruction Verifications - The Contractor shall submit the following information prior to the start of construction. The Contractor shall pay for independent laboratory services if required to obtain the following information. Current tests and certificates issued by the manufacturer will be accepted in lieu of laboratory test results.
  1. Test indicating that clay masonry units conform to ASTM C62, ASTM C216 or ASTM C652 and that concrete masonry units conform to ASTM C55 or ASTM C90. Manufacturer's certificates stating that the supplied units conform to these tests will be accepted.
  2. Grout mix designs indicating type and proportions of materials conforming to the proportion specification of ASTM C476, Table 1. Grout mix component material certificates stating conformance with applicable materials listed in ASTM C476.
  3. Mortar mix designs indicating type and proportions of materials conforming to the proportion specification of ASTM C270, Table 1. Mortar mix component material certificates stating conformance with allowable materials listed the Mortar specification section herein.

- B. Sample Panel:
  - 1. Mock-up panels of each type of masonry wall using proposed materials and procedures shall be constructed. Minimum panel size shall be 4 feet by 4 feet.
  - 2. The accepted panels shall establish the acceptance standard for the Work.
  - 3. Unless directed otherwise, panels shall be constructed separate from the Work and shall be retained at the job site until masonry work has been accepted.
- C. Fire-Resistance Ratings - Provide materials and construction identical to those of assemblies with fire resistance ratings determined per ASTM E119 by a testing and inspecting agency, by equivalent concrete masonry thickness, or by another means, as acceptable to authorities having jurisdiction.
  - 1. All concrete masonry unit walls shall have a minimum two-hour fire rating.
- D. Single-Source Responsibility for Masonry Units - Obtain exposed masonry units of a uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, from one source and by a single manufacturer for each different product required.
- E. Single-Source Responsibility for Mortar Materials - Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from one manufacturer for each cementitious component and from one source or producer for each aggregate.
- F. Masonry construction and materials shall conform to all requirements of the following codes and standards:
  - 1. "Building Code Requirements for Masonry Structures" (ACI 530/ASCE 5/TMS 402), American Concrete Institute, American Society of Civil Engineers, The Masonry Society.
  - 2. "Details and Detailing of Concrete Reinforcement" (ACI 315), American Concrete Institute.
  - 3. "Michigan Building Code".

**1.04 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver masonry units to job site in undamaged condition. Deliver and handle units to prevent chipping, breaking, or other damage.
- B. Store masonry units on elevated platforms, under cover, and in a dry location to prevent their deterioration or damage due to moisture, temperature changes, contaminants, and other causes. If units become wet, do not install until they are in an air-dried condition.
- C. Store cementitious materials on elevated platforms, under cover, and in a dry location.
- D. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.



- E. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil. Protect from bending and other damage.

## **PART 2 PRODUCTS**

### **2.01 MASONRY UNITS**

- A. Units shall be sized as shown or specified. Provide or cut special shapes for corners, jambs, lintels, or other areas as required. Special units shall match color and texture of standard units. Units shall be sound, dry, clean, free of cracks, and shall have reached the specified moisture content and compressive strength prior to placing in the structure.
- B. Facing Brick shall conform to ASTM C652 or ASTM C216, Grade SW (severe weathering), Type FBS (standard). Nominal dimensions shall be 4-inch thick by 8-inch long. Coordinating height shall be 3 courses to 8-inch used for exposed areas where appearance is an important design criteria. Color and texture shall be the same as approved wall sample constructed at the job site. Color and texture of the units are to be approved by the Owner.
- C. Common Brick (not intended as facing units) shall conform to ASTM C62, Grade SW (severe weathering), Type FBS. Nominal dimensions shall be 4-inch thick by 8-inch long. Coordinating height shall be 3 courses to 8-inch. The color shall be terra cotta red unless otherwise specified and approved.
- D. Utility Brick shall conform to ASTM C216, Grade SW, Type FBS. Nominal dimensions shall be 4-inch thick by 12-inch long by 4-inch high.
- E. Structural Glazed Facing Tile (SGFT) shall conform to ASTM C126, Grade SS (select sized), Type I (single faced), 6T or 8W series and shall be of load-bearing quality. Thickness shall be as shown. Color will be selected by Owner from manufacturer's standards. For exposed exterior applications, the tile body shall also meet the durability requirements per ASTM C652, Grade SW hollow brick units. Exterior applications shall be limited to vertical cell tiles, since horizontal cells can trap moisture in the wall. Tiles shall be supplied by The Thomas Brick Company, or approved equal.
- F. Acoustical Structural Glazed Facing Tile shall conform to ASTM C126, Grade SS, Type I, 6T (5-1/3 by 12) Series or 8W (8 by 16) series. Thickness shall be as shown. Color will be selected by Owner from manufacturer's standards. Units shall have random face perforations and shall be furnished with Vermin-resistant, chemically-inert, moisture-proof, fiberglass pads, factory-inserted in cores. Tiles shall have a minimum sound absorption coefficient of 0.192 at a frequency of 125 C.P.S. The manufacturer shall be The Thomas Brick Company, or approved equal.
- G. Concrete Masonry Unit (CMU) shall conform to ASTM C90, Type I. Nominal dimensions of standard unit shall be 8-inch high by 16-inch long. Thickness shall be as shown. Unless otherwise specified, units shall be normal weight. When CMU units are used for exterior walls add the following:

1. Units shall contain integral polymer water repellent admixture. Admixture shall be W. R. Grace "Dry-Block Water Repellent Admixture", Euclid Chemical Company "Eucon Blocktite" or equal. Admixture shall be used in accordance with manufacturer's instructions.
  2. Where required in Part 4, units shall be integrally colored with mineral oxide pigments. Color will be selected by Owner from manufacturer's standards.
- H. Architectural Concrete Masonry Unit (AMU) shall conform to ASTM C90, Type I, normal weight. Nominal dimensions of standard unit shall be 8-inch high by 16-inch long. Thickness shall be as shown.
1. Unit shall be split-faced type.
  2. Units shall contain integral polymer water repellent admixture. Admixture shall be W. R. Grace "Dry-Block Water Repellent Admixture", or equal. Admixture shall be used in accordance with manufacturer's instructions.
  3. Where required in Part 4, units shall be integrally colored with mineral oxide pigments. Color will be selected by Owner from manufacturer's standards.
- I. Glazed Concrete Masonry Unit shall conform to ASTM C744 and ASTM C90, Type I, normal weight. Nominal dimensions of standard unit shall be 8-inch high by 16-inch long. Thickness shall be as shown. Color will be selected by Owner from manufacturer's standards. Glazing shall be "Spectra Glaze II" as licensed by The Burns & Russell Company, or equal.
- J. Acoustical Concrete Masonry Unit shall conform to ASTM C90, Type I, normal weight. Nominal dimensions of standard unit shall be 8-inch high by 16-inch long. Thickness shall be as shown.
1. 8-inch and 12-inch Thick Units - Unit shall have flared slots, and sequential cavities with metal septa laminated to back of incombustible fibrous filler in each cavity. Units shall be "Soundblox Type RSC" as licensed by The Proudfoot Co., Inc., or equal.
  2. 4-inch and 6-inch Thick Units - Units shall have flared slots with metal septa laminated to back of incombustible fibrous filler in each cavity. Units shall be "Soundblox Type Q" for noise frequencies up to 250 cfs, as licensed by The Proudfoot Co., Inc., or equal.
- K. Glazed Acoustical Concrete Masonry Unit shall conform to ASTM C744 and ASTM C90, Type I, normal weight. Nominal dimensions of standard unit shall be 8-inch high by 16-inch long. Thickness shall be as shown. Color will be selected by Owner from manufacturer's standards.
1. 8-inch and 12-inch Thick Units - Unit shall have flared slots, and sequential cavities with metal septa laminated to back of incombustible fibrous filler in each cavity. Units shall be "Soundblox Type RSC" as licensed by The Proudfoot Co., Inc., or equal.

2. 4-inch and 6-inch Thick Units - Units shall have flared slots with metal septa laminated to back of incombustible fibrous filler in each cavity. Units shall be "Soundblox Type Q" for noise frequencies up to 250 cfs, as licensed by The Proudfoot Co., Inc., or equal.
3. Glazing shall be "Spectra Glaze II" as licensed by The Burns & Russell Company, or equal.
- L. Concrete Brick shall conform to ASTM C55, Type I, Grade N. Units shall be of normal weight unless otherwise specified.
- M. Precast Concrete Lintels shall have appearance similar to masonry units in wall surrounding lintel. Lintel shall be constructed as shown and shall be marked for proper location and orientation.

## 2.02 MORTAR

- A. Mortar mix shall conform to ASTM C270, Type S, proportion specification. Required Applicable specifications for mortar material components are: Masonry Cement (ASTM C-91), Mortar Cement (ASTM C1329), portland cement (ASTM C150, Type I), hydrated lime (ASTM C207, Type S) and sand (ASTM C144).
- B. Mortar for exterior masonry units shall contain integral polymer water repellent admixture. Admixture shall be W.R. Grace "Dry-Block Mortar Admixture", "Dry-Brick Mortar Admixture", or equal.
- C. Calcium chloride and other admixtures containing chloride ion are prohibited.
- D. Mortar shall be used as soon as possible after mixing. Mortar which has begun to stiffen or is not used within two hours after initial mixing shall be discarded. Mortar that cannot regain original plasticity after single retempering shall be discarded.

## 2.03 GROUT

- A. Grout mix components and mixing procedures shall conform to ASTM C476. Admixtures shall not be used without written permission of Engineer.
- B. Grout shall be proportioned in accordance with ASTM C476, Table 1. The grout shall be mixed to a slump of between 8 and 12 inches. Aggregate for grout shall conform to ASTM C404.

## 2.04 MASONRY STRENGTH

- A. Net area compressive strength (f'm) of concrete and brick masonry at 28 days, in each wythe and grouted collar joint, shall be not less than 1,500 psi.
- B. Net area compressive strength of clay masonry units shall not be less than 3,350 psi.
- C. Net area compressive strength of concrete masonry units shall not be less than 1,900 psi.

## 2.05 BAR REINFORCEMENT

- A. Reinforcement shall be grade 60 deformed bars conforming to ASTM A615.
- B. Reinforcement to be welded shall be grade 60 and conform to ASTM A706.
- C. Bars shall be fabricated in conformance with CRSI Manual of Standard Practice.
- D. Reinforcement shall be cold bent, where bending is specifically shown, but shall not be bent or straightened in injurious manner.

## 2.06 JOINT REINFORCEMENT

- A. Joint reinforcement shall be manufactured with wire conforming to ASTM A82, size number W1.7 (9 gauge) for both longitudinal and cross wires. Longitudinal wires shall be deformed in conformance with requirements of ACI 530.1/ASCE 6/TMS 602.
- B. Joint reinforcement shall be fabricated in truss or ladder configurations.
  - 1. Ladder type reinforcement shall have three longitudinal wires weld-connected to perpendicular cross rods to form a ladder design. Two wires shall reinforce back-up wythe and third wire shall act as tie and reinforcement for facing wythe. Cross wires shall be spaced at 15-inch centers and shall not have moisture drip. Hohmann & Barnard, Inc. "230 Ladder-Tri-Mesh or 220 Ladder-Mesh", Blok-Lok "BL-11 Ladder Reinforcement", Wire-Bond "Series 200 Ladder Mesh (3 Wire System)", or equal.
  - 2. Truss-type reinforcement shall have two longitudinal deformed wires welded to a continuous diagonally oriented cross wire which forms a truss design. Cross wire intersections shall be located at 16-inch maximum centers., Hohmann & Barnard, Inc. "120 Truss-Mesh", Blok-Lok "BL-30 Truss Reinforcement", Wire-Bond "Series 300 Truss Mesh", or equal.
- C. Corners and intersections shall be factory fabricated.
- D. Joint reinforcement shall be hot dip galvanized in accordance with ASTM A153, Class B-1 or B-2.
- E. Plate, header, and bent bar anchors shall conform to ASTM A36.
- F. Sheet metal anchors and ties shall conform to ASTM A1008.
- G. Wire ties and anchors shall conform to ASTM A82.

## 2.07 PREMOLDED JOINT MATERIAL

- A. Expansion Joint Filler for Face Brick - Highly compressible extrusion of four connected rubber tubes. Material shall conform to ASTM D1056, Grade 2A1 or 2B1. Williams Products, Inc. "Everlastic 1056 Joint Filler", Hohmann & Barnard "NS - Closed Cell Neoprene Sponge" or equal.
- B. Shear Keys - Designated to provide lateral stability to masonry walls at expansion and control joints: Rubber conforming to ASTM D2000, 2AA-805 with minimum durometer

hardness of 80, or PVC conforming to ASTM D2287, Type PVC 654-4 with minimum durometer hardness of 85. Hohmann & Barnard "RS Series – Rubber Control Joints" or equal.

- C. Control Joint Compressible Filler for Concrete Masonry - Expanded neoprene conforming to ASTM D1056 Grade 2A1. Thickness shall be as shown. Williams Products, Inc. "Williams Neoprene Everlastic NN-1 1040 Series", or equal.
- D. Isolation Gasket - Expanded PVC conforming to ASTM D1056 Grade 2A1 and ASTM D1667, Grade VE41. Williams Products, Inc. "Everlastic Vinyl Type U 1000 Series", or equal.

## 2.08 ANCHORS AND TIES

- A. Dovetail Anchors:
  - 1. Dovetail anchor slot shall be minimum 20-gauge hot dip-galvanized steel. Hohmann & Barnard "No. 305 - Dovetail Slot," or equal.
  - 2. Anchor shall be 1 1/4-inch wide by 12-gauge hot dip galvanized sheet metal fabricated to fit in dovetail slots. Anchor shall be notched to receive 9 gage veneer reinforcement wire. Hohmann & Barnard No. 303 SV, or equal.
- B. Weld on Ties - Anchor shall be 1/4-inch wire or 14 gauge sheet metal designed to weld to steel frame, with adjustable 3/16 wire tie. Anchor shall be mill galvanized and tie shall be hot dip galvanized. Hohmann & Barnard, Inc. "359 Weld-On Tie" or "359-FH Weld-On Tie" with "VBT Vee Byna Tie" or "301W Column Web Tie," or equal.
- C. Corrugated Wall Ties - 7/8-inch wide by 22-gauge, hot dip galvanized steel. Hohmann & Barnard "CWT-Corrugated Wall Tie," or equal.
- D. Corrugated Wall Ties - 7/8-inch wide by 22-gauge, mill-galvanized steel. Hohmann & Barnard "CWT-Corrugated Wall Tie," or equal.
- E. Rigid Straps - 1-1/2-inch-wide by 1/4-inch thick by 2 feet-0-inch-long, ASTM A36 steel bar formed in Z shape with 2-inch legs. Hohmann & Barnard, Inc., "No. 344 - Rigid Partition Anchor", or equal.

## 2.09 ACCESSORIES

- A. Weepholes shall be 3/8-inch OD by 4-inch long medium density polyethylene, white or clear in color, with two cotton wicks per weephole. Hohmann & Barnard, Inc. Model No. 341, or equal.
- B. Brickvent - Injection molded PVC vent. Williams Products, Inc. "Williams Goodco Brick Vent". Hohmann & Barnard "343 Louvered Weep Holes", or equal.
- C. Hardware cloth shall be corrosion proof, biologically inert, and shall not reduce bond in mortar joint. Hohmann & Barnard "MGS-Mortar/Grout Screen" or equal.
- D. Pan-wall flashing for single wythe exterior walls (AMU & CMU), 8 inches and larger, shall be "Blok-Flash" or equal, a one-piece, embeddable, high-density polyethylene molded

flashing pan with perimeter flanges and a concaved weep spout extending out from the base pan as manufactured by "Mortar Net" or equal. Flashing pan units shall be installed with bridge units, bug guards, and mesh mortar net mattes per manufacturer's instructions.

- E. Through-wall flashing for double wythe exterior walls shall be a two-piece system consisting of a stainless-steel drip-edge flashing and a fully adhered flexible concealed flashing. The drip-edge flashing shall have a minimum 1/2-inch lip and shall be the nominal width of the exterior wythe, not including the drip edge. The drip edge shall be 26-gauge, Type 304, stainless steel. Fully adhered flexible concealed flashing shall be Hohmann & Barnard "Textroflash Flashing", or equal.
- F. Insulation retainer shall be Blok-Lok "Wedge-Lok", CTP "Insulation Retainer Plate", or equal.
- G. Mortar dropping control device shall be used in all cavity wall construction. Mortar dropping control device shall be manufactured from an inert open weave plastic mesh, MortarNet Solutions "Mortar Net, Hohmann & Barnard, Inc. "Mortar Trap", or equal.

#### **2.10 MASONRY CLEANERS**

- A. Solution of 2 cup dry measure tetrasodium polyphosphate and two cup dry measure laundry detergent dissolved in one gallon of water.

### **PART 3 EXECUTION**

#### **3.01 COORDINATION**

- A. Cold weather construction requirements apply when ambient temperature is below 40 degrees F or temperature of masonry units is below 40 degrees F.
- B. Hot weather construction requirements apply when ambient air temperature exceeds 100 degrees F, or ambient temperature exceeds 90 degrees F and wind velocity exceeds 8 mph.
- C. Prior to beginning masonry work, Contractor shall inspect and verify that foundations are constructed within specified tolerances. Contractor shall notify the Engineer when such inspections are scheduled.
- D. Contractor shall notify Engineer when foundations are not suitable for masonry construction.
- E. The Contractor shall attend to walling-inch at their proper position all steel beams, steel columns, bar joists, lintels, openings, window and door frames, anchors, anchor bolts, cutout boxes, electric conduits, downspouts, pipe sleeves, and all similar Work, and shall form all flues, ventilating shafts, leader shafts, recesses, and openings in the walls for the complete performance of the other Work of the Contract.



Interior masonry shall be laid to minimize the need for units of less than half a unit at masonry openings. Any adjustments in location of vertical joints shall be made at inside corners.

- E. Opening frames and hollow metal door frames shall be installed square and plumb and without distortions. Frames shall be rigidly anchored to masonry. Space between masonry and steel frames shall be filled with mortar as units are laid.
- F. All aluminum materials inserted in masonry shall have the contact surface coated with mastic or coal tar paint.
- G. When new masonry is specified to match existing, this is to mean color, texture, size, grade, and type specifications. Laying new units to match existing includes laying units in running bond, window sills, soldier courses, and other feature courses as required.
- H. Cut masonry units with motor-driven saws to provide clean, sharp, unchipped edges. Cut units as required to provide continuous pattern and to fit adjoining construction. Use full-size units without cutting, where possible. Allow units cut with water-cooled saws to dry before placing, unless wetting of units is required. Install cut units with cut surfaces and edges concealed where possible.
- I. Mix units for exposed unit masonry from several pallets or cubes as they are placed to produce uniform blend of colors and textures.

### 3.04 LAYING UNITS

- A. Placing Units:
  - 1. Build cavity and composite walls and other masonry construction to the full thickness shown on the Drawings. Build single-wythe walls to the actual thickness of the masonry units, using units of thickness shown on the Drawings.
  - 2. Units shall be laid in a full bed of mortar.
  - 3. Unless shown otherwise, construct masonry in 1/2 running bond. (Vertical joints in each course centered on units in courses above and below).
  - 4. Courses shall be carried up level with no section of wall extended more than three feet above an adjacent section. When specifically permitted or required, in certain locations, courses shall be stepped as directed.
  - 5. Place units such that exposed faces or edges of masonry are unaltered manufactured surfaces. Cores, cells, and frogs shall not be exposed to view.
  - 6. Units shall be placed while mortar is soft and plastic. Units disturbed to extent that initial bond is broken after initial positioning, shall be removed and relaid in fresh mortar.
  - 7. Contaminated or damaged units shall not be used.



8. Fill cores in hollow concrete masonry units under bearing plates, beams, lintels, posts, and similar items. Unless shown otherwise, grout shall extend a minimum 24-inch deep and 24-inch on each side of the bearing plates.
  9. Build non-load-bearing interior partition walls full height of story, unless shown otherwise, to underside of solid floor or roof structure above and install compressible filler in joints between top of wall and underside of structure.
- B. Bed and Head Joints:
1. Unless specified otherwise bed and head joints shall be 3/8-inch thick except at foundation. Bed joint of starting course shall be not less than 1/4-inch and not more than 3/4-inch thick.
  2. Structural glazed facing tile shall be constructed with 1/4-inch bed and head joints.
  3. Line pin holes shall be filled.
  4. Joints shall be tooled with round jointer when mortar is thumbprint hard.
  5. Mortar protrusions extending 1/2-inch or more into cavity of cavity wall construction or into cells or cavities to be grouted shall be removed.
- C. Collar joints less than 3/4-inch wide shall be filled with mortar as Work progresses.
- D. Hollow Units:
1. Face shells of bed joints shall be fully mortared.
  2. Webs shall be fully mortared in piers, columns, and pilasters. Webs shall be fully mortared in starting course on foundation and where adjacent cells or cavities are to be grouted.
  3. Head joints shall be mortared minimum distance from each face equal to face shell thickness.
  4. Vertical cells shall be aligned.
  5. Maintain joint width of 3/8-inch, except for minor variations required to maintain bond alignment.
- E. Solid Units:
1. Bed and head joints shall be solidly filled. Bed joints shall not be furrowed.
  2. Head joints shall not be filled by slushing with mortar.
  3. Head joints shall be constructed by shoving mortar tight against adjoining unit. Closure units shall be rocked into place pushing mortar against adjacent units.
- F. In glazed tile walls, all outside corners, joints, and lintels shall be square unless noted otherwise on the Drawings. Sills shall be bullnosed. Glazed tile walls shall be provided with a structural glazed tile coved wall base unless noted otherwise on the Drawings.

### 3.05 EMBEDDED ITEMS

- A. Embedded items and accessories shall be installed and secured as units are laid. Embedded items shall be installed as shown.
- B. Chases shall be constructed as units are laid.
- C. Pipes and conduits passing through masonry shall be installed in sleeves as shown. Embedded aluminum conduits, pipes, and accessories shall be heavily coated with mastic or coal tar paint.
- D. Pan-Wall Flashing:
  - 1. Wall flashing pan units shall be installed at base of single wythe walls (CMU & AMU) and above all windows, doors, and louvers, in accordance with manufacturer's instructions. Flashing over openings shall extend to the ends of lintel.
  - 2. Pan units shall be installed over block cells on a fresh full mortar bed with bridging units between them. Mesh mortar nets shall be placed above the pan units to disrupt mortar dropping blockage. Pan units shall not be installed where cells are vertically reinforced.
  - 3. Where pan units sit on hardened concrete two rows of sealant shall be placed between the concrete and the pan. One row of sealant shall be placed at the back exterior face and one at the block interior face.
- E. Through-Wall Flashing:
  - 1. Flashing shall be installed in double wythe walls, and as shown on the Drawings, in continuous runs with all seams and joints lapped 6-inch minimum and sealed with adhesive in accordance with manufacturer's instructions. Flashing over openings shall extend a minimum of 4-inch beyond the ends of lintel. Discontinuous ends of flashing shall be folded-up 2-inch to form a dam.
  - 2. When flashing is not shown on the Drawings, it shall be installed at the top of parapet walls under the coping, at the base of all walls, above and below all wall openings, and at other obstructions to the downward flow of water in the wall.
  - 3. Metal flashing shall be brought out beyond the wall face and turned down to form a drip. Flexible flashing shall be held back an inch from the exterior face of wall.
  - 4. Thoroughly adhere drip edge flashing to substrate with adhesive that is compatible with both the substrate and the drip edge materials. Install flexible flashing above the drip edge flashing.
  - 5. Concealed flexible through-wall flashing shall be installed so it begins at the midpoint of the interior wythe, extends down the wall, then out to lap the drip edge flashing a minimum of 4-inches. Drip-edge flashing and flexible flashing shall be kept clean to maximize adhesion. Through-wall flashing shall be installed as specified in conjunction with manufacturer's recommendations.

- F. Weepholes and Brickvents:
1. Install weepholes in the head joints in exterior wythes of the first course of masonry immediately above all through-wall flashing. Mortar droppings and debris shall be prevented from blocking weephole.
  2. Unless shown otherwise on the Drawings, weepholes shall be installed at 16-inch on center above wall openings in cavity walls. Trim weephole material flush with outside face of wall.
  3. Install brickvents in place of weepholes in walls where noted on the Drawings or Specified. Brickvents shall be installed in headjoints near top of wall, just below large openings, and in the first course of masonry immediately above through-wall flashing. Unless otherwise shown on the Drawings, horizontal brickvent spacing shall be 24-inch center to center.
- G. Embedded anchor bolts shall be accurately placed, secured against displacement, and grouted in place.
- H. Anchors, ties, and rigid straps shall be installed as shown or specified. Ends of anchors and ties shall be embedded in mortar joints. Ties and anchors shall be embedded minimum of 1/2-inch into outer face shell of hollow units and 1-1/2-inch into bed joint of solid masonry unit or solid grouted hollow unit. Anchors, ties, and rigid straps shall not be field bent.
- I. Premolded joint materials shall be installed as soon as units are laid. Mortar droppings and debris shall be prevented from entering joints.
- J. Wood nailers shall be installed and secured in locations shown or as otherwise required.
- K. Lintels shall be of the type and size indicated on the Drawings or as required, and shall be acceptable to the Engineer. Lintels shall extend at least 4-inch beyond each side of the opening unless otherwise indicated on the Drawings.
- L. Unless otherwise detailed on the Drawings, structural steel shall be isolated from masonry walls by minimum 3/8-inch thick isolation gasket.
- M. Where masonry walls abut, or cover concrete columns, walls, or other concrete construction, the masonry shall be anchored to the concrete by means of dovetail anchor slots cast in the concrete and dovetail anchors. Anchor slots shall be installed at a minimum horizontal spacing of 24-inch center to center. Dovetail anchors shall be installed at a minimum vertical spacing of 16-inch center to center. Vertical cells of hollow masonry units at each anchor shall be filled with mortar.
- N. Insulation retainers shall be installed in cavity walls receiving rigid insulation. The retainers shall hold the rigid board insulation tight against interior wythe. The retainers shall be installed at all horizontal insulation joints on each cross wire.
- O. Mortar dropping control device shall be placed in the cavity between multi-wythe walls in the bed joints at approximately 16-inch and 32-inch above through wall flashing. The

devices shall be placed at a horizontal spacing of 12-inch center to center alternating between the 16-inch and 32-inch bed joints as recommended by the manufacturer.

- P. Anchors shall be installed to tie new masonry veneer to existing masonry or concrete. The anchors shall be installed at a maximum horizontal spacing of 24-inch center to center and a maximum vertical spacing of 16-inch center to center. Anchors shall be embedded a minimum of 2-inch and maintain at least 5/8-inch mortar cover. Vertical cells of hollow masonry units at each anchor shall be filled with mortar.

### **3.06 PROTECTION**

- A. Design, provide, and install bracing according to the guidelines in the “Standard Practice for Bracing Masonry Walls Under Construction” by the Council for Masonry Wall Bracing, 1999.

### **3.07 BAR REINFORCEMENT**

- A. Reinforcement shall be cleaned of mud, oil, and other materials which adversely affect bond. Reinforcement with rust, mill scale, or combination of both shall be considered satisfactory provided minimum dimensions, weight, and height of deformations of hand-wire-brushed test specimen are not less than applicable ASTM specification requirements.
- B. Reinforcement shall be accurately placed as shown on approved Shop Drawings and secured against displacements before grouting. Wire bar positioners shall be used to position and secure reinforcement.
- C. When it is necessary to move reinforcement to avoid interference with other reinforcement, conduits, or embedded items, the resulting arrangement of bars shall be subject to Engineer’s approval.
- D. Unless shown otherwise on the Drawings, clear distance between reinforcing bars and masonry surface shall not be less than 1/2-inch.
- E. Bar reinforcement shall be lapped a minimum of 48 bar diameters unless shown otherwise.
- F. Field bending or straightening of reinforcement is prohibited except as specifically shown.

### **3.08 JOINT REINFORCEMENT**

- A. Joint reinforcement shall be placed so that longitudinal wires are embedded in mortar with 5/8-inch minimum cover.
- B. Joint reinforcement shall be lapped in a minimum of 12-inch.
- C. Block walls shall have ladder type reinforcement. Multi-wythe walls or walls with mortar-filled collar joints shall have truss type reinforcement. Unless otherwise shown on the drawings, reinforcement shall be placed in horizontal joints at 16-inch center to

center vertically. An additional joint shall be reinforced above and below openings, and shall extend at least 2-feet. beyond the edges of the openings.

- D. Veneer masonry shall be horizontally reinforced in joints at 16 inches on center and shall be tied to backup support wall at 24-inch on center horizontally.
- E. Intersecting masonry walls shall be tied together with factory fabricated wire reinforcing tees unless shown otherwise. Reinforcing tees shall be installed in same horizontal joints as other common wall wire reinforcing.

### 3.09 CONTROL JOINTS AND EXPANSION JOINTS

- A. Vertical masonry control and expansion joints shall be spaced at 20-feet maximum on center, unless shown otherwise on the Drawings. The joint spacing shall include the distance measured around building corners to the next joint.

### 3.10 INSTALLATION OF REINFORCED UNIT MASONRY

- A. Temporary Formwork and Shores - Construct formwork and shores as needed to support reinforced masonry elements during construction.
  - 1. Construct formwork to conform to shape, line, and dimensions shown. Make sufficiently tight to prevent leakage of mortar and grout. Brace, tie, and support forms to maintain position and shape during construction and curing of reinforced masonry.
  - 2. Do not remove forms and shores until reinforced masonry members have hardened sufficiently to carry their own weight and other temporary loads that may be placed on them during construction.
- B. Grouting:
  - 1. Do not place grout until entire height of masonry to be grouted has attained sufficient strength to resist grout pressure. Grout spaces shall be free of mortar droppings, debris, loose aggregate and other materials deleterious to masonry grout.
  - 2. A grout pour is defined as the height of masonry to be grouted before additional height of masonry can be added. A grout pour can consist of one or several grout lifts.
  - 3. Cleanouts:
    - a. Provide cleanouts in bottom course of masonry for each grout pour when the grout pour exceeds 5-feet in height. Cleanouts shall be constructed at each vertical bar. In solid grouted masonry, cleanouts shall be spaced at 32-inch maximum centers.
    - b. Cleanouts shall have opening of sufficient size to permit removal of debris. Minimum opening dimension shall be 3-inch.

- c. After cleaning, cleanouts shall be closed and closures shall be braced against grout pressure.
4. Grout shall be placed within 1-1/2 hours after water is introduced to mixture and prior to initial set.
5. Grout shall be confined to areas shown. Hardware cloth shall be used to prevent grout from flowing into areas not intended to be grouted.
6. Contractor shall provide fine or coarse grout as required to meet the required pour height per the following table.
7. Maximum grout pour height and grout space dimension shall be as follows:

Grout Type	Maximum Grout Pour Height (ft.)	Minimum Width of Grout Space (in.)	Minimum Grout Space Dimensions for Grouting Cells of Hollow Units, (in. x in.)
Fine	1	3/4	1-1/2 x 2
	5	2	2 x 3
	12	2-1/2	2-1/2 x 3
Coarse	1	1-1/2	1-1/2 x 3
	5	2	2-1/2 x 3
	12	2-1/2	3 x 3

8. Grout lifts shall not exceed five feet unless masonry to be grouted has cured for at least 4 hours.
9. Grout lifts shall not exceed the maximum pour height. When intermediate bond beams are present grout lifts shall not exceed the distance between bond beam and floor, the distance between adjacent bond beams or the maximum grout pour height, whichever is smaller.
10. Grout shall be consolidated by mechanical vibration as it is placed. Grout pours exceeding 1-foot in height shall be reconsolidated by mechanical vibration after initial water loss and settlement have occurred.

### 3.11 CURING

- A. Moist curing methods similar to those used in concrete construction shall be used to prevent premature masonry dryouts. Periodic wetting of the finished masonry with a fine water spray shall be used to ensure that adequate moisture is available for curing, strength development, and good bond. The Contractor may use alternate methods of curing, subject to the approval of Engineer, such as covering the walls with polyethylene sheets to create a greenhouse effect to aid in moist curing.

### 3.12 COLD-WEATHER CONSTRUCTION

- A. Implement the following requirements when the ambient temperature falls below 40 degrees F or the temperature of masonry units is below 40 degrees F.
  1. Preparation:

- a. Remove visible ice and snow from the surface of existing foundations and masonry to receive new construction. Heat these surfaces above freezing.
  - b. Remove visible ice and snow from units before unit is laid. Units having temperature below 32 degrees F shall not be used. Units which ordinarily require wetting shall be sprinkled with warm or hot water immediately prior to laying.
2. Construction:
- a. When ambient temperature is between 40 degrees F and 32 degrees F, mortar sand or mixing water shall be heated to produce mortar temperatures between 40 degrees F and 120 degrees F at time of mixing. Mortar temperature shall be maintained above 40 degrees F. Grout materials need not be heated provided they are above 32 degrees F.
  - b. When ambient temperature is between 32 degrees F and 25 degrees F, mortar shall comply with the previous requirements. Heat grout aggregates and mixing water to produce grout temperature between 70 degrees F and 120 degrees F at time of mixing. Grout temperature shall be above 70 degrees F at time of placement.
  - c. When ambient temperature is between 25 degrees F and 20 degrees F, mortar and grout shall comply with the previous requirements and the following. Heat masonry surfaces under construction to 40 degrees F. Use wind breaks if the wind speed exceeds 15 mph. Heat masonry to 40 degrees F minimum prior to grouting.
  - d. When ambient temperature is below 20 degrees F, mortar and grout shall comply with the previous requirements and the following. Provide an enclosure and maintain air temperature in the enclosure above 32 degrees F.
3. Protection - Protection is to be based on the anticipated minimum daily temperature.
- a. When the minimum daily temperature is between 40 degrees F and 25 degrees F complete masonry shall be protected by covering with weather resistive membrane for 24 hours after construction.
  - b. When the minimum daily temperature is between 25 degrees F and 20 degrees F, completed masonry shall be protected with weather resistive insulating blankets, or equal protection, for 24 hours after construction. The protection period shall be 48 hours for grouted masonry.
  - c. When the minimum daily temperature is below 20 degrees F, completed masonry temperature shall be maintained above 32 degrees

F for at least 24 hours by using heated enclosures. The protection period shall be 48 hours for grouted masonry.

### 3.13 HOT WEATHER CONSTRUCTION

- A. High temperature, low humidity, and wind adversely affect performance of the masonry. When ambient temperature is above 100 degrees F or above 90 degrees F with wind velocities greater than 8 mph, protection measures shall be taken to assure continue hydration, strength, and maximum bond.
1. Mortar beds shall not be spread more than four feet ahead of masonry units.
  2. Units shall be laid within one minute of spreading mortar.
  3. Flush mixer, mortar board, etc. with cool water before they come in contact with mortar or mortar ingredients.
  4. Temperature of mortar and grout shall be below 120 degrees F.
  5. Mortar shall be used within 1-1/2 hours after initial mixing.
  6. When wind speed exceeds 10 mph, wind breaks shall be installed.
  7. Install sunshade or schedule Work during cooler parts of the day.
  8. Materials shall be stored in a shaded location and aggregate stockpiles shall be covered with plastic sheets to retard moisture evaporation.

### 3.14 TESTING/FIELD QUALITY CONTROL

- A. All inspection shall be conducted to verify through visual inspection or by testing that the construction and material meet the requirement of the specifications herein and the Contract Drawings. The Contractor shall engage and pay for the services of an independent testing agency per Section 01410, to perform the following testing for field quality control. Retesting of materials failing to meet specified requirements shall also be done at Contractor's expense.
1. At the start of work, the independent laboratory at the Site of the project shall:
    - a. Verify that the grout slump is between 8 inches to 11 inches per ASTM C143.
    - b. Verify grout mix materials and proportions comply with ASTM C476.
    - c. Verify mortar mix materials and proportions comply with ASTM C270.
    - d. Test clay masonry units per ASTM C62, ASTM C216 and ASTM 652 to verify that compressions strengths.
    - e. Test concrete masonry units per ASTM C55 and ASTM C90 to verify that compressions strengths.
    - f. Verify that materials are on site to protect masonry from hot, cold and inclement weather, as applicable.



2. During periodic inspections, the following tasks shall be performed by the independent laboratory for every 5000 square feet of wall.
  - a. Verify that the grout slump is between 8 inches to 11 inches per ASTM C143.
  - b. Verify grout mix materials and proportions comply with ASTM C476.
  - c. Verify mortar mix materials and proportions comply with ASTM C270.
  - d. Test clay masonry units per ASTM C62, ASTM C216 and ASTM 652 to verify that compressions strengths.
  - e. Test concrete masonry units per ASTM C55 and ASTM C90 to verify that compressions strengths.
  - f. Verify that masonry units and mortar joints are placed within the specified tolerances.
  - g. Verify the placement, grade and type of reinforcing, anchors and metal masonry ties.
  - h. Verify that masonry protection procedures for inclement weather are being followed.
3. Continuous Inspections:
  - a. Verify grout spaces are free of mortar droppings, debris, loose aggregate, and any material deleterious to the masonry grout.
  - b. Inspect placement of grout with respect to pour heights, lift heights and consolidation procedures.
  - c. Verify major masonry anchorage details to the building frame when called for elsewhere by the Construction Documents.
  - d. Inspect welding of reinforcing bars to other bars or steel frame. Verify welder's qualifications, electrode type and welding procedures and visual inspect welds in accordance with AWS code D1.4.
  - e. Verify that masonry protection procedures for hot weather and cold weather are being followed.

### 3.15 PROTECTION

- A. During erection, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's Work. Cover partially-completed masonry when construction is not in progress.
  1. Extend cover a minimum of 24-inch down both sides and hold cover securely in place.
- B. Do not apply any loads for at least three days after building masonry walls.

- C. Stain Prevention - Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.
  - 1. Protect floor and base of walls from mortar splatter by coverings spread on the floor and over wall surface.
  - 2. Protect sills, ledges, and projections from mortar droppings.
- D. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.

### **3.16 REPAIRING, POINTING, AND CLEANING**

- A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or if units do not match adjoining units. Install new units to match adjoining units; install in fresh mortar or grout, pointed to eliminate evidence of replacement.
- B. Pointing - During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point-up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for application of sealants.
- C. In-Progress Cleaning - Clean unit masonry as Work progresses by dry brushing to remove mortar fins and smears prior to tooling joints.
- D. Final Cleaning - After mortar is thoroughly set and cured, clean exposed masonry as follows:
  - 1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
  - 2. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes. Obtain Owner's approval of sample cleaning before proceeding with cleaning of masonry.
  - 3. Protect adjacent stone and non-masonry surfaces from contact with cleaner by covering them with liquid strippable masking agent, polyethylene film, or waterproof masking tape.
  - 4. Wet wall surfaces with water prior to application of cleaners; remove cleaners promptly by rinsing thoroughly with clear water.
  - 5. Clean brick by bucket and brush hand-cleaning method described in BIA Technical Note No. 20 Revised, using the following masonry cleaner:
    - a. Job-mixed detergent solution.
  - 6. Clean concrete masonry by cleaning method indicated in NCMA TEK 8-2 applicable to type of stain present on exposed surfaces.

**3.17 PENETRATIONS**

- A. All penetrations through masonry walls from any element that interrupts the integrity of the masonry wall, whether in part or in whole, shall be sealed such that it's structural integrity and weatherproof performance and longevity equals or exceeds that of the masonry wall system itself.

**3.18 MASONRY WASTE DISPOSAL**

- A. Recycling - Undamaged, excess masonry materials are Contractor's property and shall be removed from the Site for his use.
- B. Excess Masonry Waste - Remove excess, clean masonry waste that cannot be recycled and legally disposed of off Owner's property.

**PART 4 SPECIAL PROVISIONS**

Not used.

END OF SECTION

**SECTION 05500  
METAL FABRICATIONS**

**PART 1 GENERAL**

**1.01 SCOPE**

- A. This Section includes furnishing, shop detailing, shop coating, fabricating, delivering, and installing all miscellaneous metals and accessories needed to complete installations as shown on the Drawings, whether or not specifically listed herein, except those items specified in other sections. This Section includes design engineering where specifically called for by this Section.

**1.02 SUBMITTALS**

- A. Submittals shall be in accordance with the requirements of Section 01300 and shall include:
1. Shop Drawings for Review:
    - a. Shop Drawings shall indicate:
      - 1) Types of materials with ASTM designations.
      - 2) Plan layouts, elevations, and sections.
      - 3) Connection details.
      - 4) AWS weld designations and welding procedure.
      - 5) Surface preparation and shop coatings.
      - 6) Accessory materials.
    - b. Product literature for all materials and accessories required to complete the installation of the items covered in this Section.
    - c. Samples representative of materials and finished products.
    - d. Design and calculations shall be sealed by a professional structural engineer registered in the state where the Project resides on items where a design engineer is specified.
  2. Information for the Record:
    - a. Welder qualification certificates.
    - b. Inspection Reports and test certificates.
    - c. Required field measurements.
    - d. Manufacturer's installation instructions.

### 1.03 QUALITY ASSURANCE

- A. Standards - Metal fabrications shall be designed, fabricated, and installed in accordance with following standards.
  - 1. "Structural Welding Codes", American Welding Society.
  - 2. "Specifications for Structural Steel Buildings" as approved by American Institute of Steel Construction.
  - 3. "Specifications for the Design of Cold-Formed Steel Structural Members", American Iron and Steel Institute.
  - 4. "Specification for the Design of Cold-Formed Stainless Steel Structural Members", ASCE 8.
  - 5. "Code of Standard Practice for Steel Buildings and Bridges", as approved by American Institute of Steel Construction.
  - 6. "Specification for Aluminum Structures", Aluminum Association.
  - 7. "Specification for Structural Joints Using High Strength Bolts" as approved by the Research Council on Structural Connections of the Engineering Foundation.
  - 8. "Surface Preparation Specification," Steel Structures Painting Council (SSPC).
- B. Welders, welding operators, and tack welders shall be qualified by tests as prescribed in AWS Structural Welding Code.

### 1.04 PERFORMANCE REQUIREMENTS

- A. The Contractor is responsible for employing Design Engineer for the items listed by this Article. Design engineer shall follow the performance requirements provided in the pertinent parts of this Section.
  - 1. Ladders.

### 1.05 DELIVERY, STORAGE, AND HANDLING

- A. The Contractor shall exercise particular care in handling materials to prevent damage to shop applied finishes and coatings.
- B. Material shall be stored in a manner to prevent bending or warping. Material shall be stored away from uncured concrete and masonry.
- C. Materials to be embedded in concrete or masonry shall be delivered in sufficient time to permit proper placement.
- D. Fastening materials shall be delivered and stored in unopened boxes with labels clearly identifying fastener material, grade, and manufacturer. Only those fasteners which can be installed in same day shall be removed from storage.

## 1.06 PROJECT CONDITIONS

- A. Prior to fabrication, Contractor shall field measure new and existing structures when required for proper fit.

## PART 2 PRODUCTS

### 2.01 MATERIALS

- A. Steel (Carbon Steel):
  - 1. Wide Flange Shapes (W) - ASTM A992.
  - 2. Other Rolled Shapes, Plate, and Bar - ASTM A36 or ASTM A572, Grade 50 as indicated on the Drawings. Where no indication is given, use ASTM A36.
  - 3. Sheets - ASTM A570, Grade 36.
  - 4. Hollow Structural Sections (HHS), tube and pipe - ASTM A500, Grade B.
  - 5. Pipe - ASTM A53, type E or S, Grade B.
  - 6. Floor and Tread Plate - ASTM A786 using ASTM A36 steel.
- B. Stainless Steel:
  - 1. Unless indicated otherwise stainless steel shall be AISI Type 304, except AISI Type 304L shall be used for welded construction. The minimum yield strength shall be 30,000 ksi.
  - 2. Sheet, Strip, Plate, and Flat Bar - ASTM A666, annealed.
  - 3. Round Bar and Structural Shape - ASTM A276, condition A.
  - 4. Pipe and Tube - ASTM A312 or ASTM A554, annealed.
  - 5. Floor and Tread Plate - ASTM A793.
- C. Aluminum:
  - 1. Unless specified otherwise aluminum shall be alloy 6061-T6.
  - 2. Sheet and Plate - ASTM B209.
  - 3. Rod and Bar - ASTM B211 or B221.
  - 4. Pipe and Tube - ASTM B210 or ASTM B429.
  - 5. Floor and Tread Plate - ASTM B632.

### 2.02 ASSEMBLY AND ERECTION FASTENERS

- A. Bolts and Nuts:
  - 1. High strength bolts - ASTM A325, Type 1 or ASTM A490, Type 1. When no indication is given, ASTM A325 shall be used.
  - 2. Stainless Steel - ASTM F593, AISI Type 304.

3. High strength and stainless-steel bolts shall bear a distinctive head marking identifying bolt grade or material.
  4. Nuts - Heavy hex style, ASTM A563, Grade C, for plain A325 high-strength fasteners and DH for galvanized bolts. For A490 bolts, heavy hex nuts conforming to ASTM A194 for Grade 2H, or ASTM A563 Grades DH or DH3.
- B. Lock Nut - Prevailing torque type, IFI 100, Grade A.
- C. Carbon Steel Washers - ASTM F436 plain with plain bolts and galvanized with galvanized bolts.
- D. Lock Washer - Spring type of same material and coating as bolt.
- E. Headed Studs - ASTM A108, Grade 1010 through 1020, and AWS D1.1, Section IV.
- F. Screws:
1. Carbon Steel - SAE Grade 2, zinc plated.
  2. Stainless Steel - IFI 104, Grade 304.
- G. Nuts and washers of same finish and material as bolts shall be furnished.

## **2.03 ANCHOR BOLTS**

- A. General Requirements:
1. Bolt and Stud Material:
    - a. Carbon Steel - ASTM F1554 Grade 36, unless noted otherwise.
    - b. Stainless Steel - ASTM F593, AISI Type 304.
    - c. Heavy hex nuts and washers of the same material and coating as anchor shall be furnished. Where lock nut is indicated, prevailing torque type lock nut shall be furnished in addition to standard nut.
  2. Anchor Bolt Sleeves:
    - a. Steel Pipe - ASTM A501, ASTM A120, or ASTM A53.
    - b. Plastic - Wilson "Ankor Shield" or equal.
- B. Cast-In Anchor Bolt (Type A):
1. Sufficient thread length shall be provided to permit installation of nuts on both sides of concrete form or template.
  2. Anchor embedment, and hook dimension shall be as shown on Drawings.
  3. Where sleeve is shown, sleeve shall be fabricated from material indicated above.

- C. Adhesive Anchor (Type B):
1. Adhesive – 100% solids, 100% reactive epoxy (ester-based resins are not permitted) in conformance with ASTM C881, Type IV, Grade 3, Class B and C. Minimum bond strength to concrete, per ASTM C882, shall be 1800 psi at 7 days. Adhesive shall be mixed in accordance with manufacturer’s recommendations. The adhesive shall be formulated to withstand the maximum allowable published load permanently without creep or failure.
  2. Where adhesive anchor is installed in hollow masonry, stainless steel screen tubes shall be furnished to contain adhesive until stud is inserted.
  3. The anchor rods shall be threaded for entire length. Carbon steel rods shall conform to ASTM A193 B7 (high strength) and stainless-steel rods shall conform to AISI 304.
  4. Stud shall be threaded full length.
  5. Adhesive anchors shall be type “HIT-RE-500-V3” manufactured by Hilti, or equal. All formulations of the “Power-Fast Epoxy” as manufactured by Powers/Rawl shall not be used.
- D. Expansion Anchor (Type C):
1. Wedge Type Anchors - FS A-A 1923A, Type 4.
  2. All components shall be of the same material.
  3. Expansion anchors shall be type “Kwik Bolt TZ” manufactured by Hilti, or equal.
- E. Sleeve Masonry Anchor (Type D):
1. Sleeve Type Anchors - FS FF-S-325, Group II, Type 3, zinc plated carbon steel.

## 2.04 WELDING

- A. Carbon Steel:
1. Welders, welding operators, and tack welders shall be qualified by tests as prescribed in AWS Structural Welding Code.
  2. Welding shall be performed using only prequalified joint details in accordance with AWS Structural Welding Code.
  3. Welding electrode shall conform to the requirements of AWS D1.1 and table 3.1 therein.
  4. Welded fabrications which will be exposed to weather, submerged, or subject to sewage spray shall be continuously welded.
  5. All welding processes and procedures and joint details shall be in accordance with the requirements of AWS D1.1. Weld quality shall conform to Section 8 of AWS D1.1.



- B. Stainless Steel:
  - 1. Stainless steel shall be welded with inert gas shielded process (GTAW, GMAW, or PAW). Inert gas protection shall be provided to top and under or backside of weld to ensure protection from atmospheric contamination.
  - 2. Filler metal shall be extra low carbon (ELC) of appropriate type for base material being welded.
  - 3. Residue, oxide, and heat stain in heat affected zone shall be removed.
- C. Aluminum:
  - 1. Aluminum shall be welded by process which does not require the use of welding flux.
  - 2. Filler metal shall be as recommended by AA and AWS for base material and welding process used. Filler metal shall be selected to minimize crack sensitivity of weldment and to minimize discoloration of weldment on items to be anodized.
- D. Welding shall be performed in such a manner to prevent warping and distortion.
- E. Butt joints shall be made with full penetration welds. Weld reinforcement on back side shall be smooth, uniform, and no more than 1/16 inch in height.
- F. Rough welds shall be ground to remove sharp edges, undercuts, pinholes, and other irregularities. Chipping is permitted to remove sharp edges if followed by welding. Overgrinding, which would result in decreasing metal thickness or integrity of weld beyond limits of good welding practice shall be avoided.
- G. Weld spatter shall be removed by chipping and grinding as required. Use of an anti-spatter coating applied adjacent to weld area prior to welding is permitted.

## 2.05 FABRICATION

- A. Work shall be fabricated straight and true, free from warpage or other defects and assembled in a first-class workmanlike manner. Joints, copes, miters, and corners shall be accurately cut, machined, filed, and fitted with best methods as required for fabrication.
- B. Work shall be fabricated as shown on approved Shop Drawings. Removable parts or members shall be carefully fitted and secured by screw fastenings or other methods as may be required.
- C. Work shall be fabricated in as large as sections as practicable to minimize field connections. Field connections shall be designed and constructed in most practical locations for strength, appearance, and ease of installation. Field connections shall be mechanically fastened unless field welding is shown, specified, or permitted by Engineer.

- D. Holes and other provisions for field connections shall be accurately located. Connections shall be shop checked for proper fit. Connection materials shall be match-marked when required for proper installation.
- E. Holes produced by flame cutting shall be ground smooth.
- F. Sharp edges of flame cut or sheared carbon steel fabrications shall be removed by power grinding.
- G. Carbon steel surfaces to be coated or galvanized shall have gouges, handling marks, deep scratches, metal stamp marks, slivered steel and other surface flaws repaired. Surface flaws shall be repaired by welding and grinding as required.

## 2.06 SHOP COATING

- A. Aluminum:
  - 1. Anodizing - Where specified, provide Architectural Class I anodic coating, applied after fabrication.
  - 2. Surfaces which will be in contact with concrete, masonry, or dissimilar metals shall receive a heavy coat of coal tar paint, Bitumastic Super Service Black, or equal.
- B. Carbon Steel:
  - 1. Steel fabrications wholly embedded in concrete or masonry and with a minimum of 2 inches of concrete cover shall be abrasive blasted in accordance with SSPC SP-6, but shall not be coated. Exposed portions of partially embedded steel shall be shop coated to a point 4 inches below the concrete surface.
  - 2. Galvanizing - Component shall be hot dip galvanized after fabrication in conformance with ASTM A123. Threaded parts and hardware shall be galvanized in conformance with ASTM A153 or zinc-plated in conformance with ASTM B695.
  - 3. Painting - Unless specified otherwise, non-galvanized fabrications shall be shop primed per Section 09900.
    - a. Surfaces which will be inaccessible for field painting after installation shall receive two coats of primer.
    - b. Contractor shall ensure primer is compatible with specified field coatings.

## 2.07 LADDERS

- A. Design Engineer shall design framing and wall connections. Minimum requirements are provided on Drawings and specified.
- B. Ladders shall be fabricated from material indicated on Drawings using all-welded construction. Safety cages shall be furnished when shown or otherwise required. Ladders shall meet requirements of MIOSHA and governing building code.

- C. Edges of stringers shall be ground to remove burrs and sharp edges.
- D. Rungs shall be spaced not less than 10 inches or more than 12 inches apart. Rungs shall have skid resistance top surface such as knurled, dimpled or skid resistant coating. Adhesive grit tape is not acceptable.
- E. Where bottom landing is a roof, bottom of ladder shall be supported off wall, unless noted otherwise. Bottom rail floor connections shall have minimum 1-inch adjustment for sloped and uneven surfaces.
- F. Ladder system shall be capable of supporting its own weight plus 300 pounds of allowable live load for every 10 feet of ladder height. Each rung shall support an allowable live load of 300 pounds located at the center of rung. Where ladder rails extend above the landing the rails shall be designed to support 100 pounds of lateral load in any direction located at the top of the rail.
- G. The design of ladder bracket connections to substrate shall be included. New substrate material strengths shall be taken from the Contract Documents. The makeup of existing substrate materials shall be field determined by the contractor and strength tested as deemed necessary by the Design Engineer. Size and locations of removed materials for substrate verification, or to be strength tested shall receive prior approval by the Owner and Engineer.

## **2.08 LOOSE LINTELS**

- A. Lintels shall be carbon steel fabricated from steel angles or other shapes as shown on plans. Ends of lintel shall bear a minimum of 4 inches on concrete or masonry.
- B. Galvanize loose steel lintels located in exterior walls.

## **2.09 PIPE BOLLARDS**

- A. Metal pipe bollards shall be constructed as shown on the Drawings.
- B. Metal pipe shall be hot dipped galvanized, unless noted otherwise on Drawings.
- C. Plastic bollard guards shall be provided when specified in Part 4.

## **PART 3 EXECUTION**

### **3.01 ERECTION**

- A. Metal fabrications shall be installed in accordance with manufacturer's instructions and as shown on Drawings.
- B. Fabrications shall be installed level and plumb or as otherwise shown on Drawings. Shims shall be furnished when required.
- C. Components shall be assembled as indicated on Drawings. Light drifting is permitted to draw parts together, but drifting to match unfair holes is not permitted. Where holes do not match, holes may be reamed slightly using a tapered reamer. Enlarging holes by burning is prohibited.

- D. Contact surfaces between members and areas adjacent to bolt holes shall be free of dirt, oil, loose scale, burrs, pits, and other defects that would prevent proper seating and connection of the members.
- E. Galvanized or anodized material shall not be field bent, cut, welded, or otherwise altered. Material so altered will be considered defective.

**3.02 ASSEMBLY AND ERECTION FASTENER INSTALLATION**

- A. Washers shall be installed under turned element of bolts. Hardened washers shall be used for high strength and alloy bolts. Beveled washers shall be installed when bearing surface of the bolted parts have a slope of 1:20 or greater with respect to the bolt axis.
- B. Fastener threads which have been contaminated with dirt shall be cleaned and lubricated.
- C. Stainless Steel - Anti-seizing lubricant shall be applied to threads prior to installation.
- D. Bolts shall be tightened progressing systematically from stiffest part of connection toward free edges.
- E. Bolted connections shall be snug-tightened-joints, unless noted otherwise. All connected steel plies shall be free of dirt, oil, lacquer, and burrs, and shall be in firm contact prior to bolting.
- F. High strength and alloy bolts shall not be reused once tightened beyond snug-tight.
- G. For bolted connections, at least one full thread shall project beyond the nut when tightened.

**3.03 ANCHOR BOLT INSTALLATION**

- A. Non-cast-in type anchors shall be installed in predrilled holes of size specified or as recommended by manufacturer. Anchors shall be embedded to depth indicated below unless shown otherwise on the Drawings.
- B. Anchor bolted connections shall be snug-tightened- in accordance with "Specification for Structural Joints Using ASTM A325 or A490 Bolts" as approved by the Research Council on Structural Connections of the Engineering Foundation or as otherwise specified by anchor manufacturer.
- C. Expansion Anchor:
  - 1. Unless indicated otherwise, expansion anchors shall have an effective embedment as follows:

Stud Diameter	Minimum Embedment
1/4 inch	2 inches
3/8 inch	2 inches
1/2 inch	3-1/4 inches
5/8 inch	4 inches
3/4 inch	4-3/4 inches
1 inch	6 inches

2. Unless indicated otherwise, expansion anchors shall be spaced as follows:  
Minimum center to center spacing: 2 times embedment.  
Minimum edge distance: 3 times embedment.
3. Unsound concrete shall be reported to Engineer.

D. Adhesive Anchor:

1. Adhesive anchors shall be placed in holes larger than stud diameter using a rotary percussion hammer and carbide bit. Hole diameters shall be as recommended by manufacturer for each specific anchor diameter.
2. Unless indicated otherwise, Adhesive anchors shall have an effective embedment as follows:

Stud Diameter	Minimum Embedment
3/8 inch	3-3/8 inches
1/2 inch	4-1/2 inches
5/8 inch	5 5/8 inches
3/4 inch	6-3/4 inches
7/8 inch	7-7/8 inches
1 inch	9 inches

3. Preparation Procedure:
  - a. Hole shall be cleaned of dust and residue by blasting with dry and oil-free compressed air. Air nozzle shall be inserted to bottom of hole.
  - b. Sides of hole shall be cleaned with a nylon bristle brush.
  - c. Compressed air blast shall be repeated.
4. Standing water and frost shall be removed immediately prior to injecting adhesive.
5. Adhesive shall be injected from bulk-loading caulking gun, disposable caulking tubes, or pneumatic dispenser. Adhesive shall be injected using extension on nozzle to reach bottom of drilled hole.
  - a. Anchoring to Concrete - Nozzle shall be inserted to back of hole and adhesive dispensed while slowly withdrawing nozzle. Hole shall be filled to pre-determined depth which will cause hole to be completely filled after stud is inserted.
  - b. Anchoring to Masonry - Screen tube shall be filled with adhesive while slowly withdrawing nozzle. Screen tube shall be carefully inserted into drilled hole.
6. Stud shall be pushed into adhesive with gentle, uniform pressure while slightly rotated to ensure adhesive completely surrounds stud. Stud shall be inserted to full depth of hole.

7. Adhesive displaced from hole shall be removed immediately. Adhesive which has hardened on projecting portion of stud or on concrete surfaces shall be removed.
8. Nut shall not be tightened nor load applied until adhesive has fully cured as recommended by manufacturer.
9. Threaded anchors shall have at least one full thread projecting beyond the nut when tightened.

**3.04 FASTENER AND ANCHOR SCHEDULE**

- A. Unless shown or specified otherwise, fasteners and anchors shall be as follows:

Base Metal	Fastener Metal and Coating
Stainless steel	Stainless Steel
Aluminum	Stainless Steel
Galvanized steel	Galvanized or zinc plated carbon steel
Field painted or uncoated carbon steel	Unfinished or zinc plated carbon steel

- B. Where a connection involves dissimilar base metals, fastener shall be as required for most corrosion resistant base metal in connection, or dielectric material shall be installed.
- C. Anchors bolts and fasteners in submerged applications shall be stainless steel.
- D. Where anchor type is not shown or specified, anchor furnished shall be suitable for substrate material and specific application. Adhesive anchors are not permitted for anchoring to vertical or overhead surfaces inside of buildings or other fire rated locations.

Substrate Material	Suitable Anchor Type
Concrete	A, B, C
Solid or Grouted Masonry	A, B, D
Hollow Masonry	B, D

**3.05 FIELD WELDING**

- A. Field welding when shown, specified, or otherwise permitted by Engineer shall be performed in accordance with the requirements specified for shop welding.
- B. Areas adjacent to field welds shall not be shop primed. Primer shall be applied after welding.

**3.06 COATING REPAIR**

- A. Welds, bolts, and damage to shop applied coatings shall be touched-up with same or equivalent materials used in original coating.
- B. Minor scratches or defects in galvanized coating may be repaired with zinc-rich paint in accordance with ASTM A780 at Engineer’s discretion.

- C. Repair of anodized coatings in field is not permitted. Damaged materials shall be removed and re-anodized.

### **3.07 CLEANING**

- A. Metal fabrications shall be cleaned with mild detergents prior to final acceptance. Steel wool, harsh abrasives, or alkaline or acid cleaners are not permitted.

### **3.08 QUALITY CONTROL INSPECTION AND TESTING**

- A. The Contractor shall employ a laboratory to perform the following inspections and testing verifications: Where pretensioned or slip critical connections are indicated refer to Section 05120 for additional inspection requirements.
  - 1. At the start of Work, the inspector at the Site of the project shall:
    - a. Verify that the material identification markings for structural members, high strength bolts, nuts and washers correspond to the appropriate ASTM designations.
    - b. Verify that on-site welders designated by the Contractor are certified to perform welding.
    - c. Verify that the proper welding electrodes, equipment, and procedures are being utilized.
  - 2. If inspections determine that a specific item does not comply with the Contract Documents the contractor shall make corrections until the item passes the inspection. The cost of corrections and additional inspections shall be paid for by the Contractor.

## **PART 4 SPECIAL PROVISIONS**

### **4.01 DISSIMILAR MATERIALS**

- A. Where dissimilar materials come into contact, use neoprene washers, spacers, gaskets, or other Engineer approved materials between them to provide insulation against electrolytic action.

### **4.02 CRITERIA FOR BASE METAL REPAIR OF STRUCTURAL STEEL**

- A. This criteria shall cover damage induced to existing structural steel during or subsequent to installation of steel. Injurious imperfections, such as voids and gouges, shall herein be defined as a base metal discontinuity which results in a reduction of the cross-sectional area of a member, and which exceeds the limiting depths specified below for various thicknesses of material. Except for discontinuities of 1/32-inch and less in depth which are acceptable without any repair, base metal shall be conditioned for the removal of discontinuities by chipping or grinding. Weld repair is not required, provided the excavated area is well faired without abrupt changes in contour and the depression does not extend below the rolled surface by more than:
  - 1. 1/32 inch for material less than 3/8 inch thick.

2. 1/16 inch for material 3/8 inch to 2 inches (inclusive) thick.
  3. 1/8 inch for material over 2 inches thick.
- B. Voids and gouges greater in depth than the limits given above and all cracks and tears are considered injurious and shall be weld repaired using the methods given below; however, in no case shall the depth of excavations exceed 30% of the base metal thickness without written approval of the Engineers. Prior to welding, the excavations shall be visually (and for cracks and tears, magnetic particle or liquid penetrant) examined to insure complete removal of defects. Excavations shall have a minimum root radius of 1/8 inch, a minimum included angle of 45 degrees F on the cross section, and shall be gradually tapered up to the base metal surface at the ends. Repair welding shall be performed in accordance with the parameters of an AWS D1.1 qualified backing bar weld procedure. Completed surfaces of all repair welds shall be visually examined to the acceptance criteria of AWS D1.1 Section 8.15.

#### **4.03 CRITERIA FOR REPAIR OF WELD DEFECTS AND DAMAGED WELDS**

- A. Repair of damage or discontinuities in previously completed welds shall be in accordance with the criteria outlined below. In conjunction with the requirements outlined in weld procedure W200A, defects in welds shall be removed by chipping, arc-gouging, or grinding until sound metal is reached. Removal of indications such as cracks or tears, shall be verified by magnetic particle or liquid penetrant examination. Removal of other indications or damaged areas such as nicks, gouges, or undercuts, shall be verified by visual examination. Oxygen gouging, where required, is acceptable providing welding preheat is applied. Rewelding shall be performed in accordance with the procedure originally used to make the weld, or an alternate procedure approved in writing by the Engineer. Removal of attachment welds, when required, shall avoid removal of base material. Any remaining rough edges shall be ground flush with the surrounding surface and visually inspected to assure soundness.

#### **4.04 FABRICATOR APPROVAL**

- A. The fabricator of structural load bearing members and assemblies furnished under this Section, shall be registered and approved to fabricate these products without special inspections per the requirements of the current Building Code Section 1704. The approved fabricator shall submit evidence of such registration at the time that Shop Drawings are submitted. At the completion of production, the approved fabricator shall submit a certificate of compliance to the local building code official stating that the fabrication was performed in accordance with the Contract Documents and the approved Shop Drawings.

#### **4.05 PLASTIC BOLLARD GUARDS**

- A. Pipe bollards cover shall be a closed top, 1/8-inch-thick HDPE with UV inhibitors and rated for outdoor environment. The bollard cover shall be integrally colored; Owner shall select color. A reflective striping, as specified, shown or required shall be a 3M #680 reflective self-adhesive tape which is compatible with the HDPE cover and exterior



rated. The striping pattern and colors, shall be as specified, shown or as required. HDPE covers shall provide for a uniform height of bollards. The Contractor shall coordinate bollard cover size with the metal pipe bollard as shown on the Drawings.

END OF SECTION

**SECTION 05510  
METAL STAIRS**

**PART 1 GENERAL**

**1.01 SCOPE**

- A. This Section includes detailing, fabrication, installation and furnishing metal grating, checkered plating, concrete filled steel pan stairs, including but not limited to stringers, treads, shop coating, and delivery. Provide design engineering where indicated by this Section.
- B. Railing is specified in Section 05520.
- C. Nosing is specified in Section 05550.

**1.02 SUBMITTALS**

- A. Submittals shall be in accordance with the requirements of Section 01300 and shall include:
  - 1. Shop Drawings for Review:
    - a. Shall indicate:
      - 1) Materials of construction and structural member sizes.
      - 2) Stair framing plan, elevation, and sections. Provide building plan indicating stair locations.
      - 3) Pertinent dimensions and elevations.
      - 4) AWS weld designations and welding procedure.
      - 5) Surface preparation and shop coatings.
      - 6) Accessory materials.
      - 7) Required field measurements.
      - 8) Design loads and end reactions.
      - 9) Design and calculations shall be sealed by a professional structural engineer registered in the state where the Project resides on items where a design engineer is specified.
    - 2. Information for the Record:
      - a. Welding qualification certificates.
      - b. Material certification.
      - c. Field Measurements.

**1.03 QUALITY ASSURANCE**

- A. Standards - Metal stairs shall be designed, fabricated, and installed in accordance with following standards:

1. "Metal Stairs Manual", National Association of Architectural Metal Manufacturers.
  2. "Structural Welding Code", American Welding Society.
  3. "Specifications for Structural Steel Buildings", American Institute of Steel Construction.
- B. Welders, welding operators, and tack welders shall be qualified by tests as prescribed in AWS Structural Welding Code.

#### **1.04 PERFORMANCE REQUIREMENTS**

- A. Contractor is responsible for employing design engineer for stairs indicated as "pre-engineered" in stair table on drawings. The design engineer shall follow the performance requirements of this Section.
- B. All stairs, treads, and landings shall be capable of supporting a uniform live load of 100 pounds per square feet and a concentrated load of 300 pounds, unless designated as Heavy Duty. Framing shall be able to withstand the concentrated load placed at any location on the stair. Loads need not act congruently.
- C. Where stairs are indicated as Heavy Duty, the stairs, treads, and landings shall be capable of supporting a uniform live load of 200pounds per square feet and a concentrated load of 1,000 pounds. Framing shall be able to withstand the concentrated load placed at any location on the stair. Loads need not act congruently.
- D. Sizes and thicknesses of stair components given in this specification and shown on the Drawings are minimums. All components shall be sized as required for the above-specified design loads.
- E. Stair configurations and accessories shall meet the requirements of OSHA and local building codes, unless more stringent requirements are noted.
- F. Stair framing deflection shall be limited to  $\text{Span}/360$  for live load and to  $\text{Span}/240$  for the combination of live and dead loads.
- G. Stair treads and landings shall be limited to a deflection of  $\text{Span}/360$ , with 1/8-inch maximum deflection.
- H. The Contractor shall provide engineered design for pre-engineered stairs. The framing and connections shall be designed by a professional engineer registered in the state where the project resides. The Contract Documents indicated minimum standards to be followed. Shop drawings shall stipulate more stringent requirements where required by the design engineer to meet the performance criteria and specified codes.
- I. For pre-engineered stairs, the framing connections to the substrate shall be included. New substrate material strengths shall be taken from the Contract Documents. The makeup of existing substrate materials shall be field determined by the contractor and strength tested as deemed necessary by the design engineer. Size and locations of removed materials for substrate verification or to be strength tested shall receive prior approval by the Project Engineer.

**1.05 DELIVERY, STORAGE, AND HANDLING**

- A. The Contractor shall exercise particular care in handling materials to prevent damage to shop applied coatings.
- B. Material shall be stored in a manner to prevent bending or warping. Material shall be stored away from uncured concrete and masonry.
- C. Materials to be embedded in concrete or masonry shall be delivered in sufficient time to permit proper placement.
- D. Fastening materials shall be delivered and stored in unopened boxes with labels clearly identifying fastener material, grade, and manufacturer. Only those fasteners which can be installed on the same day shall be removed from storage.

**PART 2 PRODUCTS**

**2.01 MATERIALS**

- A. Rolled Shape, Plate, and Bar - ASTM A36.
- B. Sheets - ASTM A570, grade 36.
- C. Pipe and Tube - ASTM A501 or ASTM A53, Type E or S, grade B.

**2.02 FASTENERS AND ANCHOR BOLTS**

- A. Fasteners and anchor bolts shall be furnished and installed in accordance with Section 05500.

**2.03 STRINGERS**

- A. Stringers shall be minimum C10x15.3 channels with end closures. Unless shown otherwise, stringers and related carbon steel components shall be painted for interior applications and galvanized for exterior applications.

**2.04 TREADS AND LANDINGS**

- A. Metal stair treads shall be grating, unless noted otherwise.
- B. Tread widths shall be approximately 1-inch greater than nose to nose tread dimensions shown on Drawings.
- C. Where landing platforms serve as the top step in a flight of stairs, they shall be furnished with nosings to match treads.
- D. Grating for landing platforms shall be of material as shown on the Drawings, and shall be as specified under Section 05530.
- E. Grating treads shall be pre-manufactured from by Brown-Campbell, McNichols Co., or equal. Refer to Drawings for grating material. Minimum steel and stainless steel grating landing and tread depth shall be 1-inch and minimum aluminum tread depth shall be 1 1/2-inch. Treads shall be bolted to stringers.
- F. Aluminum checkered plate for treads, risers, and landings shall meet the requirements of ASTM B362. Steel checkered plate for treads, risers, and landings shall meet the

requirements for ASTM A786 using ASTM A36 steel. Thickness shall be 3/8-inch minimum, with additional stiffeners where necessary to meet loading and deflection criteria.

- G. Steel pan stairs shall use minimum 12-gauge steel for treads, risers, and landings with additional stiffeners where necessary. Pan tread concrete fill shall be 2-inch thick. Pan landing concrete fill shall be 3-1/2 inches minimum.

#### 2.05 NOSINGS

- A. Provide nosing in accordance with the requirements of Section 05550.

#### 2.06 RAILING

- A. Provide railing in accordance with the requirements of Section 05520.

#### 2.07 FABRICATION

- A. Stairs shall be shop fabricated in as large of sections as practicable, and in accordance with approved Shop Drawings. Stairs shall be accurately framed, true to line and slope, accurately mitered and joined and securely and rigidly supported.
- B. Shop connections may be bolted or welded. Field connections shall be bolted, unless shown otherwise. Where connection details are not shown, stringer and stair support connections shall be designed to develop 75% of the maximum allowable uniform beam load obtained from AISC tables.
- C. Bolted stringer and support connection shall use high strength bolts; minimum of two bolts per connection. Minimum bolt size shall be 3/4-inch. Bolted connections in the travel path shall be made with countersunk fasteners.
- D. Holes and other provisions for field connections shall be accurate and shop checked for proper fit in the field. Holes produced by flame cutting shall be ground smooth.
- E. Welding electrode for steel shall be E70XX. Welded joints which are exposed shall be continuous, smooth, and flush. Weld spatter and burrs shall be removed by grinding after fabrication.
- F. Surfaces to be coated shall have gouges, handling marks, deep scratches, metal stamp marks, slivered steel and other surface flaws repaired. Surface flaws shall be repaired by welding and grinding as required. Sharp edges of flame cut or sheared steel shall be removed by power grinding.

#### 2.08 SHOP COATING

- A. Galvanizing - Steel components shall be hot dip galvanized after fabrication in conformance with ASTM A123. Threaded parts and hardware shall be galvanized in conformance with ASTM A153 or zinc-plated in conformance with ASTM B695.
- B. Painting - Non-galvanized steel components shall be shop primed and field painted per Section 09900.

### **PART 3 EXECUTION**

#### **3.01 COORDINATION**

- A. Prior to fabrication, Contractor shall field measure structures when required for proper fit of stairs.

#### **3.02 INSTALLATION**

- A. Stairs shall be erected true to line and slope, rigidly supported, and shall be braced and tightened against movement. Treads shall be level and shall be aligned and spaced accurately.
- B. Components shall be assembled as shown on approved Shop Drawings. Light drifting is permitted to draw parts together, but drifting to match unfair holes is not allowed. Where holes do not match, holes may be reamed slightly using a tapered reamer. Enlarging holes by burning is prohibited.
- C. Contact surfaces between members and areas adjacent to bolt holes shall be free of dirt, oil, loose scale, burrs, pits, and other defects that would prevent proper seating and connection of members.
- D. Galvanized material shall not be field bent, cut, welded, or otherwise altered. Material so altered will be considered defective.
- E. Comply with AISC specifications for bearing, adequacy of temporary connections, alignment, and removal of paint on surface adjacent to field weld.
- F. Whenever dissimilar metals come into contact, use neoprene washers, spacers, gaskets, or other approved material between them to provide insulation against electrolytication.

#### **3.03 COATING REPAIR**

- A. Welds, bolts, and damage to shop applied coatings shall be touched-up with same or equivalent materials used in original coating.
- B. Minor scratches or defects in galvanized coating may be repaired with zinc-rich paint in accordance with ASTM A780 at Engineer's discretion.

#### **3.04 CLEANING**

- A. Stairs shall be cleaned with mild detergents prior to final acceptance. Steel wool, harsh abrasives, or alkaline or acid cleaners are not permitted.

### **PART 4 SPECIAL PROVISIONS**

Not used.

END OF SECTION

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**SECTION 05520  
METAL PIPE RAILING**

**PART 1 GENERAL**

**1.01 SCOPE**

- A. This Section includes furnishing, engineering, shop detailing, fabricating, shop coating, and installing of metal pipe railing systems and appurtenances.

**1.02 SUBMITTALS**

- A. Submittals shall be in accordance with the requirements of Section 01300 and shall include:
1. Shop Drawings for Review:
    - a. Shop Drawings shall include:
      - 1) Plan layouts, elevations, and typical sections.
      - 2) Materials of construction.
      - 3) Connection details.
      - 4) AWS weld designations and welding procedure.
      - 5) Surface preparation and shop coatings.
      - 6) Accessory materials.
      - 7) Required field measurements.
      - 8) Design certification for connection of mechanically connected railing systems.
      - 9) Seal of professional structural engineer registered in the state where the Project resides.
    - b. Product literature.
    - c. Sample of railing showing typical welds and required finish.
  2. Information for the Record:
    - a. Welding qualifications.
    - b. Material certification.
    - c. Manufacturer's installation instructions.

**1.03 QUALITY ASSURANCE**

- A. Standards - Railing shall be fabricated, and erected in accordance with following standards.



1. "Pipe Railing Systems Manual", National Association of Architectural Metal Manufacturers, AMP 521.
  2. "Specifications for Structural Steel Buildings", American Institute of Steel Construction.
  3. "Specification for Aluminum Structures", Aluminum Association.
  4. "Structural Welding Codes", American Welding Society.
- B. Regulatory Requirements - Railing shall be fabricated, and erected to comply with MIOSHA and applicable Building Code where Project resides.
- C. Welders, Welding Operators, and Tack Welders shall be qualified by tests as prescribed in AWS Structural Welding Code.

#### **1.04 DELIVERY, STORAGE, AND HANDLING**

- A. Railing shall be handled in manner to prevent damage to shop applied coatings.
- B. Railing shall be stored in manner to prevent bending or warping. Material shall be stored away from uncured concrete and masonry.
- C. Materials to be embedded in concrete or masonry shall be delivered in sufficient time to permit proper placement.

### **PART 2 PRODUCTS**

#### **2.01 ALUMINUM RAILING**

- A. Plate - ASTM B209, alloy 6061-T6.
- B. Structural Shape - ASTM B308, alloy 6061-T6.
- C. Rod and Bar - ASTM B211 or B221, alloy 6061-T6.
- D. Pipe and Tube - ASTM B429, alloy 6005-T5, 6061-T6, or 6105-T5.
- E. Connector Fitting for Mechanical Railing System:
1. Fitting shall be cast aluminum magnesium alloy conforming to ASTM B26 with minimum ultimate strength of 40 ksi, and minimum yield strength of 20 ksi.
  2. Fitting shall be internal double tang type activated by 3/8-inch stainless steel knurled cup socket setscrew, externally connected to rail or post by means of aluminum tubular rivet nut and stainless-steel socket head cap screw.
  3. Railing system shall be Internal-Rail as manufactured by The Hollaender Mfg. Co., or equal.
- F. Railing Post Base Support Fittings:
1. All aluminum railing post support fittings, fascia brackets, wall brackets, floor flanges, etc. shall be cast, extruded, or fabricated using aluminum alloys as follows:

- a. Extruded aluminum fittings shall be made of 6063-T6 alloy.
- b. Cast fittings shall be made from aluminum-magnesium alloy conforming to ASTM B26 with minimum ultimate strength of 40 ksi and minimum yield strength of 20 ksi.
- c. Railing post base support fittings shall be as manufactured by the Hollaender Mfg. Co., or equal.

## 2.02 FASTENERS AND ANCHOR BOLTS

- A. Fasteners and anchor bolts shall be furnished and installed in accordance with Section 05500.
- B. Hardware for aluminum and stainless-steel railing shall be stainless steel. Hardware for carbon steel railing shall be galvanized or zinc-plated carbon steel.

## 2.03 RAILING SYSTEM

- A. Railings shall be shop fabricated using mechanical connections in as large of sections as practicable. Holes required for field erection shall be shop drilled.
- B. Field splices shall be made with an internal sleeve and steel screws. Splices shall be located within 6 inches of post.
- C. Expansion Joints:
  1. Expansion joints shall be provided in straight runs of railing in excess of 40-feet and at structural expansion joints.
  2. Expansion joints shall have internal sleeve extending 2-inch beyond joint on each side.
- D. Unless otherwise specified on the Drawings, posts and rails shall be 1-1/2-inch pipe, schedule 40 minimum. Railing system shall consist of top rail, intermediate rail or rails and posts with 4-inch high toe plate stiff enough to resist warping due to temperature changes.
- E. Posts shall be 1 1/2-inch nominal diameter and reinforced with internal metal stud as required by design; however, where top of post connections are more than 9-inches below the walking surface, a 2-inch nominal maximum diameter post shall be used. Top and intermediate rails shall match the diameter of the posts. Balusters shall be 5/8-inch diameter minimum and provided when indicated on Drawings.
- F. Provide internal reinforcing and stud where necessary to meet strength requirements.
- G. Post spacing shall not exceed the maximum spacing of 5 feet.
- H. Handrail bracket spacing for wall mounted railings shall not exceed 5-feet.
- I. Access openings in railings shall be provided where shown on the Drawings. Openings shall be spanned with two 1/4-inch stainless steel chains with swivel eye spring snap hooks and stainless-steel eyebolts.

- J. Handrails shall be 1 1/2-inch nominal diameter and continuous between flights of stairs or runs of ramp, and shall return to railing post at top and bottom terminations. Wall mounted handrail shall be furnished with returns to wall.
- K. Self-closing swing gates shall be provided where indicated on plan. Furnish 180-degree heavy-duty spring hinges, closure stops, top rail, bottom rail, intermediate rail, or balusters that match the encompassing railing system.

#### **2.04 PERFORMANCE REQUIREMENTS**

- A. Railing systems and their connections shall be designed by a professional engineer registered in the state where the project resides. The Contractor is responsible for employing Design engineer.
- B. Contract Documents indicated minimum standards, shop drawings shall stipulate more stringent requirements where required by the Design engineer to meet the performance criteria.
- C. The design of railing post connections to substrate shall be included. New substrate material strengths shall be taken from the Contract Documents. The makeup of existing substrate materials shall be field determined by the contractor and strength tested as deemed necessary by the Design engineer. Size and locations of removed materials for substrate verification or to be strength tested shall receive prior approval by the Engineer.
- D. Railing system shall be detailed and installed as shown on Drawings and capable of supporting the following loads without exceeding the allowable design working stresses of the materials, anchorages, and connecting devices utilized. The allowable working stresses shall be as defined by the applicable building codes and material standards. Each load shall be applied so as to produce the maximum stress in each of the respective components and post base connections. The following load cases shall be considered separately.
  - 1. Top Rail of Guardrail and Handrails:
    - a. 200 pounds concentrated load applied in any direction at any point along the rail.
    - b. 50 pounds per linear feet applied in any direction along the rail.
  - 2. Intermediate Rail:
    - a. 50 pounds per linear feet applied in any direction along the rail.
  - 3. Panel Fillers, Spindles, and Balusters:
    - a. 150 pounds per one square foot applied in any direction where load produces the maximum stress on the panel, spindles, or balusters.
  - 4. Maximum 2-inch deflection at top of railings.

#### **2.05 FABRICATION**

- A. The railing system shall be fabricated as specified herein and as shown on the Drawings.

- B. Rail-to-end post and rail-to-corner post connections shall be formed with accurately mitered joints. Other changes in rail direction shall be formed by radius bends.
- C. Elbow bends and wall returns shall be formed to uniform radius, free from buckles and twists, with smooth finished surfaces.
- D. Exposed ends of pipe and tube shall be closed with welded metal closures or prefabricated fittings.
- E. Burrs, sharp edges, and other projections shall be removed. Exposed cut edges shall be blunted by grinder.
- F. Joints shall be fabricated so as to exclude water. Weep holes shall be provided in locations where water may accumulate.

## 2.06 SHOP COATING

- A. Aluminum:
  - 1. Aluminum railing shall have Architectural Class I, anodic coating applied after fabrication.
  - 2. Surfaces which will be in contact with concrete or masonry or dissimilar metals shall receive heavy coat of coal tar paint, Bitumastic Super Service Black, or equal.
- B. Carbon steel railing shall be hot dip galvanized after fabrication in conformance with ASTM A123.

## PART 3 EXECUTION

### 3.01 COORDINATION

- A. Prior to fabrication, Contractor shall field measure structures to which railing is attached.

### 3.02 INSTALLATION

- A. Railing shall be installed in accordance with manufacturer's instructions. Railing shall be installed straight and level or parallel to rake of steps and ramps as required.
- B. Railing shall be placed on both sides of stairs and ramps. All ramps higher than 6-inches shall be provided with railings.
- C. Type V handrail shall be installed 34 inches above the leading edge of the stair treads or ramp surface. Type V handrail shall be provided along interior and exterior stairs and ramps that run along walls, unless noted otherwise on the Drawings.
- D. Components shall be assembled as indicated on Drawings. Light drifting is permitted to draw parts together, but drifting to match unfair holes is not permitted. Enlarging holes by burning is prohibited.

- E. Field bending, cutting, welding, or other altering of galvanized or anodized material is not permitted. Railing so altered will be considered defective.

**3.03 COATING REPAIR**

- A. Welds, bolts, and damage to shop applied coatings shall be touched-up with same or equivalent materials used in original coating.
- B. Minor scratches or defects in galvanized coating may be repaired with zinc-rich paint in accordance with ASTM A780 at Engineer's discretion.
- C. Repair of anodized coatings in the field is not permitted. Damaged railing shall be removed and re-anodized.

**3.04 CLEANING**

- A. Railing shall be cleaned as it is installed using ordinary wax cleaners, soaps, or mild detergents. Steel wool, harsh abrasives, or alkaline or acid cleaners are not permitted.

**PART 4 SPECIAL PROVISIONS**

Not used.

END OF SECTION

**SECTION 05530  
METAL BAR GRATING**

**PART 1 GENERAL**

**1.01 SCOPE**

- A. This Section includes furnishing, shop detailing, fabricating, shop coating, and installing grating as shown on the Drawings and specified herein.

**1.02 SUBMITTALS**

- A. Submittals shall be in accordance with the requirements of Section 01300 and shall include:
  - 1. Shop Drawings for Review.
    - a. Shop Drawings shall indicate:
      - 1) Layout of grating panels.
      - 2) Location of openings.
      - 3) Accessory materials.
      - 4) Required field measurements.
    - b. Product literature.
    - c. Samples of each type of grating required.
  - 2. Information for the Record:
    - a. Span tables.
    - b. Installation instructions.

**1.03 QUALITY ASSURANCE**

- A. Standards - Grating shall be designed, fabricated, and installed in accordance with the following standards.
  - 1. "Metal Bar Grating Manuals" MBG531 (Aluminum and Light Duty Steel Grating) and MBG532 (Heavy-Duty Steel Grating), National Association of Architectural Metal Manufacturers (NAAMM).

**1.04 DELIVERY, STORAGE, AND HANDLING**

- A. The Contractor shall exercise particular care in handling materials to prevent damage to shop applied coatings.
- B. Material shall be stored in a manner to prevent bending or warping. Material shall be stored away from uncured concrete and masonry.

## **PART 2 PRODUCTS**

### **2.01 RESERVED**

### **2.02 ALUMINUM GRATING**

- A. Bearing Bars - 3/16-inch thick alloy 6061-T6 or 6063-T6 conforming to ASTM B221, rectangular in cross-section and spaced at 1-3/16-inch centers. Where accessible grating is indicated, bearing bars shall be spaced at 11/16-inch centers. The depth of bearing bars shall satisfy loading, span, and deflection requirements but shall not be less than shown on the Drawings.
- B. Banding Bars - 1/4-inch thick alloy 6061-T6 or 6063-T6 conforming to ASTM B221.
- C. Cross bars shall be spaced at 4-inch maximum. Bearing bars shall be punched to receive cross bars. Cross bars shall be inserted through punched holes in bearing bar and swage-locked to prevent turning, twisting, or loosening.
- D. Surface of grating shall be plain unless other surface types are shown on the Drawings.

### **2.03 RESERVED**

### **2.04 FASTENERS**

- A. Where fastening of grating is shown or specified:
  - 1. Grating less than 2-1/2-inch deep shall be secured with saddle type grating clips. Clips for aluminum grating shall be stainless steel. Clips for steel grating shall be galvanized.
  - 2. Grating 2-1/2-inch and deeper shall be secured by means of anchor blocks welded between bearing bars.

### **2.05 PERFORMANCE REQUIREMENTS**

- A. Grating shall be capable of supporting uniform live load of 100 pound per square feet or a moving concentrated load of 300 pounds, whichever results in a stronger design, unless noted otherwise.
- B. Deflection shall not exceed 1/4-inch for the required span and specified loads.
- C. Unit stress in bending for steel grating shall not exceed 20,000 psi. Steel shall conform to ASTM A36.
- D. Unit-stress in bending for aluminum grating shall not exceed 12,000 psi. Grating shall be made of aluminum alloy 6061-T6 or 6063-T6 conforming to ASTM B221.
- E. All grating shall comply with OSHA General Industry Regulations, latest edition.

### **2.06 FABRICATION**

- A. Bearing bar shall be rectangular in cross section. Depth shall be as shown or specified, but not less than that required to meet specified loading and deflection criteria. Minimum depth shall be 1-inch.

- B. Notching, cutting, or slotting top or bottom of bearing bars is prohibited.
- C. Grating panels shall bear a minimum of 1-inch on structural supports or grating frame.
- D. Ends of grating panels shall be finished with trim banding bars. Depth of trim banding shall be 1/4-inch less than depth of bearing bar. Trim banding shall be attached flush to the walking surface and welded to bearing bars at 5-inch maximum spacing.
- E. Holes and cutouts shall be shop cut and banded. Banding bars shall be full depth of grating and shall be welded to each bearing bar.

## **2.07 SHOP COATING**

- A. Aluminum Grating - Surfaces which will be in contact with concrete, masonry, or dissimilar metal shall receive heavy coat of coal tar paint, Bitumastic Super Service Black, or equal.
- B. Steel Grating - Grating shall be hot dip galvanized after fabrication in conformance with ASTM A123.

## **PART 3 EXECUTION**

### **3.01 COORDINATION**

- A. The Contractor shall field measure grating frames and openings and locate obstructions which will pass through grating prior to fabricating grating.
- B. The Contractor shall coordinate size and locations of openings in grating with other Work.

### **3.02 INSTALLATION**

- A. Grating shall be installed in accordance with manufacturer's instructions. Cross bars shall be on top.
- B. Grating shall be set flush with surrounding surface and shall not rock during use. Bearing bars shall not be notched nor shimmed to maintain proper elevation or to eliminate rocking.
- C. Grating shall not be field bent, cut, welded, or otherwise altered. Grating so altered will be considered defective.
- D. Grating shall be removable unless noted otherwise. Grating that is indicated as being fastened shall be secured to frame or other supporting members as specified herein.
- E. Platforms, landings, catwalks, and walkways shall be fastened to supporting structure.

### **3.03 COATING REPAIR**

- A. Shop applied coatings which have been damaged shall be repaired with the same or equivalent materials used in original coating.
- B. Repair of minor scratches or defects in galvanized coating may be repaired with zinc-rich paint in accordance with ASTM A780 at Engineer's discretion.



**3.04 CLEANING**

- A. Grating shall be cleaned with mild detergents prior to final acceptance. Steel wool, harsh abrasives, or alkaline or acid cleaners are not permitted.

**PART 4 SPECIAL PROVISIONS**

**4.01 FABRICATOR APPROVAL**

- A. The fabricator of structural load bearing members and assemblies furnished under this Section, shall be registered and approved to fabricate these products without special inspections per the requirements of the current Building Code Section 1704. The approved fabricator shall submit evidence of such registration at the time that Shop Drawings are submitted. At the completion of production, the approved fabricator shall submit a certificate of compliance to the local building code official stating that the fabrication was performed in accordance with the Contract Documents and the approved Shop Drawings.

END OF SECTION

**SECTION 07200  
WALL AND CEILING INSULATION**

**PART 1 GENERAL**

**1.01 SCOPE**

- A. This Section includes thermal insulation for buildings excluding roof insulation.

**1.02 SUBMITTALS**

- A. Submittals shall be in accordance with the requirements of Section 01300 and shall include:
1. Shop Drawings for Review:
    - a. Product literature.
    - b. Two samples of each type and thickness of insulation. Samples shall be minimum 8-inch by 8-inch.
  2. Information for the Record:
    - a. Manufacturer's certification.
    - b. Manufacturer's installation instructions.

**PART 2 PRODUCTS**

**2.01 MATERIALS**

- A. Insulation shall be of type and thickness shown or specified.
- B. Insulation shall not rot, disintegrate, slump, or leave uninsulated voids and shall not provide sustenance to vermin, rodents, insects, bacteria, or fungi. Insulation shall not react with or accelerate corrosion of steel, aluminum, or copper. Insulation shall be odorless.
- C. Combustible insulation shall be treated with fire retardant.
- D. Insulation shall retain thermal capacity for minimum of 20 years.
- E. Production of insulation shall not utilize chemicals banned by the Montreal Accord.

**2.02 TYPES**

- A. Type A - Fiberglass Batts - Insulation shall be fiberglass batts or blankets with integral vapor barrier unless indicated otherwise. Maximum thermal conductivity shall be 0.32 Btu per hour per degree F per inch of thickness per square foot.
- B. Type B - Rigid Polystyrene - Insulation shall be rigid boards of extruded polystyrene foam. Tongue and groove joining shall be utilized in all applications except in cavity walls. Cavity wall insulation shall be square edge, board width to match horizontal reinforcing. Insulation shall be as manufactured by Dow Chemical Company, or equal.

- C. Type C – Vermiculite - Insulation shall be free-flowing granular Vermiculite in conformance with ASTM C516, Type 2. Insulation shall be treated with water repellent. Zonolite, Perlite, or equal.
- D. Type D - Block Inserts - Insulation shall be polystyrene foam formed to fit inside cells of hollow concrete masonry units. Korfil Inc. "Korfil", or equal.
- E. Type E - Sprayed-in-Place Polyurethane Foam Insulation:
  - 1. The in-place density of the polyurethane foam shall be a minimum of 2.8 pounds per cubic feet.
  - 2. The minimum compressive strength of the in-place foam shall be 50 psi.
  - 3. The thermal conductivity K-factor shall not exceed 0.12 Btu per hour per degree F per inch of thickness per square feet area.
  - 4. The polyurethane's in-place flame spread rating shall not exceed 75, as defined in ASTM E84.
  - 5. The polyurethane insulation shall be IPI Isofoam SS-0558, or equal.
  - 6. The insulation thickness shall be a minimum of 1-1/2 inch unless otherwise shown on the Drawings or specified in Part 4.
  - 7. The insulation shall be placed in two layers. The second layer of insulation shall be applied within 48 hours of the first. No insulation shall be left exposed to the atmosphere for more than 84 hours.

### **PART 3 EXECUTION**

#### **3.01 PREPARATION**

- A. The Contractor shall examine surfaces to receive insulation prior to installation. Surfaces shall be dry, free of dirt, dust, and debris.
- B. Unacceptable conditions shall be reported to the Engineer.

#### **3.02 INSTALLATION**

- A. Insulation shall be installed and secured in locations shown. Installation shall be in accordance with manufacturer's instructions.
- B. Cavity wall insulation shall be placed against interior wythe of masonry and shall be secured with insulation retainers attached to wire joint reinforcement. Each board shall be secured top and bottom at 30-inch centers.

#### **3.03 APPLICATION OF SPRAYED-IN-PLACE POLYURETHANE FOAM**

- A. The foam shall be applied uniformly over the entire surface with a tolerance of plus 1/4-inch, per inch of thickness, minus zero except where variations are required to ensure proper drainage or to complete a feathered edge.

- B. The spray-applied foam shall be applied in uniform pass thicknesses from 2-inch to 3/4-inch.
- C. Foam used in masonry block cores shall fill the entire core. Foam shall not be used in reinforced cores.

**3.04 PROTECTION**

- A. Insulation shall be protected from moisture and inclement weather. Exposed insulation shall be covered at end of each work day or at onset of inclement weather.
- B. Damaged or wet insulation shall be removed and replaced with new material.

**PART 4 SPECIAL PROVISIONS**

Not used.

END OF SECTION

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**SECTION 07532  
ADHERED MEMBRANE PVC ROOFING SYSTEM**

**PART 1 GENERAL**

**1.01 SCOPE**

- A. This Section includes complete, fully-adhered, single ply, membrane PVC roofing system.

**1.02 SUBMITTALS**

- A. Submittals shall be in accordance with the requirements of Section 01300 and shall include:
1. Shop Drawings for Review:
    - a. Manufacturer's product literature describing the physical properties of all roofing components.
    - b. Drawings showing layout of insulation, including crickets and tapered boards.
  2. Submittals for the Record:
    - a. Membrane manufacturers complete instructions for the application of the membrane system including membrane termination details.
    - b. Insulation manufacturer's instructions for securement of insulation to the deck, including fastener density and pattern.
    - c. Contractor's qualifications.
    - d. Manufacturer's certification.
    - e. Performance guarantee and manufacturer's warranty.

**1.03 QUALITY ASSURANCE**

- A. The Contractor shall be licensed by membrane manufacturer to install manufacturer's product.
- B. The manufacturer shall certify that all components and materials meet requirements of Specifications and are compatible with roofing system.
- C. Roof system shall meet the following:
1. UL - Class A.
  2. Factory Mutual – Windstream Classification, Class - I-90.

**1.04 WARRANTY**

- A. The Contractor shall provide manufacturer's 20-year Total System Warranty on roofing system and related components. The roofing system is defined as membrane, insulation boards, flashings, adhesives, sealants, and other components provided by manufacturer

as an integral part of membrane system, as well as the authorized, licensed roofing contractor's workmanship used to install these materials. Warranty to also include a 72-mph wind warranty as standard.

- B. In addition to the above manufacturer's total system warranty, the Contractor shall provide following performance agreement, which shall bear notarized signature of the Contractor, before payment for the roofing will be made.
1. "For a 2-year period, from the date of final acceptance, the Contractor will provide for the repair of defects and leaks in the roof system within 24 hours of notification from the Owner. The Contractor shall restore the affected areas to the standard of the original Contract Documents without cost to the Owner, unless it is determined that such leaks and defects were caused by abuse, or by an unusual natural phenomenon or failure of related work by others not party to the original Contract."

## PART 2 PRODUCTS

### 2.01 MANUFACTURERS

- A. Duro-Last Supreme membrane system shall be standard products of single manufacturer.
- B. Acceptable manufacturers: Duro-Last, Inc.

### 2.02 MEMBRANE SYSTEM

- A. Membrane shall be 60 mil reinforced fire retardant polyvinylchloride polymer blend. Standard membrane sheet shall be a minimum of 10-feet wide.
- B. Membrane shall meet the following minimum physical properties:

Physical Property	Test Method	Specification
Tolerance on nominal thickness, percent	ASTM D751	+ 10
Thickness over scrim	ASTM D7635	28 mil
Elongation, ultimate, min. percent	ASTM D751	31%x31%
Tear strength	ASTM D751	132x163 lbf.
Breaking strength	ASTM D751 Grab Method	438x390 lbf/in
Resistance to water absorption 7-day immersion @ 158-degree F (70-degree C) Change in mass, max. percent	ASTM D570	2.6
Heat Aging	ASTM D3045	10,000 hrs
Static Puncture	ASTM D5602	56 lbf
Dynamic Puncture	ASTM D5635	14.7 ft-lbf

- C. Membrane flashing shall be white 60 mil PVC sheet roofing as required by membrane manufacturer's details.
- D. Splice cleaner, adhesives, primers, sealants, and pourable sealers shall be integral components of membrane system.

**2.03 INSULATION**

- A. As indicated on the roof plans and details, provide rigid polyisocyanurate foam core in layers and thicknesses indicated. Insulation board to comply with ASTM 3273 for mold resistance with coated glass facers on both sides. Flat and tapered board as indicated on Drawings.
- B. Acceptable manufacturers: Duro-Last, Inc.
- C. Insulation shall have a density of 1.5 pcf and shall have minimum compressive strength of 21 psi nominal at 10% deformation.
- D. Insulation board size shall be 4-feet by 8-feet. Preformed tapered boards shall be used to slope roof where indicated on Drawings. Insulation thickness shall be as shown on Drawings.
- E. Insulation shall be manufactured with non-ozone depleting agents.

**2.04 FASTENING COMPONENTS**

- A. Insulation and vapor barrier shall be fully adhered to concrete deck. The adhesive shall be compliant with FM I-90 requirements and installed per the membrane manufacturer’s recommendations.
- B. Fasteners for use with steel or plywood decks shall be high performance, threaded, flouropolymer grit coated fasteners, with minimum pullout of 360 pounds per fastener.
- C. Insulation fastening plates shall be 3-inch diameter FM approved metal plates.

**2.05 VAPOR BARRIER**

- A. SBS modified bitumen adhesive, factory-laminated to a tri-laminate woven, high-density polyethylene top surface. V-Force Vapor Barrier Membrane by Firestone or roof membrane manufacturer equal including the appropriate primers as required.
- B. Vapor barrier shall meet the following minimum physical properties:

Property	Test Method	Firestone Typical Performance
Thickness:	D5147	30 mils (0.076 mm)
Tensile Strength:	D5147	64 lbf/in (11.3 kN/m), MD
		88 lbf/in (15.4 kN/m), XMD
Ultimate Elongation, Bitumen Portion, at 73 degrees F (23 degrees C):	D5147	52%, MD
		24%, XMD
Low Temperature Flexibility (Cold Bending):	D5147	-31 °F (-35 °C)
Static Puncture:	D5602	90 lbf (400 N)
Tear Strength at 73 degrees F (23 degrees C):	D5601	84 lbf, MD (375 N)
		90 lbf, XMD (400 N)
Lap Adhesion at 73 degrees F (23 degrees C):	D1876	6 lbf/in (1.05 kN/m)
Water Absorption, % by Weight:	D5147	<0.1 %
Peel Resistance:	D903	8 lbf/in (1.4 kN/m)
Water Vapor Permeance, Max.:	E96 Procedure B	0.017 perms (0.92 Ng/Pa•s•m <sup>2</sup> )
Air Permeability:	D1970	0.00114 ft <sup>3</sup> /min•ft <sup>2</sup> (0.007 L/sec•m <sup>2</sup> )



## 2.06 WALKWAYS

- A. Duro-Last Roof Pavers shall be light grey pad with factory rounded corners, and shall be standard product of membrane manufacturer.

## PART 3 EXECUTION

### 3.01 PREPARATION

- A. Deck shall be cleared of debris and foreign material.
- B. Deck shall be even without high spots or depressions and shall be free of water, ice, or snow.
- C. Contractor shall inspect deck and notify Engineer of defects before beginning Work.

### 3.02 INSTALLATION

- A. Vapor Barrier:
  - 1. Deck surface shall be primed as required by vapor barrier manufacturer.
  - 2. Vapor barrier shall be installed loose laid directly over deck with a minimum lap of 6-inch at adjoining sheets.
- B. Insulation:
  - 1. Insulation shall be installed directly over vapor barrier. When insulation thickness is greater than 2-inch insulation shall be installed in two layers. Top layer shall be minimum of 2-inch thick.
  - 2. Insulation boards shall be butted together with no gaps greater than 1/4-inch.
  - 3. Joints between layers of insulation shall be staggered minimum of 12-inch.
  - 4. On metal decks, after placement of top layer, insulation shall be secured to deck with insulation fasteners and plates. Fastener pattern and density shall be as required by the insulation manufacturer.
  - 5. On concrete decks, pilot holes shall be predrilled through insulation and into deck prior to installation of fasteners. Size and depth of pilot holes shall be as recommended by fastener manufacturer.
- C. Membrane System:
  - 1. Membrane shall be installed, spliced, and secured in accordance with manufacturer's written instructions and details.
  - 2. Position membrane over insulation without stretching.
  - 3. Allow membrane to relax 1/2 hour before bonding to insulation.
  - 4. Lap splices shall be minimum of 6-inch wide.
  - 5. Additional membrane securement shall be provided at perimeter of each roof level, roof section, expansion joint, curb, skylight, interior wall, penthouse, angle

change greater than 2-inch in one horizontal foot, and at other penetrations where recommended by membrane manufacturer.

6. Penetrations and walls shall be flashed with PVC membrane or prefabricated accessories (pre-molded and pressure-sensitive products such as pipe boots, pourable sealer pockets, inside/outside corners) that are standard products of membrane manufacturer. Where use of cured membrane or prefabricated accessories is not practical, uncured moldable neoprene shall be used. Membrane flashing shall be installed and terminated in accordance with the membrane manufacturer's written instructions and details.
- D. Walkways:
    1. Provide and install 21 24x24 walkway pads at location selected by the Owner.
  - E. Daily Seal - When completion of flashings and terminations is not completed by end of work day, loose edges of membrane shall be temporarily sealed in accordance with membrane manufacturer's written instructions and details.

#### **PART 4 SPECIAL PROVISIONS**

Not used.

END OF SECTION

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**SECTION 07600  
FLASHING AND SHEET METAL WORKS**

**PART 1 GENERAL**

**1.01 SCOPE**

- A. This Section includes furnishing and installing metal flashing, except through-wall flashing for masonry construction.

**1.02 SUBMITTALS**

- A. Submittals shall be in accordance with the requirements of Section 01300 and shall include:
  - 1. Shop Drawings for Review:
    - a. Manufacturer's product literature.

**PART 2 PRODUCTS**

**2.01 ALUMINUM SHEET**

- A. Alloy and temper of sheet shall be 3003-H14.
- B. Thickness of sheet shall be 0.032-inch.
- C. Sheet shall conform to standards published by the Aluminum Association.

**2.02 SPECIAL FINISHES**

- A. Anodic coating shall be Architectural Class I. Color will be selected by Owner.
- B. Paint shall be a fluorocarbon coating containing polyvinylidene fluoride resin (Kynar® or equal).

**2.03 FASTENERS**

- A. Cleats shall be aluminum of same alloy, temper, and thickness of sheet being fastened, and shall not be less than 2-inch wide.
- B. Nails shall be aluminum alloy 6061 conforming to FS FF-N-105B, Type II, Style 20.
- C. Screws, bolts, nuts, and washers shall be aluminum alloy 6061-T6. Washers shall not be less than 0.040-inch thick.

**2.04 FABRICATION**

- A. Flashing shall be formed of aluminum sheet not longer than 10 feet.
- B. Mechanical seams and joints shall be flat-lap or lock seams. Seams and end joints shall not be riveted or fastened to restrict thermal movement. Sealant-filled controlled slip joints shall be used to allow thermal movement.

- C. Brazing of aluminum sheet shall be permitted only under shop conditions. Filler alloy 4047 shall be used for brazing and flux residue shall be completely removed.
- D. Field welding of aluminum sheet shall be permitted only when done with gas tungsten-arc (TIG) or gas metal-arc (MIG) welding processes. Filler alloy 4043 or 1100 shall be used.
- E. Oxyfuel-gas welding of aluminum sheet shall be permitted only under shop conditions. Filler alloy 4043 or 1100 shall be used and flux residue shall be completely removed.
- F. Soldering of aluminum shall not be permitted.

#### **2.05 BITUMINOUS PAINT**

- A. Bituminous paint shall be of the cutback type conforming to Specification MIL-C B (1).

### **PART 3 EXECUTION**

#### **3.01 COORDINATION**

- A. Contractor shall examine the roofing manufacturer's details and coordinate Work between trades before sheet metal is installed.

#### **3.02 PREPARATION**

- A. Surfaces receiving aluminum sheet shall be smooth, dry, and free of small projections and hollows.
- B. Aluminum sheet surfaces to be in contact with concrete or masonry shall be coated with bituminous paint.
- C. Anodizing shall be done subsequent to forming and fabricating.

#### **3.03 INSTALLATION**

- A. Apron Flashing:
  - 1. The ends of each length of apron flashing shall be lapped not less than 4-inch, or alternatively, a 2-inch sealant filled "S" lock shall be formed at one end of the flashing sheet to receive the end of the adjacent sheet.
  - 2. Where sloping roof meets vertical wall, the flashing shall extend up the wall face not less than 4-inch and shall be counter-flashed. The flashing shall extend over the roofing not less than 5-inch. The lower edge shall be hemmed and secured by blind cleats spaced at 24-inch centers.
- B. Valleys:
  - 1. Valley sheets shall extend not less than 6-inch under the roof covering on each side of the valley, and side edges shall be folded 1/2-inch for cleating. Sheets shall lap not less than 6-inch in the direction of the flow and the upper edge shall be nailed to the roof deck. Side edges shall be secured and aluminum cleats spaced at 24-inch.

2. The open portion of the valley shall not be less than 5-inch in width at the top and increase in width 1/8-inch per foot toward the eaves.
  3. Where intersecting roofs are on different slopes, an inverted "V" 1 1/2-inch high shall be formed in the metal along the center line of the valley and the lap of the valley sheets shall be increased to 8-inch.
- C. Gravel Stops:
1. Gravel stop shall not be less than 1 1/2-inch high and the outer edge shall extend down not less than 4-inch to form a fascia. The horizontal flange shall extend onto the roof not less than 4-inch and shall be secured to wood nailer with aluminum nails spaced at 3-inch on centers.
  2. The lower edge of the fascia shall be turned out 3/4-inch at an angle of 45 degrees to form a drip and shall hook 3/4-inch over a previously placed aluminum edge strip.
  3. Edge strips shall be continuous with ends of adjacent lengths lapping not less than 1-inch. The lower edge shall be turned out 45 degrees to receive the drip edge of the fascia. Edge strips shall be fastened to wood with aluminum nails spaced at 4-inch, or to masonry with screws spaced at 10-inches.
  4. Corner pieces shall be fabricated and mitered. End joints shall be made using a 12-inch long back-up plate and a 5-inch long top cover plate.
- D. Counter Flashing:
1. Counter flashing shall be installed over base flashings where shown on the Drawings.
  2. On masonry walls, the mortar joint to receive counter flashing shall be raked out to a depth of 1-inch. The counter flashing shall extend into the raked-out joint with the inner edge bent back to form a hook dam. The counter flashing shall be secured by aluminum wedges not more than 8-inch apart and the joint shall be filled with sealant, as specified in Section 07900.
  3. The counter flashing shall overlap the base flashing by not less than 3-inch, and the ends of adjacent lengths shall overlap not less than 3-inch.
- E. Coping Covers:
1. Flat seam cap flashing shall cover parapet walls and shall be joined by 1-inch loose lock seams filled with sealant. Walls shall have a continuous edge strip along both sides secured to wood plate with aluminum nails spaced at 4-inch. The cap flashing shall be hooked over the edge strips with a 3/4-inch loose lock seam.
  2. Corner pieces shall be shop fabricated and mitered.

- F. Miscellaneous:
1. Scupper flashing shall cover the interior of the opening provided in wall and shall extend through and project outside of wall as shown on Drawings. Scupper box shall have continuous sides and shall be 1/2-inch smaller than the masonry opening. Flange on the roof side of the scupper box shall extend not less than 4-inch on all sides. Flange shall be continuous with rounded corners.
  2. Aluminum cap flashing shall be provided for curbs, roof hatches, etc., as required by roofing manufacturer's details.
- G. Drip edge, soffit, and fascia shall be installed where shown on the Drawings.

**PART 4 SPECIAL PROVISIONS**

Not used.

END OF SECTION

**SECTION 07630  
GUTTERS AND DOWNSPOUTS**

**PART 1 GENERAL**

**1.01 SCOPE**

- A. This Section includes furnishing and installing gutters and downspouts.
- B. All work performed under this Section shall comply with and be in accordance with all approved trade practices and manufacturers' recommendations.

**1.02 SUBMITTALS**

- A. Submittals shall be in accordance with the requirements of Section 01300 and shall include:
  - 1. Shop Drawings for Review:
    - a. Manufacturer's literature.
  - 2. Information for the Record:
    - a. Samples as requested by Engineer.

**PART 2 PRODUCTS**

**2.01 ALUMINUM GUTTERS AND DOWNSPOUTS**

- A. Aluminum gutter and downspout system shall meet the following thicknesses:

Gutters	0.032-inch
Downspouts	0.024-inch
Roof Apron	0.027-inch
End Caps	0.027-inch

- B. Sealing material shall be Alcoa Gutterseal, Reynolds Aluminum, or equal.
- C. Expansion joints shall be aluminum neoprene.
- D. Downspout anchors shall be aluminum die casting and spaced no greater than 30 inches apart.
- E. Finishes shall be baked enamel; color selected by the Owner from manufacturer's standards.

**2.02 RESERVED**

**PART 3 EXECUTION**

**3.01 INSTALLATION**

- A. Installation shall be complete and in accordance with the manufacturer's recommendations, the Engineer's instructions, and the Contract Documents.



- B. Gutters and downspouts shall be installed in accordance with the International Building Code Chapter 15 and the International Plumbing Code Chapter 11.

**3.02 ALUMINUM INSTALLATION**

- A. Sealing joints and final cleaning shall be in accordance with Alcoa Architectural Aluminum Care During Construction, latest edition.

**3.03 RESERVED**

**PART 4 SPECIAL PROVISIONS**

**4.01 GUTTER SCHEDULE**

Gutter Size	Downspout Size	Material	Location
5"K – Style	3" x 4"	Aluminum	SCBS

END OF SECTION

**SECTION 07800  
ROOF ACCESSORIES**

**PART 1 GENERAL**

**1.01 SCOPE**

- A. This Section includes roof hatches, domed hatchways, skylights, prefabricated roof curbs, and the necessary appurtenances to provide a complete project.
- B. All Work performed under this Section shall comply and be in accordance with all approved trade practices and manufacturers' recommendations.

**1.02 SUBMITTALS**

- A. Submittals shall be in accordance with the requirements of Section 01300 and shall include:
  - 1. Shop Drawings for Review:
    - a. Manufacturer's literature.
    - b. General arrangement, sectional assembly, and dimension drawings.
    - c. Materials of construction.

**PART 2 PRODUCTS**

**2.01 GENERAL**

- A. All roof hatches, hatchway domes, and skylights shall be capable of withstanding a uniform 40 pounds per square feet snow load.
- B. All roof hatches not encompassed by handrails or protective guards shall be capable of withstanding a 300-pound concentrated live load applied to any one area perpendicular to its surface. Such units need not support this load concurrently with the snow load.
- C. All skylights and hatchway domes shall be encompassed by a protective handrail meeting the requirements of Section 05520.

**2.02 RESERVED**

**2.03 SKYLIGHTS**

- A. Skylights shall consist of a double acrylic dome (one clear and one frosted pane), supported in extruded aluminum frames. Frame extrusions shall be a minimum of 0.08-inch thick and be designed for attaching to a curb as shown on the Drawings. Skylight design shall include integral condensation gutter and drainage slots to carry moisture to the exterior. The size of skylights to be furnished is shown on the Drawings.
- B. Skylight assembly shall be Wasco CWD2-5252, deck mount with 16" curb and safety screen.

- C. Use cadmium plated fastenings to secure skylight frame to curb. Provide 16-gauge aluminum flashing for curb in accordance with details shown on the Drawings.

**2.04 RESERVED**

**2.05 PREFABRICATED ROOF CURBS**

- A. Prefabricated roof curbs shall be installed where shown on the Drawings.
- B. Curbs shall be produced by the Pate Co., ThyCurb, or equal.
- C. Curbs shall be a minimum of 16-gauge aluminum construction, continuous mitered and welded corner seams, integral base plate, factory installed railer, and insulated with 1-1/2-inch thick rigid fiberglass. The exposed surface of the insulation shall be covered with a minimum of 22-gauge aluminum sheet firmly fastened in place.
- D. Aluminum surfaces shall be insulated from concrete with application of a bitumastic paint.

**PART 3 EXECUTION**

**3.01 INSTALLATION**

- A. Roof openings shall be roofed in to form a completely weathertight unit. Roofing shall be turned up under the flashing of the roof accessories and mopped in.
- B. All units shall have the parts touching concrete heavily coated with a bituminous compound. If factory coating is damaged or scratched, it shall be repaired.
- C. Installation shall be complete and in accordance with the manufacturer's recommendations, Engineer's instructions, and the Contract Documents.

**PART 4 SPECIAL PROVISIONS**

Not used.

END OF SECTION

**SECTION 07900  
CAULKING AND SEALANTS**

**PART 1 GENERAL**

**1.01 SCOPE**

- A. This Section includes caulking and sealants.

**1.02 SUBMITTALS**

- A. Submittal shall be in accordance with the requirements of Section 01300 and shall include:
1. Shop Drawings for Review:
    - a. Contractor shall indicate variances from requirements of Contract Documents.
    - b. Product literature.
    - c. Manufacturer's standard color chart.
  2. Information for the Record:
    - a. Manufacturer's surface preparation and installation instructions.
    - b. Written guarantee.

**1.03 QUALITY ASSURANCE**

- A. The Contractor shall have minimum of five years' experience installing sealants.

**1.04 GUARANTEES**

- A. The Contractor shall guarantee sealant joints against adhesive and cohesive failure of sealant and against water penetration through joint for five years.

**PART 2 PRODUCTS**

**2.01 CAULKING AND SEALANTS**

- A. Type A:
1. Sealant shall be two component polyurethane sealant, conforming to ASTM C920, Type M, Class 25, Type I, and either Grade NS or Grade P as appropriate. Sealant shall have Shore A hardness of 20-40 and minimum elongation of 500%.
  2. Sealant shall be suitable for continuous immersion service in water and sewage.
  3. Sealant shall be Sika Corporation "Sikaflex-2c NS/SL", Polymeric Systems, Inc. "PSI 501/551", or equal.

- B. Type B:
  - 1. Sealant shall be one component neutral or acetoxy cure silicone sealant conforming to ASTM C920, Type S, Class 25, Grade NS with Shore A hardness of 25-30.
- C. Type C:
  - 1. Sealant shall be one component, non-sag mildew resistant silicone sealant conforming to ASTM C920, Type S, Class 25, Grade NS, with Shore A hardness of 25-30.
- D. Type D:
  - 1. Sealant shall be one component acrylic latex caulk conforming to ASTM C834. Material shall be suitable for painting.
- E. Type E:
  - 1. Two component, coal-tar extended, fuel resistant polyurethane sealant conforming to ASTM C920, Type M, Class 25, Grade NS or Grade P as appropriate, with Shore A hardness of 15-35.

## 2.02 ACCESSORIES

- A. Primer shall be sealant manufacturer's recommended primer for intended substrates and intended service conditions. Primer shall be non-staining.
- B. Backer rod shall be closed cell polyethylene or polyurethane as recommended by sealant manufacturer. Materials impregnated with oils, asphalt, or solvents are not acceptable. Backer rod shall be minimum of 33% oversized.
- C. Bond breaker tape shall be polyethylene or similar type material which does not bond to sealant.

## PART 3 EXECUTION

### 3.01 COORDINATION

- A. Manufacturer's recommendations for proper temperature and humidity conditions for installation shall be followed. Sealants shall not be installed when the ambient temperature is below 40 degrees F.
- B. Substrate surface shall be inspected to ensure that no bond breaking materials contaminate surfaces to which sealant is to adhere.
- C. Joint dimensions shall be verified prior to installing sealant to ensure that dimensions are within tolerances specified in sealant manufacturer's literature.

### 3.02 PREPARATION

- A. Surfaces shall be prepared in accordance with manufacturer's recommendations to ensure maximum adhesion. Surfaces shall be dry, sound, and free of oil, grease, dust,

dirt, curing agents, temporary protective coatings, and other materials deleterious to bond.

- B. Adjacent surfaces which are not to receive sealant shall be masked before primer and sealant is applied. Masking shall be removed immediately after sealant has been installed and tooled.
- C. Primer shall be applied prior to installation of backer rod or bond breaker tape.

**3.03 INSTALLATION**

- A. Backer rod shall be installed using only blunt or rounded tools designed to ensure uniform depth of backer rod without puncturing the material. Backer rod shall not be stretched, twisted, or braided.
- B. Where joint depth does not permit use of backer rod, bond breaker tape shall be installed to prevent three-sided adhesion.
- C. Sealants shall be prepared, mixed, and installed in accordance with manufacturer's instructions using equipment recommended by sealant manufacturer. Sealant shall be installed as shown.
- D. Sealants shall be tooled to uniformly smooth, slightly concave surface as shown on Drawings.

**3.04 SCHEDULE**

- A. Unless shown or specified otherwise, sealant types shall be as follows:

Joint Type or Use	Sealant Type
Expansion joints, control joints, isolation joints, precast concrete joints.	A
Door, window, and other wall penetrations in exterior walls.	A
Joints in liquid-retaining structures	A
Structural or non-structural glazing	B
General building-interior use in bathrooms, kitchens, locker rooms, and other wet or humid areas.	C
General building use in areas other than those specified above.	D

- B. Sealant color will be selected by the Owner.

**PART 4 SPECIAL PROVISIONS**

Not used.

END OF SECTION

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**SECTION 08120  
ALUMINUM DOORS AND FRAMES**

**PART 1 GENERAL**

**1.01 SCOPE**

- A. This Section includes aluminum doors, frames, required fasteners, and other required accessories needed for completion of the Work.
- B. Additional product requirements are specified in Section 01350.

**1.02 SUBMITTALS**

- A. Submittals shall be in accordance with the requirements of Section 01300 and shall include:
  - 1. Shop Drawings for Review:
    - a. The Contractor shall indicate all variances from the requirements of the Contract Documents.
    - b. Door Schedule.
    - c. Dimensional Drawing.
    - d. Manufacturer's literature.
    - e. Samples - When requested by the Engineer.
      - 1) Samples of finish, frame corner construction, door construction, and glazing frame.
      - 2) Samples shall be clearly identified as to location and type of finish.

**PART 2 PRODUCTS**

**2.01 GENERAL**

- A. Aluminum doors shall be manufactured or furnished by Kawneer Architectural Products; Special-Lite, Inc.; Cross Aluminum Products; or equal.
- B. When possible, products furnished for use in this Section shall be of one manufacturer unless specifically shown otherwise.

**2.02 DOORS**

- A. Aluminum doors shall be flush type with or without glazing or louvers, or medium-stile entrance type, and shall have all related hardware.
- B. The doors shall be reinforced, drilled, and fitted for hardware at the manufacturer's plant.



- C. The finish of doors and door parts shall be free of scratches, defects, die lines, and blemishes and shall have a natural anodized finish in conformance with AA Specification M12C22A41.
- D. Door stiles shall consist of extruded aluminum shapes with interlocking edges to lock in face sheets. Top and bottom rails to be extruded with legs for interlocking weather bar. Corners accurately cut and milled to provide flush hairline joints.
- E. Door rims shall be tie-bolted with 3/8-inch diameter galvanized steel tension rods bearing against 1/8-inch by 1-1/2-inch by 4-inch aluminum back plates, alloy 6061-T6.
- F. Faces of doors shall consist of No. 10 Pattern aluminum sheets, 5005 Alloy, not less than 0.060-inch thick and bonded to the stiles with 3-M No. EC-2158 A-B Epoxy Adhesive. Door face sheets shall be backed with 0.125-inch tempered hardboard for added impact resistance.
- G. The interior space between face panels shall be filled with fiberglass insulation or urethane foam insulation at a minimum density of 3-pounds per cubic feet.
- H. Exterior doors shall be constructed with bottom rail weather-stripping in addition to standard top rail and stile weather-stripping.
- I. Doors shall have extruded snap-in glass stops with vinyl inserts for dry glazing.
- J. Each door of double doors shall be free to open independently of each other.

### **2.03 ALUMINUM FRAMES**

- A. All sections of frames shall be fabricated from aluminum alloy 6063 and T-6 temper with a minimum thickness of 0.125-inch. Screws shall be 18-8 stainless steel.
- B. All framing members shall be accurately milled with flush hairline joints. Frames shall be closed back or open back as detailed on the Drawings.
- C. Door frame corner members shall be heavily reinforced with channel type corner gussets fastened with concealed stainless-steel screws.
- D. Frames shall be reinforced in the areas to receive locks, hinges, and door closers.
- E. Door frames shall receive a natural anodized finish AA-C22A41. The finished product shall be free of scratches, defects, and blemishes.
- F. Door stops, overhead, shall be attached to the frame with concealed fastenings with vinyl inserts for weatherproofing and silencing.

### **2.04 METALS**

- A. Aluminum extrusion shall conform to ASTM B221 Type 6063-T5 aluminum alloy.
- B. Thickness of major portion of door sections shall be not less than 0.125-inch.
- C. Moldings, trim, and glass stops shall be not less than 0.050-inch thick.

### **PART 3 EXECUTION**

#### **3.01 DELIVERY, HANDLING, AND STORAGE**

- A. Delivery, handling, and storage shall be in accordance with the requirements of Section 01350.

#### **3.02 INSTALLATION OF FRAMES**

- A. Set frames to maintain scheduled dimensions, hold head level, and set jambs plumb and square.
- B. Secure anchorages and provide connections to adjacent construction.
- C. Apply protective coating of bituminous paint to backs of frame to separate aluminum from contact with masonry or other galvanically incompatible materials.
- D. Frame shall be set with a minimum of eight anchors.

#### **3.03 INSTALLATION OF DOORS**

- A. Comply with manufacturer's instructions for installation of door hardware, operators, and other components.
- B. Adjust hinges so doors operate smoothly and fit properly when closed.
- C. Adjust and lubricate locks, operators, and hinges.
- D. Clean aluminum surfaces and remove protective tape and excess caulking sealants.
- E. Remove all accumulated debris from Work site.
- F. Thresholds are to be provided at exterior doors. Bottom, head, and jamb weather-strips shall be adjusted to fit correctly.

### **PART 4 SPECIAL PROVISIONS**

#### **4.01 DOOR SCHEDULE**

- A. Doors in the new construction areas are in Door Schedules appearing on the Drawings.
- B. Door types are as shown on the Drawings.
- C. All dimensions are to be field verified before fabrication of the doors and frames.

END OF SECTION

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**SECTION 08125  
HEAVY-DUTY ALUMINUM DOORS AND FRAMES**

**PART 1 GENERAL**

**1.01 SCOPE**

- A. This Section includes furnishing and installing heavy duty aluminum doors, frames, required fasteners, and other accessories required for completion of the Work.
- B. Additional product requirements are specified in Section 01350.

**1.02 SUBMITTALS**

- A. Submittals shall be in accordance with the requirements of Section 01300 and shall include:
  - 1. Shop Drawings for Review:
    - a. Door Schedule.
    - b. Dimensional Drawing.
    - c. Manufacturer's literature.
    - d. Samples - When requested by the Engineer.
      - 1) Samples of finish, frame corner construction, door construction, and glazing frame.
      - 2) Samples shall be clearly identified as to location and type of finish.

**PART 2 PRODUCTS**

**2.01 GENERAL**

- A. Aluminum doors shall be as manufactured by Cross Aluminum Products, or equal.
- B. Products furnished for use in this Section shall be of one manufacturer unless specifically shown otherwise or approved by the Engineer.

**2.02 DOORS**

- A. Door sections to be 4-inch tubular shapes of 6063-T5 alloy.
- B. Joinery shall be steel tie rod bolted through stiles, where applicable a minimum of three 3/8-inch diameter cadmium plated steel rods a door.
- C. The finish of doors and door parts shall be free of scratches, defects, die lines, and blemishes and shall have a natural anodized finish in conformance with AA Specification M12C22A41.
- D. Minimum wall thickness 0.100-inch with 0.187-inch minimum at lock and hinge stiles.

- E. Door sections are to interlock a minimum of 3/8-inch and form a 1/4-inch thick vertical reinforcement every 4 inches.
- F. Exterior doors to be installed with urethane boardstock.
- G. Glass stops to be extruded glazing channels, which are easily removed from the inside. Minimum wall thickness 0.080-inch.
- H. Fluted No. 10 pattern extruded in door section.
- I. Exterior doors shall be fully weather-stripped.
- J. All double doors shall have a continuous astragal of the same material and color as the doors and installed on the exterior of the active leaf to cover the gap between doors. Each door shall have non-ferrous lever handles in place of knobs on the passing slide of the astragal or as called for on the hardware schedule. The assembly shall contain a booster spring to ensure the lever returning to a horizontal position.

### **2.03 ALUMINUM FRAMES**

- A. All sections of frames shall be fabricated from aluminum alloy 6063 and T-6 temper with a minimum thickness of 0.125-inch. Screws shall be 18-8 stainless steel.
- B. All framing members shall be accurately milled with flush hairline joints. Frames shall be closed back or open back as detailed on the Drawings.
- C. Door frame corner members shall be heavily reinforced with channel type corner gussets fastened with concealed stainless-steel screws.
- D. Frames shall be reinforced in the areas to receive locks, hinges, and door closers.
- E. Door frame finish shall match that of the door. The finished product shall be free of scratches, defects, and blemishes.
- F. Door stops shall be attached to the frame with concealed fastenings with vinyl inserts for weatherproofing and silencing.

## **PART 3 EXECUTION**

### **3.01 DELIVERY, HANDLING, AND STORAGE**

- A. Delivery, handling, and storage shall be in accordance with the requirements of Section 01350.

### **3.02 INSTALLATION OF FRAMES**

- A. Set frames to maintain scheduled dimensions, hold head level, and set jambs plumb and square.
- B. Secure anchorages and provide connections to adjacent construction.
- C. Apply protective coating of bituminous paint to backs of frame to separate aluminum from contact with masonry, concrete, or other galvanically incompatible materials.
- D. Frame shall be set with a minimum of eight anchors.

**3.03 INSTALLATION OF DOORS**

- A. Comply with manufacturer's instructions for installation of door hardware, operators, and other components.
- B. Adjust hinges so doors operate smoothly and fit properly when closed.
- C. Adjust and lubricate locks, operators, and hinges.
- D. Clean aluminum surfaces and remove protective tape and excess caulking sealants.
- E. Thresholds are to be provided at exterior doors. Bottom, head, and jamb weather-strips shall be adjusted to fit correctly.

**PART 4 SPECIAL PROVISIONS**

Not used.

END OF SECTION

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### Locksets

<b>Specify:</b>	<b>Ordering Example:</b>
Design .....	662-9551RH-US10
Function .....	662-9551RH-US10
Hand of Door .....	662-9551RH-US10
Finish .....	662-9551RH-US10

Also specify door thickness, special keying, strikes, screws, etc. when required.

#### Hand Of Door Is Always Determined From The Outside

1. The outside of an exterior door is the street or entrance side.
2. The outside of an auditorium or room door is the corridor or hall side.
3. The outside of a closet door is the room, corridor or hall side.
4. The outside of a single communicating door is the side from which the hinges are invisible when the door is closed.
5. The outside of twin communicating doors is the space between the two doors.



Left Hand



Right Hand



Left Hand Reverse Bevel (LHR)



Right Hand Reverse Bevel (RHR)

### Exit Devices

<b>Specify:</b>	<b>Ordering Example:</b>
Number .....	3726-31A-RHR-US10
Trim .....	3726-31A-RHR-US10
Hand of Door .....	3726-31A-RHR-US10
Finish .....	3726-31A-RHR-US10



Left Hand Reverse Bevel (LHR)



Right Hand Reverse Bevel (RHR)

Also specify special keying, measurements, strikes, screws, etc. when required.

### Door Closers

<b>Specify:</b>	<b>Ordering Example:</b>
Series .....	P110H-3-F-RH-SBL
Number .....	P110H-3-F-RH-SBL
Size .....	P110H-3-F-RH-SBL
Hand of Closer .....	P110H-3-F-RH-SBL
Finish .....	P110H-3-F-RH-SBL

Also specify Backcheck, Delayed Action, Door thickness, etc. when required.

#### Regular Application



Door: Left Hand  
Closer: Left Hand



Door: Right Hand  
Closer: Right Hand



Door: Left Hand Reverse Bevel  
Closer: Right Hand



Door: Right Hand Reverse Bevel  
Closer: Left Hand

#### Parallel Arm



Door: Left Hand Reverse Bevel  
Closer: Right Hand



Door: Right Hand Reverse Bevel  
Closer: Left Hand

#### Corner Bracket



Door: Left Hand Reverse Bevel  
Closer: Left Hand



Door: Right Hand Reverse Bevel  
Closer: Right Hand

Ordering



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**SECTION 08700  
FINISH HARDWARE**

**PART 1 GENERAL**

**1.01 SCOPE**

- A. This Section includes furnishing and installing all hardware necessary to operate the doors scheduled or shown on the Drawings.
- B. Additional product requirements are specified in Section 01350.

**1.02 SUBMITTALS**

- A. Submittals shall be in accordance with the requirements of Section 01300 and shall include:
  - 1. Shop Drawings for Review:
    - a. The Contractor shall indicate all variances from the requirements of the Contract Documents.
    - b. Hardware schedule.
    - c. Key schedule.
    - d. Manufacturer's literature.
    - e. Manufacturer's warranty.

**1.03 MANUFACTURER'S WARRANTY**

- A. A two-year guarantee shall be provided by the hardware manufacturer on the workmanship and materials for door closers, lock sets, door handles, and exit devices.
- B. All other hardware items are subject to one year's guarantee requirements from the date of final acceptance.
- C. The provisions of these warranties shall not be construed as relieving or reducing the obligations of the Contractor outlined in the General Conditions of these Specifications.

**1.04 QUALITY ASSURANCE**

- A. Hardware shall be a standard product of one of the following manufacturers or equal.

<b>Item</b>	<b>Manufacturer</b>
Hinges, Pulls, Push Plates	Stanley, Sargent, or equal
Locks, Closers, Dead Bolts	Yale, Corbin, Russwin, or equal
Thresholds	Zero, National Guard, or equal
Weather-stripping	Zero, Tremco, National Guard, or equal
Flush Bolts	Ives, Stanley, Corbin, Glyn Johnson, or equal

## **PART 2 PRODUCTS**

### **2.01 GENERAL**

- A. All hardware shall be made of stainless steel or bronze with finish as scheduled. Concealed parts of hardware shall be of nonferrous metal unless otherwise specified.
- B. All door closers shall have cast iron bodies with scheduled finish and of proper size for the doors on which they will be mounted. Door closers shall be applied indoors and equipped with brackets if necessary. All door closers shall have hold-open features unless otherwise indicated or required.
- C. All hardware (for each opening) shall be delivered to the building site separately wrapped and packaged with the correct screws and bolts for installation. Each package shall be properly labeled with location numbers corresponding with the hardware schedule.
- D. Each package of finish hardware shall include all screws, strikes, plates, knobs, roses, and other items required for complete and finished installation.
- E. All double doors shall have nonferrous lever handles in place of knobs on the passing side of the astragal. The assembly shall contain a booster spring to ensure the lever returning to a horizontal position.

### **2.02 TEMPLATES**

- A. Furnish and deliver directly to the metal door manufacturer templates of all hardware to be applied to doors and frames.

### **2.03 KEYS AND KEYING**

- A. Locks shall be heavy duty. Each cylinder shall have six pin tumblers. Strikes shall be of the box type.
- B. Locks shall be master keyed to existing doors according to instructions provided by the Owner.
- C. Submit keying schedule to Engineer and Owner for approval (including an explanation of the keying system).
- D. Four keys shall be furnished for each lock.

### **2.04 PANIC GUARD EXIT DEVICE**

- A. Panic Exit Device shall include as an integral part of the device a retractable deadlocking bar mechanism which provides a continuous barrier at the meeting stiles. The device shall not require additional mullions, coordinators, timing devices, etc., to allow proper door function.
- B. Panic Exit Device shall have the capability of being dogged in the unlocked position by a single turn of the cylinder key.

- C. Meeting stiles shall be designed and constructed to house and conceal all mechanical components and provide a smooth, uncluttered appearance. No exposed screws or fasteners shall occur on the exterior surface of the door stiles.
- D. "Panic Guard" Exit Device shall be installed by the manufacturer at the factory before shipment is made. Device shall be listed by UL.

**PART 3 EXECUTION**

**3.01 HARDWARE INSTALLATION**

- A. Finish hardware shall be applied in a workmanlike manner. All butts shall be of uniform spacing and the leaves so set as to avoid screw holes penetrating the face of the door. Locks shall be set level and with true back sets. The striking plates, opposite same, shall be in exact alignment with latches and bolts.
- B. Upon completion, the Contractor shall check all hardware, fit all keys in their respective locks, and deliver all keys properly tagged to the Owner. Delivery of the keys shall not constitute acceptance of the building.

**PART 4 SPECIAL PROVISIONS**

**4.01 HARDWARE SCHEDULE**

- A. The manufacturers' names and catalog numbers shown on this schedule have been used as a guide to type, style, and materials of construction only. Other manufacturers of the hardware are noted in Subsection 1.04 of this Section.
- B. The hardware schedule does not necessarily include all the hardware for all the buildings.
- C. The Contractor shall furnish all hardware of whatever nature as necessary to complete the buildings whether or not shown on this hardware schedule.
- D. Hardware Schedule:

1. Set A:

1-1/2 pr	4-1/2 inch Butts FBB 199*	Stanley	US32D
1	Closer	Corbin J4609	SBL
1	Threshold	none	
1	Weatherstrip	National Guard 160SA	
1	Door Bottom Seal	National Guard 112N	
1	Pull	Handle	US32D
1	Keying & Lockset	Privacy	
1	Exit Device	Handle	US32D
1	Kickplate	10 inch by 34 inch	32D

2. Set B:

1-1/2 pr	4-1/2 inch Butts FBB 199*	Stanley	US32D
1	Closer	Corbin J4609	SBL
1	Threshold	National Guard 426	
1	Weatherstrip	National Guard 160SA	
1	Door Bottom Seal	National Guard 112N	
1	Mortise (Lever Only)	Corbin ML2051	US32D
1	Keying & Lockset	Best Premium	
1	Exit Device	Corbin ED 5000	US32D
1	Kickplate	10 inch by 34 inch	32D

3. Set C:

3 Pair Butts	Stanley FBB199, 4-1/2 x 4-1/2	32D
1 Keying and Lockset	Best Premium	
1 Exit Device	Corbin ED5000	32D
1 Mortise Cylinder		
1 Closer	Corbin J4609	SBL
2 Sets Weatherstripping	National Guard 160S	162A
2 Door Bottom Seals	National Guard 200N	162A
1 Threshold	National Guard 613	
1 Kickplate	10-inch by 34-inch	32D
1 Trim	Corbin AGM 55	32D

END OF SECTION

**SECTION 09900  
PAINTING**

**PART 1 GENERAL**

**1.01 SCOPE**

- A. This Section includes furnishing and application of protective coatings to all wood, concrete, and metal surfaces as specified or as shown on the Drawings.
- B. Included in this Section is surface preparation, shop application inspection, and field touch up work as required to provide a complete protective coating system.
- C. In general, the Work shall include the field painting of the following:
  - 1. All exposed interior cast-in-place concrete (except floors) above ground floor.
  - 2. All exposed concrete blocks and hollow core precast slabs.
  - 3. All exposed plaster.
  - 4. All exposed wood.
  - 5. All exposed pipe insulation.
  - 6. All exposed piping, including fittings, valves, couplings, flanges, and other in-line accessories.
  - 7. All machinery, pumps, and equipment.
  - 8. All metal surfaces except the following:
    - a. Bronze surfaces.
    - b. Stainless steel surfaces.
    - c. Aluminum or galvanized steel not requiring color coding or otherwise specified to be coated.
- D. Additional product requirements are specified in Section 01350.
- E. A Coating Schedule appears in Part 4 of this Section.

**1.02 SUBMITTALS**

- A. Submittals shall be in accordance with the requirements of Section 01300 and shall include:
  - 1. Shop Drawings for Review:
    - a. Coating manufacturer's product data and technical literature including:
      - 1) Catalog number.
      - 2) General classification.
      - 3) Coating material analysis.

- 4) Detailed surface preparation guidelines.
  - 5) Mixing, thinning, and application instructions for each material.
  - 6) Induction time, pot life, viscosity, and drying and curing times for acceptable ranges of temperature and humidity.
- b. Abrasive manufacturer's information including:
- 1) Name, address, and phone number of manufacturer and local supplier.
  - 2) Bulk density.
  - 3) Mohs ranking.
  - 4) Sieve analysis.
  - 5) Chemical analysis including impurities.
  - 6) Free silica content.
  - 7) Grain shape (roundness).
- c. Submittals of coatings by a manufacturer not named in these specifications shall include performance criteria on abrasion, adhesion, exterior exposure, hardness, humidity exposure, salt spray (fog), impact, immersion, etc., as applicable, per the appropriate ASTM standards. If requested by the Engineer, the Contractor shall submit manufacturers complete formula for the coatings which are proposed to be furnished. The Engineer may also require the submission, at the Contractor's expense, of test reports from private laboratories showing results of comparable tests on the coatings proposed and the coatings specified.
- d. Details of application equipment and procedures.
- e. Samples of manufacturer's standard colors.
2. Information for the Record:
- a. Certification that materials meet or exceed Specifications and that coating systems are suitable for intended use.
  - b. Certification that coating systems are compatible with substrate, specified surface preparation, prime coats, sealants, and existing finishes.
  - c. Safety Data Sheets (SDS) for coating materials, thinners, diluents, abrasives, cleansers, and other materials.
  - d. Schedule of coating work showing each phase and step of Work.

### 1.03 QUALITY ASSURANCE

- A. Standards - Surface preparation, coating, and patching work performed under this Section shall conform to the applicable provisions and recommendations of the following standards.
  - 1. SSPC Steel Structures Painting Manual, Volume 1, "Good Painting Practice."
  - 2. SSPC Steel Structures Painting Manual, Volume 2, "Systems and Specifications."
  - 3. SSPC Vis. 1 and 2, visual standards and written guidelines.
  - 4. NACE Coatings and Linings Handbook.
  - 5. Applicable NACE standards and recommended practices including RP0178 and RP0184.

### 1.04 DELIVERY, STORAGE, AND HANDLING

- A. Delivery, storage, and handling shall be in accordance with Section 01350.
- B. Include the following information on container labels or packing slips:
  - 1. Manufacturer's name.
  - 2. Name or title of material.
  - 3. Batch numbers.
  - 4. Stock number and date of manufacture.
  - 5. Shelf life or expiration date.
  - 6. Contents by volume of pigment, binder, and vehicle.
  - 7. Thinning instructions when recommended.
  - 8. Application instructions.
  - 9. Color name and number.
  - 10. Safety Data Sheets (SDS).
- C. Provide controlled storage for coating materials and abrasives. Store coating materials in environmentally controlled enclosure with minimum ambient temperature of 55 degrees F. Store abrasives in dry area.
- D. Maintain inventory of coating materials, solvents, and cleaners.

### 1.05 SCHEDULING AND SEQUENCING

- A. Notify Engineer two weeks in advance of surface preparation and coating application.
- B. Work systematically in accordance with submitted schedule.
- C. Sequence and coordinate abrasive blasting and coating application with Work of other sections. Do not interrupt plant process or interfere with Owner's operations.



- D. Coordinate coating work with installation of sealants specified in Section 07900.
- E. Furnish specified testing and inspection equipment to Owner a minimum of two weeks prior to beginning surface preparation and coating work.

**1.06 MANUFACTURER'S RECOMMENDATIONS**

- A. Apply coatings in strict compliance with manufacturer's recommendations and instructions as to environmental conditions, surface preparation, mixing, application, and curing. Where Specifications are more stringent than manufacturer's recommendations, Specifications shall prevail.
- B. Resolve conflicts between Specifications and manufacturer's recommendations and instructions by obtaining written agreement between Engineer and coating manufacturer prior to beginning Work.

**1.07 DESCRIPTION**

- A. Shop Painting - Shop painting shall be performed to the extent and as required under Section 01350 and the various individual sections of the specifications. All metal surfaces shall be given a protective shop coat of primer compatible with the field coating. Shop primer color shall be beige where available. If a prime coat has not been applied in the shop, then a prime coat shall be applied in the field after proper surface preparation and prior to the application of the finish coats.
- B. Compatibility - The Contractor shall ensure the primer or finish coating applied in the shop is compatible with the specified field coatings. If the coatings are incompatible, the shop coatings shall be removed by abrasive blasting and coatings applied in conformance with this Section.

**PART 2 PRODUCTS**

**2.01 MATERIALS**

- A. The products shall be as specified in the Coating Schedule. Materials selected for each coating system shall be the product of one manufacturer. The Contractor shall be responsible for the compatibility of all components of each coating system including primer, thinner, and solvents.

**2.02 COATING SCHEDULE**

- A. The Coating Schedule included in Part 4 of this Section identifies the areas to be painted, the required materials, and number of coats required.

**PART 3 EXECUTION**

**3.01 ENVIRONMENTAL REQUIREMENTS**

- A. Environmental Conditions:
  - 1. Perform Work of this Section under the following environmental conditions.

- a. Abrasive blast only when surface contamination can be prevented. Abrasive blast only when surface temperature is more than 5 degrees F above dew point and relative humidity is less than 85%.
  - b. No coating shall be applied when the air temperature, as measured in the shade, is below 40 degrees F or above 90 degrees F. No coating shall be applied when the temperature of the surface to be painted is below 35 degrees F or as recommended by the paint manufacturer, whichever is greater. Coatings shall not be applied to wet or damp surfaces, when the relative humidity exceeds 85%, or when the surface to be painted is less than 5 degrees F above the dew point.
2. Coating work may proceed during inclement weather in environmentally controlled enclosures. Environment within enclosure shall comply with Specifications and manufacturer's recommendations. Provide adequate ventilation and illumination. Minimum illumination shall be 150-foot candles.
- B. Interior Painting may be done only when the building has been thoroughly dried, by natural or artificial heat, and when the Work area is properly heated and ventilated, clean, and as nearly dust free as possible. Room temperature shall be maintained within the manufacturer's recommendations during application and until coatings are dry.
- C. Dust - Coating shall not be applied in areas where dust is being generated.

### 3.02 PROTECTION

- A. During the construction period, all electrical and mechanical equipment and other equipment and apparatus shall be protected from paint drippings by means of tarpaulins, burlap, wooden housings, or other protection.
- B. Finished work of other trades, surfaces not being painted concurrently or not to be painted, and factory finished lockers, toilet partitions, etc., that will not require field painting shall be protected at all times from paint spots and damage to the finish.
- C. Perform cleaning and coating operation in manner which prevents dust and contaminants from falling in newly applied coating.
- D. Protect portions of Work which are partially or entirely completed and which are adjacent to surfaces being prepared by abrasive blasting.
- E. Protect completed Work from solvents, contaminants, or other substances which may damage coating.
- F. Prominently display "Wet Paint" signs in sufficient number to protect newly applied coating.

### 3.03 PREPARATION OF SURFACES

- A. General - All surfaces, of whatever material, which are to be painted shall be thoroughly cleaned of dirt, grease, rust scale, or other injurious substance, and, at the time of application of the coating, shall be clean and dry.

- B. Metal Surfaces:
1. Remove weld spatter and other projections. Grind sharp edges to a minimum radius of 1/8-inch. Grind rough welds smooth. Grinding shall be in accordance with SSPC Surface Preparation Commentary. Surfaces shall be smooth and contoured in compliance with SSPC-SP 12.
  2. Surfaces which have not been shop coated shall be abrasive blasted prior to any prime coats. Abrasive blasting shall be done in accordance with the Coating Schedule.
  3. Shop primed surfaces shall receive a field sweep blast prior to the application of subsequent coats.
  4. Abrasions or defects on shop coated surfaces shall be spot primed.
  5. Surfaces which are to receive a high heat coating shall be Near White Blast Cleaned (SSPC, SP-10) and painted within eight hours; or, if recommended by the manufacturer of the approved high heat coating, the surfaces may be thoroughly cleaned to bare metal and given wash coats or a cold phosphatizing treatment as recommended by the manufacturer and as approved by the Engineer.
- C. Concrete and Masonry Surfaces:
1. New concrete and masonry surfaces shall be allowed to become completely cured for at least 30 days at a temperature of 75 degrees F and, immediately prior to treatment, shall be thoroughly cleaned of all dirt, grease, form release agents and stains. Curing compounds shall be removed.
  2. Concrete surfaces shall be pressure washed with solution of trisodium phosphate (4 ounce per gallon) and detergent in hot water. Water temperature shall be approximately 180 degrees F. Immediately flush surface with clean potable water until pH of surface meets acceptance criteria of ASTM D4262.
  3. If recommended by the coating manufacturer, on concrete surfaces less than six months old, one coat of zinc sulfate solution shall be uniformly applied and allowed to dry before application of the coating.
  4. Concrete surfaces shall be abrasive blasted with coarse, hard, and angular abrasive after cleaning. Air stream shall be free of moisture and oil.
  5. Acid etching is not permitted.
- D. Wood Surfaces shall be sanded smooth and filled with an approved paste or liquid grain filler, and cracks and crevices shall be filled with a non-shrinking, elastic composition especially prepared for this purpose. Wood surfaces to be varnished shall be rubbed smooth with pumice and oil.
- E. Clean up all debris from the surface preparation operation.

### 3.04 ABRASIVE BLASTING

- A. Abrasives shall be expendable coal slag or aluminum oxide, free of silica, or a steel shot/grit mixture. Maintain abrasives free from dust, salts, and other impurities. Select the type and size of abrasive to yield a surface as specified in the Coatings Schedule.
- B. Provide moisture and oil separators or traps of adequate size in compressed air system to provide dry and clean air supply. Drain traps automatically during blasting operation. Remove oil and moisture accumulated in air receiver by regular purging.
- C. Remove weld splatter, slivers, laminations, and underlying mill scale which become visible after abrasive blasting, by grinding in accordance SSPC SP-3 and NACE RP0178. Follow grinding by final abrasive blast.
- D. Surfaces which cannot be properly cleaned by abrasive blasting because of their location may be prepared by power tool cleaning in accordance with SSPC SP-11 (Power Tool Clean to Bare Metal) in lieu of abrasive blasting, subject to Engineer's approval.
- E. After surface preparation but prior to priming inspect surface for corrosion. Remove corrosion products which become visible when viewed without magnification by re-blasting.
- F. Remove dust and blasting residue by blowing with clean, dry air, and vacuum cleaning with clean tools.

### 3.05 MIXING AND THINNING

- A. All mixing shall be performed by mechanical paint shakers or mixers in strict accordance with the manufacturer's printed instructions.
- B. Do not use coating material which has livered, gelled, or otherwise deteriorated during storage. Thixotropic materials which obtain normal consistency when stirred are acceptable. Where a skin has formed in container, cut skin loose from sides of container and discard prior to mixing.
- C. Each component of multi-component materials shall be mixed individually before use. The material shall be mixed in a manner which will insure the break-up of all lumps, complete dispersion of pigment, and a uniform composition. Materials shall be inspected after mixing for uniformity and to verify that no unmixed pigment remains at the bottom of the container.
- D. The individual parts shall be mixed together in the proportions recommended by the manufacturer. The materials shall be mixed thoroughly before use and shall be agitated often enough during application to ensure a uniform composition.
- E. Mixed coatings shall be strained after mixing unless the application equipment is provided with strainers. Strainers shall be of a type to remove skins and undesirable matter without removing pigment.
- F. Thinner shall not be added unless required for proper application. Thinning shall be in strict accordance with the manufacturer's recommendations.

- G. Mixed coatings shall have pot life stated on label and indicated in approved Shop Drawing. When pot life limit is reached, discard material, clean equipment, and mix and induct new material.
- H. Store materials not in actual use in tightly covered containers. Maintain containers and equipment used in storage, mixing, and application in clean condition, free of foreign materials and residue.

### **3.06 COATING APPLICATION**

- A. Apply prime coat within eight hours of completion of surface preparation. If surface is degraded, contaminated, or wet by rain or moisture subsequent to surface preparation and prior to coating, restore surface in accordance with Specifications.
- B. Prior to applying each coat, remove dust with industrial vacuum cleaner using new filters, clean tools, and clean hopper. Remove residue or foreign matter on coating before applying additional coats by pressure rinsing with 1800-2000 psi water, when required by Engineer's representative.
- C. Apply coatings in accordance with applicable provisions of SSPC Paint Application Specification PA 1. Use equipment best suited for the coating material.
- D. Cloudiness, spotting, laps, brush marks, roller marks, runs, sags, drips, ropiness, voids, discontinuities, pinholes, and other surface imperfections are unacceptable.
- E. When spray application is approved by Engineer. Spare fittings, gun tips, gun parts, and other spray equipment shall be acceptable to Engineer.
- F. Stripe coat edges, welds, corners, crevices, and other surfaces difficult to coat before applying full coat in accordance with SSPC-PA 1.
- G. Coverage shall be in conformance with the manufacturer's instructions. The dry mil thickness of coatings shall be as specified in the Coating Schedule.

### **3.07 APPLICATION BY SPRAYING**

- A. Application of coatings by spraying may be permitted in locations and on surfaces approved by the Engineer. The Contractor must submit for approval a written request giving the proposed locations and the coating manufacturer's instructions for spray application. Applicator and equipment must conform to the following paragraphs:
  - 1. Spraying shall conform to the manufacturer's recommendations.
  - 2. Equipment:
    - a. The spray equipment used shall be suitable for the intended purpose, capable of properly atomizing the coating, and equipped with suitable pressure regulators and gages. The equipment shall be in good working order.

- b. Spray equipment shall be kept sufficiently clean so that dirt, dried coating, and other foreign substances are not deposited with the coating.
  - c. All solvents used in cleaning the equipment shall be completely removed before use.
  - d. The equipment manufacturer's instructions for proper use shall be strictly followed.
3. Air Spray:
- a. Air caps, nozzles, and needles shall be those recommended by the manufacturers of the coating system and spray equipment being used.
  - b. Moisture and oil separators or traps shall be used in the compressed air system to provide a dry and clean air supply. The traps or separators must be of adequate size and must be drained periodically during the coating application.
4. Airless Spray:
- a. Fluid tips shall be of the proper orifice size and fan angle, and the fluid control gun of proper construction, as recommended by the manufacturer of the coating system and the spray equipment being used.

### 3.08 CURING

- A. Each coat shall be in a proper state of cure or dryness prior to the placement of the succeeding coat. Coating shall be considered sufficiently dry for recoating when an additional coat can be applied without the development of any detrimental film irregularities such as lifting, wrinkling, or loss of adhesion of the undercoat. Where an overcoat will not properly adhere to an overly cured undercoat, it shall be applied within the time period recommended by the manufacturer.
- B. The curing times for the coatings shall conform to the coating manufacturer's recommendations considering ambient temperature and relative humidity.

### 3.09 FIELD QUALITY CONTROL

- A. Thickness - The Contractor shall furnish the Engineer a suitable thickness detector of a type recommended by the coating manufacturer. Dry film measurements shall be taken in accordance with SSPC-PA 2.
- B. The color of the prime coat shall be beige when available. It shall be inspected before application of intermediate or finish coats.
- C. Intermediate Coats shall be the approximate shade of final coat; however, each coat shall be of a slightly different tint. Each coat shall be inspected and approved before the next coat may be applied; otherwise, credit will not be given, and the Work shall be recoated.

**3.10 PATCHING AND REPAIRS**

- A. All defective coatings shall be removed or repaired as the Engineer may direct. Surfaces with defective shop primer shall be repaired per the manufacturer’s recommendations of the system in the Coating Schedule.
- B. Before final approval of the Work all damaged coating surfaces (field or factory applied) shall be cleaned and repainted or touched up as directed.

**3.11 CLEANING**

- A. Remove coating and splatter inadvertently placed on items not scheduled to be coated. Remove splatter by washing or scraping, taking care not to scratch or otherwise damage finished surfaces.
- B. Remove and dispose spent abrasives, discarded coating materials, rubbish containers, rags, and other debris at the end of each work day.

**3.12 MARRED EXISTING FINISHES**

- A. Existing buildings, pipelines, plumbing, etc., marred during construction by the Contractor shall be repainted to match the existing coating. Repainting shall be carried far enough to match the newly painted area with the existing coating.
- B. Surface preparation, primer, and finish coats shall be in accordance with the Coating Schedule.

**PART 4 SPECIAL PROVISIONS**

**4.01 PAINTING OF EXISTING EQUIPMENT AND STRUCTURES**

- A. Surface preparation shall be in accordance with the manufacturer’s recommendations of the system in the Coatings Schedule.
- B. The scope of the repainting work is described in the following table.

	Previously Painted Interior Concrete	Interior Piping	Doors and Interior Equipment	Interior Str. Steel	Window Frames	Door Frame

- 1. Interior concrete includes all concrete walls, columns, beams, ceilings, curbs, and machinery bases. Floors and stair treads are not included.

**4.02 COLORS**

- A. The colors used shall be selected by the Owner and the Engineer, from the manufacturer’s standard colors.
- B. All pipelines and associated equipment shall be color coded and banded as follows. Banding shall consist of 3-inch wide painted bands at 30-inch center to center.

Pipeline	Color of Pipe	Color of Legend
Finished or Potable	Dark Blue	White
Chlorine (Solution)	Yellow	Black
Sewer (Sanitary or Other)	Dark Grey	White

- C. Electrical conduit, roof drains, sanitary drains, etc., shall be painted to match the color of adjacent wall or ceiling surface.

**4.03 STENCILS AND LABELS**

- A. Lettering and flow direction arrows shall be stenciled on each pipeline describing the function of the pipeline near the equipment served, at both sides of walls and floors where pipe passes through, and at intervals of not more than 50-feet. Flow direction arrows shall be stenciled on each pipeline adjacent to valves and at each branch or tee. It is intended that all pipelines shall bear labels at the most visible point. If, in the opinion of the Engineer, the foregoing requirements will result in an excessive number of labels or arrows on a run of pipe, the number shall be reduced as directed.
- B. Where the flow of a pipeline is in one direction only, an additional flow arrow shall be stenciled in front of each legend on the pipe.
- C. For pipes smaller than 1-inch in outside diameter, a white plastic tag with black lettering shall be used. Secure to piping with self-locking nylon straps.
- D. The legends and flow arrows shall be stenciled with approved stencil paint. Following the completion of other Work under this Item, all stencils used shall remain the property of the Owner.
- E. Each chemical storage tank shall have stenciled on its side a legend describing the tank contents and the tank number as shown on the Drawings such as "Alum Tank No. 1".
- F. Preprinted pressure sensitive vinyl labels may be used in lieu of stencils. Labels shall be additionally secured to the pipe at each end by 2-inch roll tape with preprinted directional arrows. Tape color shall match the label. Label size shall be determined by pipe size as recommended by the manufacturer's standard literature. Labels shall be Opti-Code as manufactured by Seton Name Plate Corporation, or equal.

**4.04 INSPECTION EQUIPMENT**

- A. The Contractor shall furnish the following testing equipment:
  - 1. Wet Film Thickness Gauge:
    - a. Nordson Model 790-010; Range 0 to 20 mils.
    - b. Quantity: 2 required.



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4.05 COATING SCHEDULE

A. The following coating schedules is not guaranteed to be complete. The coating systems manufacturers are listed in no particular order, any of the four listed systems, or equal may be used.

General Coating Schedule					
		Carboline	Tnemec	AkzoNobel (International, Devoe, Glidden Professional)	Sherwin Williams
B.	Exterior nongalvanized, ferrous metal surfaces not submerged:				
	1. Subject to splash or spills or atmospheric:				
	Surface Preparation:	SSPC-SP 6 (NACE 3) Commercial Blast Cleaning, surface profile 1.5-2.0 mils	SSPC-SP 6 (NACE 3) Commercial Blast Cleaning, surface profile 1.5- 2.0 mils	SSPC-SP 6 (NACE 3) Commercial Blast Cleaning, surface profile 1.5-2.0 mils	SSPC-SP 6 (NACE 3) Commercial Blast Cleaning, surface profile 1.5-2.0 mils
	Primer:	1 coat, Carbozinc 859 (3.0-5.0 mils DFT)	1 coat, 90-97 Tneme-Zinc, (DFT 2.5-3.5 mils).	1 coat, CathaCoat 313 (DFT 2.0-4.0 mils)	1 coat, Corothane I Galvapac (DFT 2.0-4.0 mils)
	Intermediate:	1 coat, Carboguard 60 (4.0-6.0 mils DFT)	1 coat, 27 Typoxy, (DFT 2.5-4.0 mils).	1 coat, Devran 224HS (DFT 4.0-8.0 mils)	1 coat, Macropoxy 646 (DFT 3.0-5.0 mils).
	Final:	1 coat, Carbothane 134HG (2.0-2.5 mils DFT)	1 coat, 72/73 Endura-Shield (DFT 2.5-5.0 mils).	1 coat, Devthane 359 (DFT 3.0-5.0 mils)	1 coat, Hi-Solids Polyurethane (DFT 3.0-5.0 mils).
C.	Interior wall surfaces of masonry block construction and precast concrete walls and ceiling surfaces:				
	1. Concrete Masonry Block (CMU and AMU)				
	Surface Preparation:	SSPC-SP 13 (NACE 6) Remove surface contaminates per ASTM D4258 (Concrete), and ASTM D4261 (Block). Masonry shall be moisture free.	SSPC-SP 13 (NACE 6) Remove surface contaminates per ASTM D4258 (Concrete), and ASTM D4261 (Block). Masonry shall be moisture free.	SSPC-SP 13 (NACE 6) Remove surface contaminates per ASTM D4258 (Concrete), and ASTM D4261 (Block). Masonry shall be moisture free.	SSPC-SP 13 (NACE 6) Remove surface contaminates per ASTM D4258 (Concrete), and ASTM D4261 (Block). Masonry shall be moisture free.
	Sealer/Surfacers:	1 coat, Sanitile 100 (5.0-20.0 mils DFT) depending on porosity must be pin hole free prior to applying	1 coat, 130 Envirofill (DFT 10.0-15.0 mils).	1 coat, Tru-Glaze-WB 4015 (DFT 9.0-11.0 mils)	1 coat, Cement Plex 875 Masonry Filler/Sealer (DFT 13-25 mils).
	Finish:	2 coats, Carboguard 60 (DFT 4.0-6.0 mils per coat)	2 coats, N69 H.B. Epoxoline II (DFT 4.0-6.0 mils per coat).	2 coat, Devran 224HS (DFT 4.0-6.0 mils per coat)	2 coats, Macropoxy 646 (DFT 4.0-6.0 mils per coat)
	2. Pre-Cast Concrete				
	Surface Preparation:	SSPC-SP 13 (NACE 6) Remove surface contaminates per ASTM	SSPC-SP 13 (NACE 6) Remove surface contaminates per ASTM	SSPC-SP 13 (NACE 6) D4258 (Concrete). Abrade precast	SSPC-SP 13 (NACE 6) Remove surface contaminates per ASTM

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		D4258 (Concrete). Abrade precast concrete, if recommended by coating manufacturer, per ASTM D4259. ASTM D4263 (plastic sheet test method) to ensure concrete is moisture free. If moisture is detected, retest until dry.	D4258 (Concrete). Abrade precast concrete, if recommended by coating manufacturer, per ASTM D4259. ASTM D4263 (plastic sheet test method) to ensure concrete is moisture free. If moisture is detected, retest until dry.	concrete, if recommended by coating manufacturer, per ASTM D4259. ASTM D4263 (plastic sheet test method) to ensure concrete is moisture free. If moisture is detected, retest until dry.	D4258 (Concrete). Abrade precast concrete, if recommended by coating manufacturer, per ASTM D4259. ASTM D4263 (plastic sheet test method) to ensure concrete is moisture free. If moisture is detected, retest until dry.
	Filler:	Fill bug holes with Carboguard 501/510	Fill bug holes with 215 surfacing epoxy or 218 MortarClad	Fill bug holes with Devfil 145 (DFT 16.0-22.0 mils)	Fill all bugholes with Steel Seam FT 910 or Dura-Plate 2300 or cementitious repair mortar from AW Cook
	Finish:	2 coats, Carboguard 60 (DFT 4.0-6.0 mils per coat)	2 coats, N69 H.B. Epoxoline II (DFT 4.0-6.0 mils per coat).	2 coats, Devran 224HS (DFT 4.0-6.0 mils per coat)	2 coats, Macropoxy 646 (DFT 4.0-6.0 mils per coat)
D.	Interior concrete walls, columns, beams, and ceilings; concrete curbs; concrete bases for machinery and equipment; etc.:				
	Surface Preparation:	SSPC-SP 13 (NACE 6) Remove surface contaminates per ASTM D4258 (Concrete). Abrade precast concrete, if recommended by coating manufacturer, per ASTM D4259. ASTM D4263 (plastic sheet test method) to ensure concrete is moisture free. If moisture is detected, retest until dry.	SSPC-SP 13 (NACE 6) Remove surface contaminates per ASTM D4258 (Concrete). Abrade precast concrete, if recommended by coating manufacturer, per ASTM D4259. ASTM D4263 (plastic sheet test method) to ensure concrete is moisture free. If moisture is detected, retest until dry.	SSPC-SP 13 (NACE 6) Remove surface contaminates per ASTM D4258 (Concrete). Abrade precast concrete, if recommended by coating manufacturer, per ASTM D4259. ASTM D4263 (plastic sheet test method) to ensure concrete is moisture free. If moisture is detected, retest until dry.	SSPC-SP 13 (NACE 6) Remove surface contaminates per ASTM D4258 (Concrete). Abrade precast concrete, if recommended by coating manufacturer, per ASTM D4259. ASTM D4263 (plastic sheet test method) to ensure concrete is moisture free. If moisture is detected, retest until dry.
	Filler:	Fill bugholes with Carboguard 501/510	Fill bugholes with 215 Surfacing Epoxy or 218 MortarClad	Fill bug holes with Devfil 145 (16.0-22.0 mils DFT)	Fill all bugholes with Steel Seam FT 910 or Dura-Plate 2300 or cementitious repair mortar from AW Cook
	Primer:	1 coat, Carboguard 60 (DFT 4.0-6.0 mils)	1 coat, 27 Typoxy (DFT 2.5-4.0 mils).	1 coat, Devran 224HS (DFT 4.0-8.0 mils)	1 coat, Macropoxy 646 (DFT 3.0-5.0 mils).
	Final:	2 coats, Carboguard 60 (DFT 4.0-6.0 mils)	2 coats, N69 H.B. Epoxoline II (DFT 4.0-6.0 mils).	2 coats, Devran 224 HS (DFT 4.0-6.0 mils per coat)	2 coats Macropoxy 646 (DFT 4.0-6.0 mils).
E.	Interior, nongalvanized, ferrous metal surfaces of items such as pipe; machinery, equipment; doors and door frames; rolling doors; exposed ductwork; hoppers, chutes, pipe supports, trays, and hangers; walkway platforms; stairs; structural members; floor frames and covers; miscellaneous metal tanks shall be finished as follows:				

	Surface Preparation:	SSPC-SP 6 (NACE 3) Commercial Blast Cleaning, surface profile 1.5-2.0 mils.	SSPC-SP 6 (NACE 3) Commercial Blast Cleaning, surface profile 1.5-2.0 mils.	SSPC-SP 6 (NACE 3) Commercial Blast Cleaning, surface profile 1.5 to 2.0 mils.	SSPC-SP 6 (NACE 3) Commercial Blast Cleaning, surface profile 1.5-2.0 mils.
	Primer:	1 coat, Carboguard 60 (DFT 4.0-6.0 mils)	1 coat, 27 Typoxy (DFT 2.0-4.0 mils).	1 coat, Devran 201H (DFT 2.0-3.0 mils)	1 coat, Recoatable Epoxy Primer, Macropoxy 646 (DFT 3.0-5.0 mils).
	Finish:	2 coats, Carboguard 60 (DFT 4.0-6.0 mils per coat)	2 coats, N69 H.B. Epoxoline II, or equal (DFT 4.0-6.0 mils per coat).	2 coats, Devran 224 HS (DFT 4.0-6.0 mils per coat)	2 coats, Macropoxy 646, (DFT 4.0-6.0 mils per coat).
F.	Ferrous metal surfaces of all chemical pipe supporting trays throughout the project and ferrous metal surfaces of items in chemical rooms such as pipes, machinery, equipment, doors, ductwork, hoppers, walkways, and stairs, but not structural wall panels and roof joists, shall be finished as follows:				
	Surface Preparation:	SSPC-SP 6 (NACE 3) Commercial Blast Cleaning, surface profile 1.5-2.0 mils.	SSPC-SP 6 (NACE 3) Commercial Blast Cleaning, surface profile 1.5-2.0 mils.	SSPC-SP 6 (NACE 3) Commercial Blast Cleaning, surface profile 1.5-2.0 mils.	SSPC-SP 6 (NACE 3) Commercial Blast Cleaning, surface profile 1.5 -2.0 mils.
	Primer:	1 coat, Carboguard 60 (4.0-6.0 mils DFT)	1 coat, 27 Typoxy, or equal (DFT 2.0-4.0 mils).	1 coat, Devran 201H (DFT 2.0-3.0 mils)	1 coat, Recoatable Epoxy Primer, Macropoxy 646 (DFT 3.0-5.0 mils).
	Finish:	2 coats, Carboguard 890 (4.0-6.0 mils DFT)	2 coats, N69 H.B. Epoxoline II (DFT 4.0-6.0 mils per coat).	2 coats, Devran 224 HS (DFT 4.0-6.0 mils per coat)	2 coats, Macropoxy 646, (DFT 4.0-6.0 mils per coat).
G.	Galvanized ferrous, aluminum, copper, fiber reinforced plastic or other plastic piping and conduits located inside buildings requiring color coding:				
	1. Aluminum and Copper:				
	Surface Preparation:	SSPC-SP 16 - Brush-Off Blast Cleaning of Coated and Uncoated Galvanized Steel, Stainless Steels, and Non-Ferrous Metals	SSPC-SP 16 - Brush-Off Blast Cleaning of Coated and Uncoated Galvanized Steel, Stainless Steels, and Non-Ferrous Metals	SSPC-SP 16 - Brush-Off Blast Cleaning of Coated and Uncoated Galvanized Steel, Stainless Steels, and Non-Ferrous Metals	SSPC-SP 16 - Brush-Off Blast Cleaning of Coated and Uncoated Galvanized Steel, Stainless Steels, and Non-Ferrous Metals
	Primer:	N/A	1 coat, 27 Typoxy, or equal (DFT 2.0-4.0 mils).	1 coat, Devran 201H (DFT 2.0-3.0 mils)	N/A
	Finish:	2 coats, Carboguard 60 (DFT 4.0-6.0 mils per coat)	1 coat, N69 H.B. Epoxoline II (DFT 4.0-6.0 mils per coat).	1 coat, Devran 224 HS (DFT 4.0-6.0 mils)	2 coats, Macropoxy 646 (DFT 4.0-6.0 mils per coat).
	2. Galvanized Metal:				
	Surface Preparation:	SSPC SP 16 "Brush-off Blast Cleaning of Coated and Uncoated Galvanized Steel, Stainless Steels, and Non-ferrous Metals	SSPC SP 16 "Brush-off Blast Cleaning of Coated and Uncoated Galvanized Steel,	SSPC SP 16 "Brush-off Blast Cleaning of Coated and Uncoated Galvanized Steel,	SSPC SP 16 "Brush-off Blast Cleaning of Coated and Uncoated Galvanized Steel,

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			Stainless Steels, and Non-ferrous Metals	Stainless Steels, and Non-ferrous Metals	Stainless Steels, and Non-ferrous Metals
	Primer:	None	1 coat, 27 Typoxy, or equal (DFT 2.0-4.0 mils).	1 coat, Devran 201H (DFT 2.0-3.0 mills)	N/A
	Finish:	2 coats, Carboguard 60 (DFT 4.0-6.0 mils per coat)	1 coat, N69 H.B. Epoxoline II (DFT 4.0-6.0 mils per coat).	1 coat, Devran 224HS (DFT 4.0-6.0 mils)	2 coats, Macropoxy 646 (DFT 3.0-5.0 mils per coat).
3. FRP, PVC, CPVC, and Other Plastics:					
	Surface Preparation:	Scuff sand to uniformly roughen surface	Scuff sand to uniformly roughen surface	Scuff sand to uniformly roughen surface	Scuff sand to uniformly roughen surface
	Primer:	None	1 coat, 27 Typoxy, or equal (DFT 2.0-4.0 mils).	1 coat, Devran 201H (DFT 2.0-3.0 mills)	None
	Finish:	2 coats, Carboguard 60 (DFT 4.0-6.0 mils per coat)	1 coat, N69 H.B. Epoxoline (DFT 4.0-6.0 mils per coat).	1 coat, Devran 224 HS (DFT 4.0-6.0 mils)	2 coats, Macropoxy 646 (DFT 3.0-5.0 mils per coat).
H.	Exterior piping requiring color coding and made of galvanized ferrous, aluminum, fiberglass reinforced plastic, or other plastic and all exterior fiberglass reinforced plastic piping and galvanized conduit:				
	Surface Preparation:	SSPC SP 16 "Brush-off Blast Cleaning of Coated and Uncoated Galvanized Steel, Stainless Steels, and Non-ferrous Metals	SSPC SP 16 "Brush-off Blast Cleaning of Coated and Uncoated Galvanized Steel, Stainless Steels, and Non-ferrous Metals	SSPC SP 16 "Brush-off Blast Cleaning of Coated and Uncoated Galvanized Steel, Stainless Steels, and Non-ferrous Metals	SSPC SP 16 "Brush-off Blast Cleaning of Coated and Uncoated Galvanized Steel, Stainless Steels, and Non-ferrous Metals
	Surface Preparation: FRP and Other Plastics:	Scuff sand to roughen surface	Scuff sand to roughen surface	Scuff sand to roughen surface	Scuff sand to roughen surface
	Primer:	1 coat, Carboguard 60 (4.0-6.0 mils DFT)	1 coat, 27 Typoxy, or equal (DFT 2.0-3.0 mils).	1 coat Devran 201H (DFT 2.0-3.0 mils)	1 coat, Macropoxy 646 (DFT 2.0-3.0 mils).
	Finish:	2 coats, Carbethane 134 HG (DFT 4.0-6.0 mils per coat)	1 coat, 72/73 Endura-Shield (DFT 2.0-4.0 mils).	1 coat, Devthane 359 (DFT 2.0-4.0 mils)	1 coat Hi-Solids Polyurethane (3.0-5.0 mils DFT)
I.	Exposed pipe insulation				
	Surface Preparation:	Surface must be clean and dry, no contamination.	Surface must be clean and dry, no contamination.	Surface must be clean and dry, no contamination.	Surface must be clean and dry, no contamination.
	Finish:	2 coats, Carbocrylic 3359 (DFT 2.0-3.0 mils per coat)	2 coats, 6 Tneme-Cryl (DFT 2.0-3.0 mils)	2 coats, Devflex 4020 PF (DFT 2.0-3.0 mils per coat)	2 coats, Metalatex Semi-Gloss Acrylic or Pro Industrial 0 VOC Acrylic (DFT 2.0-4.0 mils per coat).

END OF SECTION

**SECTION 10251  
FIREFIGHTING EQUIPMENT**

**PART 1 GENERAL**

**1.01 SCOPE**

- A. This Section includes furnishing and installing portable fire extinguishers, and additional equipment described in Part 4 of this Section.
- B. Additional product requirements are specified in Section 01350.

**1.02 SUBMITTALS**

- A. Submittals shall be in accordance with the requirements of Section 01300 and shall include:
  - 1. Shop Drawings for Review:
    - a. The Contractor shall indicate all variances from the requirements of the Contract Documents.
    - b. A complete list of all appurtenances, materials, and a general arrangement drawing.
    - c. Design information and drawings for the Engineer's review.
  - 2. Operation and maintenance manual.

**PART 2 PRODUCTS**

**2.01 GENERAL**

- A. All firefighting devices shall be in accordance with OSHA Standards found in Part 1910, Subpart L, "Fire Protection".
- B. All devices shall be listed by Underwriter's Laboratories and approved by Factory Mutual.

**2.02 PORTABLE FIRE EXTINGUISHERS**

- A. Fire extinguishers shall have multi-purpose dry chemical extinguishing agent and the capability of fighting Class A, B, and C fires.
- B. All fire extinguishers shall be mounted with wall hangers, unless a cabinet is called for in Part 4 of this Section, at the location shown on the Drawings.
- C. Wall cabinets to house fire extinguishers, when required by Part 4 of this Section, shall be of adequate size to hold the fire extinguisher with the door closed. The cabinet shall be recessed-mounted into the wall. The door shall be full glass type with double strength glass. The cabinet frame shall be steel with a baked enamel finish.

- D. The fire extinguisher shall have a heavy-duty steel cylinder as manufactured by J. L. Industries, Larsen's, or equal. The fire extinguisher shall conform to or exceed an Underwriter's Laboratory classification as indicated in Part 4.
- E. Extinguishers with plastic valves are not acceptable.

**PART 3 EXECUTION**

**3.01 INSTALLATION**

- A. Installation shall be made as shown on the Drawings and recommended by the manufacturer.

**PART 4 SPECIAL PROVISIONS**

**4.01 FIRE EXTINGUISHER SCHEDULE**

- A. Fire extinguishers of the given types shall be mounted as noted in the following schedule. Mounting locations not shown on the Drawings shall be determined by the Engineer.

Building	Room	Extinguisher UL Rating	No. Req'd.	Mounting
SCBS	Existing Building	4A:60BC	2	Wall
SCBS	Building Addition	4A:60BC	2	Wall

END OF SECTION

**SECTION 10702  
SIGNS AND TAGS**

**PART 1 GENERAL**

**1.01 SCOPE**

- A. Under this Section, the Contractor shall furnish all labor, materials, equipment, and incidentals required to provide and install identification devices as shown and specified.
- B. The extent of identification devices is shown on the Drawings and described herein.
- C. The types of identification devices include the following:
  - 1. Door Signs.
  - 2. Floor Loading Signs.
  - 3. Safety Signs.
  - 4. Fire Extinguisher Location Signs.
  - 5. Hazardous Material Signs.
  - 6. Equipment Identification Nameplates.
  - 7. Valve Tags.
  - 8. Exit Signs.
- D. The type and number of each sign required are scheduled in Part 4 unless otherwise noted.
- E. Additional product requirements are specified in Section 01350.

**1.02 QUALITY ASSURANCE**

- A. The Contractor is responsible for all field measurements to ensure the proper fitting of the Work and use of the correct anchoring device.

**1.03 SUBMITTALS**

- A. Submittals shall be in accordance with the requirements of Section 01300 and shall include:
  - 1. Shop Drawings for Review:
    - a. The Contractor shall indicate all variances from the requirements of the Contract Documents.
    - b. Materials of construction.
    - c. Manufacturer's catalog data.
    - d. Anchorage and accessory items.
    - e. Samples - When requested by the Engineer:
      - 1) Full size sample of proposed product.



## **PART 2 PRODUCTS**

### **2.01 DOOR SIGNS**

- A. Material - Laminated thermoset plastic, minimum 1/16-inch thick and 2-inch by 12-inch in size, engraved condensed 1-inch high block lettering on contrasting background and beveled front edges. Signs shall be provided with a pressure sensitive adhesive backing. Colors shall be selected by the Owner from the manufacturer's standard colors.
- B. Door Sign Schedule - Signs as scheduled in Part 4.

### **2.02 FLOOR LOADING SIGNS, SAFETY SIGNS, AND FIRE EXTINGUISHER LOCATION SIGNS**

- A. Material - As a minimum, 20-gauge steel with a baked enamel finish, 10-inch by 14-inch in size, colors and contrasting colors and letter sizes per OSHA regulations.
- B. Appropriate mounting holes or anchoring device as required, single faced sign and appropriate for indoor or outdoor use.
- C. Signs to conform to OSHA Safety and Health Standards - General Industry (29 CFR 1910), Subpart J - General Environmental Controls, Section 1910.145 Specifications for accident prevention signs and tags.
- D. Danger Signs - White background on bottom half with red oval on black background top half; black letters on bottom half and top half to have the word "DANGER" in white letters all in the red oval; letter sizes as appropriate.
- E. Caution Signs - Yellow background with black panel on top one-third with yellow letters of word "CAUTION" on panel; black letters for words and of appropriate size.
- F. Informational Signs - White background with blue panel on top one-third with white letters of word "NOTICE" on panel; blue letters for words and of appropriate size.
- G. Fire Extinguisher Sign - Red background with white letters of appropriate size.

### **2.03 HAZARDOUS MATERIAL SIGNS**

- A. Material - As a minimum, 20-gauge steel with a baked enamel finish, 10-3/4-inch by 10-3/4-inch in size, colors and contrasting colors and letters per DOT Specifications of the DOT Hazardous Material Regulations 40 CFR Part 172.500 as amended.
- B. Sodium Hypochlorite - White background with black lettering and symbols as required.
- C. Signs shall be as detailed on the Drawings and specified herein.

### **2.04 EQUIPMENT NAMEPLATES**

- A. Material - Brass or 304 Stainless Steel, 19 gauge thick, 2-inch diameter in size, engraved condensed black lettering on contrasting background. Provide hole(s) in tag for attachment.
- B. All equipment, not included in Section 16030 and 09900 to be stenciled, shall have an identification nameplate attached. Notation shall be as shown on the Drawings,

described in the appropriate sections of the Specifications, or as directed by the Engineer.

**2.05 VALVE AND ACCESSORY TAGS**

- A. Material – Brass or 304 Stainless Steel, 19 gauge thick, 2-inch diameter in size, engraved condensed black lettering on contrasting background. Provide hole(s) in tag for attachment.
- B. Signs shall be as detailed on the Drawings and specified herein.

**2.06 MANUFACTURER**

- A. Seton Name Plate Corp. - New Haven, CT; Industrial Safety & Security Co. - Lima, OH; or equal.

**PART 3 EXECUTION**

**3.01 INSPECTION**

- A. Examine the substrates and conditions under which the devices are to be installed and notify the Engineer in writing of conditions detrimental to the proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions have been corrected.

**3.02 INSTALLATION OF SIGNS**

- A. Install identification devices and components at the locations shown or as directed by the Engineer, securely mounted with concealed theft-resistant fasteners, unless otherwise indicated.
- B. Attach signs to substrates using appropriate methods so that signs are secure and free from movement, not easily removed or damaged. Such methods shall include:
  - 1. Exterior, wet/damp/corrosive areas shall use stainless steel fasteners in substrate.
  - 2. On handrail provide stainless steel strapping material which is wrapped around the handrail top and bottom rail and bolted to the sign. There shall be a minimum of two anchors at top and tow at the bottom.
  - 3. Pole mount shall have a stainless steel backer plate same a 1/2 inch lager than the sign attached to the pole and the sign attached to the backer plate.
- C. Install level, plumb, and at the proper height. Cooperate with other trades for installation of sign units to finish surfaces. Repair or replace damaged units as directed by the Engineer.

**3.03 INSTALLATION OF EQUIPMENT NAME PLATE AND VALVE AND ACCESSORY TAGS**

- A. Equipment nameplates shall be attached to the electrical motor, if there is one, or at the location designated by the Owner.

- B. All buried and exposed valves and accessories shall be tagged.
- C. Valve tags shall be attached to the valve in a location designated by the Owner.
- D. Attach tags with one of the following:
  - 1. Stainless steel chain.
  - 2. Aluminum or stainless steel key-hole shape snap rings.
  - 3. Plastic zip tie (remove excess strapping).
  - 4. By placing tag under an existing screw on equipment in location acceptable to Owner.
  - 5. Tapping or self-tapping screw into the casting of equipment (as approved by Manufacturer).
- E. For buried valves with valve boxes and valves with operating nut and floor box, attach plastic tags with stainless steel screws to underside of valve box covers. For exposed valves, the tags shall be secured with self-locking nylon straps.
- F. Fire hydrants and lawn hydrants do not require tagging.

**PART 4 SPECIAL PROVISIONS**

**4.01 SCHEDULE**

- A. The following signs shall be provided:

Type	Number Required	Location
Floor Loading	1	North wall
High Voltage	2	Adjacent new electrical panels
The Equipment In This Room Starts and Stops Automatically	2	Adjacent new electrical panels
Keep Electric Panel Area Clear	2	Adjacent new electrical panels
Wear Eye Protection	2	North wall and chemical room
Fire Extinguisher	18	At each fire extinguisher

END OF SECTION

**SECTION 10800  
TOILET AND BATH ACCESSORIES**

**PART 1 GENERAL**

**1.01 SCOPE**

- A. This Section includes furnishing all labor and materials to install complete all bathroom accessories as herein specified and shown on the Drawings.
- B. Accessories shall be provided as per the following schedule and/or required drawings.
- C. Additional product requirements are specified in Section 01350.

**1.02 SUBMITTALS**

- A. Submittals shall be in accordance with the requirements of Section 01300 and shall include:
  - 1. Shop Drawings for Review:
    - a. The Contractor shall indicate all variances from the requirements of the Contract Documents.
    - b. Manufacturer's catalog data.

**PART 2 PRODUCTS**

**2.01 EQUIPMENT**

- A. Paper Holders - One for each water closet. Bradley Model 522 double roll dispenser or equal. Unit shall accommodate two standard core tissue rolls and include a controlled delivery mechanism.
- B. Paper Towel Dispenser - One for each lavatory. Bradley Model 250-15, or equal.
- C. Soap Bar Tray - One for each lavatory and shower. Bradley Model 900, Type 304 stainless steel or equal.
- D. Waste Receptacles - One for each restroom. Bradley, Model 377-38 or equal. Stainless steel with 36-gallon reusable vinyl liner.
- E. Mirror - One for each lavatory, 16-inch by 20-inch Bradley 700, or equal.
- F. Sanitary Napkin Dispenser - Wherever noted on the Drawings. Bradley Model 427 or equal, surface mounted, Type 304 stainless steel. Coin mechanism required.
- G. Water Closet Grab Bars - Two for each handicap toilet. Bradley Model 817, Type 304 stainless steel, or equal. Each grab bar shall be 48-inch long.

**2.02 QUALITY ASSURANCE**

- A. Accessories shall be as manufactured by Bradley, American Dispenser, Bobrick, or equal.

**PART 3 EXECUTION**

**3.01 INSTALLATION**

- A. Installation shall be complete and in accordance with the equipment manufacturer's recommendations, ADA requirements (where specified or shown on the Drawings) and the Contract Documents.

**PART 4 SPECIAL PROVISIONS**

Not used.

END OF SECTION

**SECTION 11050  
COMMON EQUIPMENT REQUIREMENTS**

**PART 1 GENERAL**

**1.01 SCOPE**

- A. The Section includes the general requirements for all equipment installed under this Contract.
- B. Equipment items shall meet the requirements specified herein, plus the specific requirements noted in the technical sections.
- C. The specific requirements included under a particular section shall take precedence.
- D. Additional product requirements are specified in Section 01350.
- E. Motors shall be US Motor or Alliance.

**1.02 SUBMITTALS**

- A. Submittals shall be in accordance with the requirements of Section 01300 and shall include:
  - 1. Shop Drawings for Review:
    - a. Specific equipment submittals are specified in the related sections.
    - b. Equipment shop drawings shall include outline and dimension drawings of the actual equipment being furnished.
    - c. With the shop drawings, the complete motor nameplate data shall be furnished as well as all information requested below which may not be on the motor nameplate:
      - 1) Manufacturer.
      - 2) Rated Horsepower.
      - 3) Operating Speed Range\*.
      - 4) Operating Voltage(s).
      - 5) Current Draws at Operating Voltage(s)\*.
      - 6) Operating Frequency (Hz).
      - 7) Service Factor.
      - 8) Type Enclosure.
      - 9) Frame Size.
      - 10) NEMA Design Designation.
      - 11) Locked Rotor Code Letter.

- 12) Duty Rating.
- 13) Minimum Full Load Efficiency.
- 14) Nominal Efficiency\*.
- 15) Power Factor\*.
- 16) Maximum Size Capacitor Permitted to be Connected to Motor.
- 17) Insulation Class.
- 18) Location of motor terminal housing (F1 or F2).
- 19) Motor no load sound pressure level of dB(A) weighted at 3 feet from motor.
- 20) Motor Full Load Sound Pressure Level of dB(A) - weighted at 3 feet from motor.
- 21) Bearing Ratings.
- 22) Full Load Torque.
- 23) Break Down Torque.
- 24) Locked Rotor Torque.

\* Provide data at following loads: Service factor (if greater than 1.0) times full load (i.e., 1.15 x full load), 100%, 75%, 50%, 25%, and no load.

- d. Minimum full load efficiency shall be tested in accordance with IEEE Standards 112 Test Method B as described in Section 6.4 of IEEE Standard 112. Polyphase motors larger than 125 horsepower shall be listed in accordance with IEEE Standard 112 with stray-load loss determined by direct or indirect measurements.

2. Information for the Record:

- a. Operation and maintenance manual.

### 1.03 QUALITY ASSURANCE

- A. Manufacturer's name, make, model number and other designations provided in the contract documents are to establish the significant characteristics, including but not limited to, type, function, dimensions and physical properties, performance, and appearance for the purpose of evaluating comparable products. The Contractor shall verify product, equipment or system proposed meets or exceeds the requirements as specified or shown on the drawings.

### 1.04 ELECTRICAL AND CONTROL COORDINATION

- A. If the current requirement of any motor or piece of equipment is increased to such an extent that the wiring, conduit, and/or starter for that motor or equipment must be

increased from that shown on the Electrical Drawings, the Contractor shall furnish and install the larger items. The increased wiring, conduit, and/or starter cost shall be included under the Contract and no additional compensation will be allowed.

- B. All electrical, instrumentation, and control equipment and panels furnished under this Contract shall conform to appropriate Sections of Division 16 of these Specifications. Equipment and panels shall be NEMA 4X, unless otherwise shown on the Drawings or Specifications.
- C. Certain equipment items shall be connected to the plant control system as shown on the Control (P&ID) Drawings. Those connections and any remote-control connections shall be wired to clearly labeled terminal strips within the equipment control panel.
- D. Analog signals for input to a programmable controller system or other device shall be 4-20 mADC and where required, current to current transducers or other device shall be furnished to produce an isolated signal to the programmable controller analog input module.
- E. Digital input signal sources shall provide an isolated contact rated at 5-amp minimum, 115 VAC for AC programmable controller inputs or devices and 1 amp minimum 28 VDC for DC rated inputs or devices.

#### 1.05 PRODUCT HANDLING

- A. Unless otherwise specified in the individual sections, the Contractor shall deliver, handle, store, and maintain materials and equipment in accordance with the requirements of the manufacturer.
- B. Materials, equipment, and articles to be incorporated into the Work shall be stored so as to facilitate inspection and inventory and in such manner as to ensure the preservation of their quality and fitness for the Work. Stocked materials shall be subject to test and shall meet the requirements of the Specifications at the time of substantial completion of the Work.
- C. Where construction is in roads or streets, that portion of the right-of-way not required for public travel may be used for temporary storage purposes unless otherwise prohibited. Materials shall not be stored in areas where such storage creates a hazard. Any other additional space required for construction or storage of materials and equipment shall be obtained by the Contractor at his expense.
- D. The Contractor shall confine his equipment, the storage of materials and equipment, and the operations of his workers to areas permitted by law, ordinances, permits, and the requirements of the Contract Documents, and shall not unreasonably encumber the premises with materials or equipment.
- E. Switchgear, motor control centers, panelboards, instrument control panels, fixtures, and like equipment shall be received and stored in a dry, clean, dust-free, heated area. If no such area is available at the time such equipment is received, such space shall be provided by the Contractor at no expense to the Owner. If equipment is stored in an area conducive to the formation of condensation, heaters shall be provided to prevent



condensation. Once the equipment is installed in its final position, suitable protection shall be provided to prevent damage by falling material, dust, paint, dirt, and moisture.

## **PART 2 PRODUCTS**

### **2.01 GENERAL**

- A. AC motor(s) shall conform to the latest applicable NEMA, IEEE, and ANSI standards.
- B. Motor installation shall not exceed 88 dB(A) weighted maximum level at 3 feet from the motor throughout the entire speed range and load range.
- C. Motor bearings shall be antifriction type, grease lubricated with a minimum L-10 rating of 17,500 hours for belted duty and 100,000 hours for direct coupled duty.
  - 1. Thrust bearings in vertical motors shall be adequate for the loading encountered.
  - 2. Belt-driven power systems with jackshafts, and couplings, to isolate the belt loadings from the motor bearings shall be regarded as direct coupled duty.
- D. Motor conduit boxes shall be sized with capacity to meet the requirements of the National Electrical Code. Motors shall be furnished in an "F1" terminal housing assembly (facing connection box, motor shaft extension is to the right) unless otherwise shown on Drawings or specified.
- E. Motor frames shall be cast iron construction with corrosion resistant hardware.
- F. Each motor shall be continuous duty rated NEMA Design B with normal starting torque, unless otherwise shown or specified.
- G. Output torque and speed characteristics of each motor shall be suitable to operate the connected load over the full range of operating speeds and load conditions without exceeding the nameplate current rating or temperature rise on a continuous duty basis.
- H. Insulation shall be Class F or Class H.
- I. Each polyphase squirrel-cage induction motor shall meet or exceed minimum and nominal efficiencies listed in NEMA MG-1, Table 12-10.

### **2.02 AC MOTORS UNDER 1 HP**

- A. Unless otherwise shown or specified, each fractional motor under 1/2 hp shall be designed for single phase, 115 and 230 volt, 60 Hz service.
- B. Unless otherwise shown or specified, each fractional motor 1/2 through 3/4 hp shall be designed for 3 phase, 208, 230, and 460 volt, 60 Hz service.

### **2.03 INTEGRAL AC MOTORS**

- A. AC motor(s) 1 hp and larger shall have a 1.15 service factor at a 40 degrees C ambient temperature. Motor shall be capable of operating at the 1.15 service factor rating on a continuous basis per NEMA MG1-12.42 Item 1b.

- B. Motor enclosure types shall be as specified in the equipment specifications and shall be of one of the following designations.
  - 1. Open drip-proof protected (ODP).
  - 2. Totally enclosed non-ventilated (TENV), or totally enclosed fan cooled (TEFC).
  - 3. Explosion proof Class 1, Division 1, Group D.
  - 4. Submersible water cooled.
- C. Multi-speed motors shall have the energy efficient design designated for the high-speed winding operation.

#### **2.04 SPECIAL APPLICATION MOTOR(S)**

- A. Special application motor(s) are defined as those used on such devices as appliances, tools, unit heaters, door operators, refrigeration units and sump pumps.
- B. Manufacturer's standard motor may be approved by the Engineer where a re-design of the unit would be required to furnish energy efficient motors.

#### **2.05 DEFINITE PURPOSE MOTORS**

- A. Equipment requiring a motor drive with unusual characteristics shall be equipped with a definite purpose motor to meet the necessary requirements.
  - 1. Definite purpose motors are hermetic refrigeration compressors, jet pumps, shaft mounted fans and blowers, submersible deep well pumps, submersible mixers, elevator, crane, close coupled pumps, and torque motors.
  - 2. If available, an energy efficient design motor shall be furnished on this application.

#### **2.06 MOTORS ON VARIABLE FREQUENCY DRIVES**

- A. Motors for use with a Variable Frequency Drive (VFD) shall be TENV, TEFC, or submersible, water cooled.
  - 1. Design to meet or exceed the efficiencies listed in NEMA MG-1, Table 12-10.
  - 2. Motor shall be "Inverter Duty Rated", and so stamped on the nameplate.
  - 3. Motor shall have an insulation system that meets or exceeds the requirements of NEMA MG-1, Part 31.40.4.2, and is rated at 1,600 volts peak to ensure that the motor is rated for operation with non-sinusoidal waveforms at 1.0 service factor.
  - 4. Bearings in motors greater than NEMA Frame size of 300 and controlled by variable frequency drives must be guaranteed against premature bearing failure caused by discharge current. All such motors shall be provided with a shaft grounding device.

- B. AC motor used with a VFD shall have internal thermal protectors guaranteed by the motor manufacturer to protect the motors against overheating from stalled or slow turning due to lack of adequate cooling at low motor speeds.
  - 1. Thermal protection devices shall be imbedded within the motor windings with normally closed contacts to be used in series with the coil of the motor's magnetic bypass starter and the stop circuit on the VFD.
  - 2. Thermal protection devices shall all be provided and housed within the motor housing, unless otherwise specified.
- C. Explosion proof motors shall use thermal protectors required by UL as covered by 2.08, and meet the requirements of 2.06 preceding, and shall be rated and labeled for "Inverter Duty".
- D. Tachometer generators when required by the Specifications or the P&ID Drawings shall be DC generators of the enclosure required for the particular motor location.

#### **2.07 DIRECT CURRENT MOTORS ON VARIABLE SPEED DRIVES (VSD)**

- A. Each motor shall be equipped with internal thermal protectors as covered in 2.06. Permanent magnet field DC motors are not acceptable.
- B. Motors and tachometer generators shall be in totally enclosed non-ventilated or totally enclosed fan cooled enclosures except where required to be explosion proof motors.

#### **2.08 EXPLOSION-PROOF MOTORS**

- A. AC motors for use in a Class I, Division 1, Group D location shall meet the requirements of paragraph 2.01 above.
- B. Explosion-proof motors 3 hp and larger shall have a 1.15 service factor. Such motors shall be capable of operating at the 1.15 service factor rating on a continuous basis per NEMA MG1-12.42 Item 1b.
- C. Each motor shall be furnished with internal thermal protectors with normally closed contacts that will open should the safe operating motor temperature be exceeded per UL requirements. These contacts shall be placed in series with each other and with the coil of the magnetic motor starter, and/or the VFD enable circuit if used with a VFD, on all applications.

#### **2.09 MOTOR SPACE HEATERS**

- A. Space heaters as specified or shown on the Drawings shall be factory installed by the motor manufacturer.

#### **2.10 V-BELT DRIVES**

- A. Belts for V-belt drives shall be provided with a minimum service factor of 2.0.
- B. Drives shall be submitted with manufacturer's data supporting the horsepower rating of the V-Belt drives being used.

- C. Assembled cog belts and other assembled belt drives are not acceptable.
- D. V-Belts on multiple V-Belt drives shall be provided in matched sets.
- E. The Contractor shall provide one spare belt or one spare matched set of drive belts, whichever is applicable, for all belt-driven equipment supplied under this Contract. The spare belts shall be the same size, type, and quality as supplied by the equipment manufacturer.

#### **2.11 COUPLED DRIVES**

- A. Coupled drives shall have the service factor recommended by the coupling manufacturer.
- B. Coupled drives shall be submitted with engineering data supporting the horsepower rating of each coupling.

#### **2.12 SAFETY GUARDS**

- A. Installed equipment shall be equipped with all guards, shields, and devices to meet OSHA requirements.
- B. Chain and belt guards shall be totally enclosed steel construction, 14-gauge minimum for guards up to 60-inch center distance and 12-gauge minimum for larger guards.
- C. Guards shall include expanded metal inspection panels. Removable access panels shall be provided to perform routine maintenance.

#### **2.13 MANUFACTURER'S NAMEPLATE**

- A. Equipment shall be identified by permanently attached nameplate of corrosion-resistant metal. Plates shall bear the following information:
  - 1. Manufacturer's name.
  - 2. Serial and model numbers.
  - 3. Rated capacity.
  - 4. Temperature, pressure, or other limitations.

#### **2.14 ANCHOR BOLTS**

- A. Equipment anchor bolts shall be as specified in Section 05500.

### **PART 3 EXECUTION**

#### **3.01 INSTALLATION**

- A. Equipment shall be installed in accordance with the manufacturer's instructions and Contract Documents. Required anchors, grout, and leveling shims shall be provided by the Contractor.
- B. Alignment procedures and acceptable runout tolerances on couplings shall be submitted.

### **3.02 ROTATING EQUIPMENT ALIGNMENT**

- A. To aid in the field alignment of all equipment base plate mounted rotating equipment, push bolts (jacking bolts) shall be furnished and welded to the base plate.
- B. All rotating equipment shall be field checked for alignment after installation and initial operation. The equipment shall be at operating temperature. The minimum method of indicating alignment will be the "16-point" method. Other proposed methods must be submitted for approval to the Engineer.
- C. The alignment results are to be submitted for record. They are to include the final set of indicator readings and a plan view sketch of the motor and driven machine base, and the thickness of shims for each shimmed anchor bolt. The thickness of shims shall not exceed 0.25 inches.

### **3.03 INITIAL LUBRICATION**

- A. Initial lubrication required for start-up, field test operation, and normal operation prior to substantial completion shall be furnished and applied in accordance with the manufacturer's recommendations.
- B. Where lubricating points are not easily accessible, provide extensions as required for easy access with normal grease gun.

### **3.04 PACKING**

- A. Each shaft containing a packing gland shall be checked for condition by backing the packing gland off and examining for proper grade, amount, and type of packing as recommended by the manufacturer.

### **3.05 MAINTENANCE**

- A. The Contractor shall perform and log all preventive maintenance tasks as recommended by the manufacturer while the equipment is in storage and after installation until the equipment has been accepted by the Owner.

### **3.06 TROUBLESHOOTING**

- A. Should a problem occur before acceptance, the Contractor shall determine the cause and recommend corrective actions to the Engineer. The Contractor shall correct equipment and installation deficiencies.

## **PART 4 SPECIAL PROVISIONS**

Not used.

END OF SECTION

**SECTION 11735  
PUMPING EQUIPMENT**

**PART 1 GENERAL**

**1.01 SCOPE**

- A. This Section includes the furnishing and installing of vertical turbine pumping equipment as shown on the Drawings, as scheduled in Part 4, and as specified herein.
- B. The pumping equipment shall be furnished with all drives, drive shafts, couplings, steady bushing, drive shaft and pump bases, and other appurtenances as specified or required for a complete installation and satisfactory operation.
- C. All Work performed under this Section shall be in accordance with all approved trade practices and manufacturers' recommendations.

**1.02 SUBMITTALS**

- A. Submittals shall be in accordance with the requirements of Section 01300 and shall include:
  - 1. Shop Drawings for Review:
    - a. Manufacturer's warranty.
    - b. Manufacturer certification/affidavit.
    - c. Manufacturer's literature.
    - d. Manufacturer's certified test curves (computer model printouts are not acceptable).
    - e. Information and data concerning the materials of construction, salient components, and details of construction of equipment and components.
    - f. Motor data in accordance with Section 11050.
  - 2. Information for the Record:
    - a. Manufacturer's installation instructions.
    - b. Operation and maintenance manuals.
    - c. Manufacturer's certification of installation.

**1.03 QUALITY ASSURANCE**

- A. Manufacturer Warranty and Service Packages:
  - 1. Warranty Submittals - At the time of shop drawing submittal, the Contractor shall submit a written warranty from the manufacturer(s) covering workmanship and materials on those pumps with drive motors of 7-1/2 hp or larger when used as intended for this installation. Warranty period shall be one-year, unless specified otherwise. The warranty period shall commence on the

date of Substantial Completion. Under terms of this warranty, the manufacturer shall furnish and install all replacement parts for any defective component at no cost to the Owner. The provisions of this warranty shall not be construed as relieving or reducing the obligations of the Contractor outlined in the General Conditions of these Specifications.

- B. Manufacturer Certification/Affidavit:
1. Manufacturer shall provide affidavit certifying that:
    - a. Manufacturer has examined the Contract Documents, including but not limited to the Drawings and Specifications.
    - b. Understand the installation and parameters specified herein and shown on the Drawings.
    - c. The equipment specified is suitable for this application.
    - d. Notified Owner and Engineer of any modifications required to the system or the equipment in this application.

## PART 2 PRODUCTS

### 2.01 PUMPS

- A. General:
1. Each pump shall be designed and furnished to meet the operating conditions specified in Part 4 of this Section. The type of pump for each service is given in the Schedule in Part 4.
  2. Each pump shall be of the manufacturer and model listed in Part 4, or approved equal. All pumps used for one type of service shall be of the same manufacturer.
  3. The manufacturer shall perform a factory non-witnessed hydraulic performance test on the bowl assemblies per ANSI/HI 14.6-2016 acceptance grade. The test shall be performed utilizing a factory lab motor. A certified copy of the test results shall be provided to the Engineer prior to shipment.
  4. No point on the pump performance curve shall require more than the nameplate horsepower of the drive motor.
- B. Bowl Assembly:
1. The pump bowls shall be of close-grained ASTM A48 class 30 cast iron free of blow holes, sand holes, and other detrimental defects. They shall be accurately machined and fitted. The water passageways shall be enamel lined to reduce friction loss. The bowls shall be capable of withstanding a hydrostatic pressure equal to twice the pressure at rated capacity or 1-1/2 times the shut-off pressure, whichever is greater. The bowls shall be flange connected with bolting of ASTM F593 group 1 condition CW 18-8 stainless steel. The bowls shall be equipped with ASTM B505 alloy C93200 bronze replaceable wear rings on the

- suction side of the enclosed impellers. Sealing between bowls shall be accomplished by means of an O-ring.
2. The impellers shall be of investment cast ASTM A743 CF8 304 stainless steel, enclosed type, and statically and dynamically balanced. The impellers shall be balanced to ISO 1940 grade G6.3. They shall be securely fastened to the shaft with 416 stainless steel tapered locking collets. The impellers shall be adjustable by means of a nut at the top of the motor.
  3. The bowl shaft shall be of ASTM A582 type 416 stainless steel pump shaft quality (PSQ) and shall be turned, ground, and polished. It shall be supported by ASTM B505 alloy C83600 bronze bearings above and below each impeller. The size of the bowl shaft shall be no less than that determined by ANSI/AWWA Specification E101.
  4. The bowl assembly shall be supplied with a top discharge case of ASTM A536 grade 65-45-12 ductile iron. The discharge case shall be accurately machined to accept the specified size of column pipe.
  5. The suction case shall be of close-grained ASTM A48 class 30 cast iron free of blow holes, sand holes, and other detrimental defects. The suction case bearing shall be of ASTM B505 alloy C83600 bronze. It shall be grease lubricated. A C1045 steel sand collar shall protect the suction case bearing from abrasives in the pumping fluid. The suction case shall be provided with a NPT threaded connection for an optional suction bell, tail pipe, or strainer.
  6. A belled suction shall be provided to reduce entrance losses to a minimum. The suction bell shall be of close-grained ASTM A48 class 30 cast iron free of blow holes, sand holes, and other detrimental defects.
- C. Anti-Vortex Suppressor:
1. A 316 stainless steel basket type clip-on anti-vortex suppressor shall be provided having a net inlet area equal to at least four times the suction pipe area. The maximum opening size shall not be more than 75 percent on the minimum opening of the water passage through the bowl and impeller.
- D. Discharge Column Pipe Assembly:
1. Lineshafts and Couplings:
    - a. The lineshafts shall be of ASTM A582 type 416 stainless steel PSQ and shall be turned, ground, and polished. They shall be furnished in interchangeable sections not over 10 feet in length.
    - b. The size of the lineshafts shall be as recommended by the pump manufacturer, but the size shall not be less than that determined by ANSI/AWWA Specification E101. They shall be sized to handle the torque and hydraulic down thrust imposed on the shafts by the pumping unit during operation. Shaft elongation due to hydraulic down



- thrust shall not exceed the axial clearance of the impellers in the pump bowls.
- c. To ensure accurate alignment of the shafts, they shall be straight within 0.005-inch total indicator reading (TIR) for a 10-foot section, and the butting faces shall be machined square to the axis of the shaft. The maximum permissible error in the axial alignment of the thread axis with the axis of the shaft shall be 0.002-inch in 6-inch.
  - d. The lineshafts shall be coupled with 416 stainless steel couplings. The couplings shall have left-hand threads that tighten during pump operation. Lineshafts larger than 2-11/16-inch shall utilize a ring and key type coupling design with no threaded fasteners.
2. Lineshaft Bearings and Retainers:
- a. The lineshaft bearings shall be designed for vertical turbine pump service, to be lubricated by the pumping fluid. They shall be of neoprene rubber with a minimum 70 shore hardness. They shall be the snap-in type with internally spiral grooves to flush out sand and other abrasives.
  - b. The lineshaft bearings shall be spaced at intervals not to exceed 10-feet for 1,800 RPM and below. The bearing spacing shall not exceed 5-feet for 2,200 RPM and above.
  - c. The lineshaft bearings shall be mounted inside drop-in type bearing retainers held in position between sections of column pipe. The bearing retainers shall be of ASTM A743 CF8 304 stainless steel.
3. Column Pipe:
- a. The column pipe shall be fabricated of standard schedule ASTM A53 grade B steel pipe with ASTM A36 steel flanges. The column pipe shall be flange connected with bolting of ASTM F593 group 1 condition CW 18-8 stainless steel.
  - b. The column shall be furnished in interchangeable sections having a nominal length of not more than 10-feet. The top and bottom sections of column pipe shall not exceed 5-feet in length.
  - c. The flanges shall be faced parallel and machined with registered fits to butt against the bearing retainer shoulder to ensure proper alignment and to secure the bearing retainers when assembled.
  - d. If possible, the column pipe size shall be such that the friction loss will not exceed 5-feet of head per 100-feet of column pipe, based on the rated capacity of the pump.
4. Discharge Head:
- a. The discharge head shall be fabricated steel or single cast iron design equipped with an ANSI discharge flange. The discharge head shall be

designed to withstand all stresses incidental to service, including a vertical hollow shaft mounting assembly and driver. Large hand holes in the mounting assembly shall be provided for ease of adjusting the packing. A tap and plumbing for draining the stuffing box leakage shall also be provided.

5. Foundation Plate:
  - a. A square, ASTM A36 steel, foundation plate shall be provided. The foundation plate size shall be equal to or greater than the diameter of the discharge head base, and it shall be of sufficient size and strength to support all loads to which it may be subjected. Four holes shall be provided, one at each corner, to accommodate anchor bolts. The foundation plate shall have a center opening of adequate size to facilitate the setting and removal of the pumping unit without removal of the foundation plate.
6. Seal-Housing Assembly:
  - a. The lower and upper seal housings shall be of ASTM A48 class 30 cast iron. A lower seal housing throttle bearing of ASTM B505 alloy C83600 bronze shall be provided to support the top lineshaft. All fasteners shall be of ASTM F593 group 1 condition CW 18-8 stainless steel.
  - b. Sealing between the lower seal housing and the discharge head shall be accomplished by means of an O-ring.
  - c. The mechanical seal shall be of the component type. The rotating face shall be of carbon, and the stationary face shall be of silicon carbide. All seal hardware shall be of 300 series stainless steel. Seal shall be one piece and shall be capable of being replaced without removal of the motor.
  - d. The seal materials shall be compatible with the pumping fluid.
7. Paint and Coatings:
  - a. The bowl assemblies, discharge heads, and foundation plates shall be provided with the manufacturer's standard factory applied paint.
8. Motor:
  - a. The electric motor shall be of the vertical hollow shaft, NEMA design B, P-base, squirrel cage induction design. It shall be premium efficient and inverter duty rated per NEMA MG-1 Part 31 at a 1.00 service factor.
9. Horsepower:
  - a. The motor rating shall be sized such that it will not be loaded beyond the nameplate rating at any point along the pump characteristic curve. Use of the motor's service factor will not be acceptable.

- b. The motor shall be equipped with a non-reverse ratchet to prevent the pump from spinning backwards. The motor shall be equipped with winding thermostat, inverter grade insulation, internal shaft grounding ring, and 115 volt space heater (through 250 hp).
- c. The thrust bearing shall be capable of carrying the continuous hydraulic down thrust generated by the pump during operation at any point along the pump characteristic curve with an AFBMA L-10 minimum bearing life of 44,000 hours. The bearing shall be capable of withstanding a momentary upthrust of at least 30% of the rated hydraulic down thrust.
- d. A motor steady bushing shall be required for all 2 pole applications or when a mechanical seal is used with a vertical hollow shaft motor.
- e. Eyebolts or equivalent lifting points shall be provided to lift the motor safely.
- f. The motor shall be manufactured by Nidec (US Motors), or approved equal.

## **2.02 VARIABLE SPEED DRIVES AND CONTROLS**

- A. Variable Frequency Drive:
  - 1. Variable frequency drives shall conform to the requirements of Section 16230.

## **2.03 MOTORS**

- A. Motors shall conform to the requirements of Section 11050.

## **2.04 ACCESSORIES**

- A. Each pump shall be provided with easily identifiable terminal points to facilitate the exchange of the central control functions between the pumps and the process control system as indicated on the Contract Drawings.
- B. Pressure Gauges and Connections:
  - 1. Pump discharge flanges shall be tapped for gauge. The gauge shall be properly installed on the pump discharge line. Gauge shall be a product of H. O. Trerice, Ashcroft, or approved equal, as specified in Section 15400.
  - 2. Gauge connections shall be 1/2-inch in diameter.
  - 3. Each connection shall include a shutoff needle valve and necessary lengths of pipe to allow the mounting of a pressure gauge. The open end on the gauge connection shall be plugged to prevent the accumulation of debris.
- C. Each set of pumps shall be provided with one set of special tools required for complete service and maintenance.

## **2.05 RESERVED**

## **2.06 SHOP PAINTING**

- A. Shop painting shall be in accordance with the requirements of Section 01350.

## **PART 3 EXECUTION**

### **3.01 ERECTION**

- A. The equipment shall be erected in accordance with the manufacturer's recommendations. Required grout and leveling shims shall be provided by the Contractor.
- B. All stuffing boxes, seals, packing glands shall be piped to the nearest drain with 1/2-inch Schedule 40 PVC pipe.

### **3.02 INITIAL LUBRICATION**

- A. Initial lubrication required for start-up and field test operation shall be furnished and applied in accordance with the manufacturer's recommendations.

### **3.03 INSPECTION, STARTUP, AND TESTING**

- A. The Contractor shall furnish a qualified representative of the manufacturer to perform inspection, startup, and training services. The manufacturer's representative shall be experienced in the installation, startup, operation, and maintenance of the equipment.
- B. The representative shall check the installation and supervise final adjustments and initial startup of the equipment. The representative shall certify that the installation is correct, and that the equipment is operating satisfactorily.
- C. Within two weeks of startup, the manufacturer shall submit to the Engineer a written report (minimum 4 copies) covering the representative's inspection and startup of the equipment. This report shall include the manufacturer's certification that the installation is correct, and that the equipment is operating satisfactorily.
- D. After the installation and operation of the equipment has been certified, the manufacturer's representative shall train the Owner's personnel for one, eight-hour day in the proper operation and maintenance of the equipment. The Owner may videotape the training.

## **PART 4 SPECIAL PROVISIONS**

### **4.01 SEAL WATER CONNECTIONS**

- A. See Section 15211 for seal water connections.

### **4.02 PUMP SCHEDULE**

- A. The following tables provide the operating conditions, type of pump, manufacturer name and model number, along with salient features specific to each manufacturer. The pumps listed are selected for the specified service and acceptable to the Owner.

- B. The listed pumps, for the specified service, are intended to provide equal operation in the application, therefore there may be variations from one manufacturer to another.

#### 4.03 PUMP SCHEDULE

Service	Quantity	Type	Location
Water Booster	1	Vertical Turbine	SCBS

#### 4.04 BOOSTER PUMP

- A. Operation Conditions:
1. Service: Water booster pump.
  2. Pump shall be Vertical Turbine Pumps.
  3. Capacity: 3280 gpm at 127 feet TDH at 1785 rpm and 1500 gpm at 100 feet TDH at 721 rpm.
  4. Impeller diameter: 12.57 inch for basis of design pump.
  5. Column Size: 12-inch.
  6. Discharge Flange 12-inch.
  7. Motor: 150 HP, 1785 rpm, 3-phase, 60 hertz, 460 volts.
  8. Motor shall include a temperature switch. See Section 11050.
  9. Motor shall be VFD driven. See Section 16230.
  10. Pump shall be manufactured by Peerless, Patterson, American Marsh, or equal.

#### 4.05 MECHANICAL SEALING SYSTEM

- A. Split Mechanical Seal:
1. All components shall be split in half except for seal faces. Seal faces shall be solid (un-split) for initial installation at rotating equipment manufacturers only. If seal is to be installed on existing pump, faces shall be split.
  2. The non-shaft elastomers must incorporate a ball and socket to provide easier handling during installation. No glue is to be applied to the elastomers.
  3. The seal shall be installed outside of the sealing chamber/stuffing box. Repair/replacement of the seal shall be accomplished without any rotating equipment disassembly.
  4. The seal shall be of stationary, hydraulically balanced, O-ring design to reduce heat generation, face wear and minimize horsepower consumption. The design will seal both positive pressure and vacuum.
  5. The seal shall be mechanically loaded with multiple springs. The springs will be isolated from the pumped product to eliminate corrosion or clogging problems.

6. A universal adjustable gland shall be provided to fit most popular pumps. Two flush ports with standard 3/8-inch NPT tapped connections shall be provided in the gland.
  7. The rotary holder shall have a drive pin to ensure positive drive of rotating parts.
  8. The seal shall be capable of sealing up to 28 inches of vacuum to 300 psig dependent upon size and materials.
  9. To minimize on-going maintenance costs, the mechanical seal must be field repairable utilizing a spare parts kit of wearable elements only. Spare parts kit shall include split rotary and stationary faces, springs, elastomers, gaskets, and fasteners.
  10. Mechanical Seal shall be AW Chesterton, PSS4, or approved equal.
- B. Rotating equipment will be equipped with a throat bushing that:
1. Creates fluid exchange and improved circulation in the seal chamber that reduces frictional heat accumulation around the mechanical seal.
  2. Positions particulate matter/contaminants for removal by conveying them from the bore to the shaft by means of an integral machined spiral.
  3. Removes particulate matter/contaminants from the seal chamber to the impeller for expulsion.
  4. Reduces or eliminates flush water requirements depending on pumped fluid.
  5. Throat Bushing will be a Spiral Tractm as provided by AW Chesterton, Solid Extruder Bushing, or approved equal.
- C. Split Mechanical Seal:
1. Gland and rotary holder shall be 316 stainless steel.
  2. Springs shall be Elgiloy, Alloy C-276, or approved equal to prevent chloride stress corrosion.
  3. The rotary face shall be solid silicon carbide or alumina ceramic.
  4. The stationary seal face shall be solid silicon carbide or carbon.
  5. Elastomers shall be Viton, EPR, or Aflas.
- D. SpiralTrac Throat Bushing:
1. 316 stainless steel, 416 stainless steel, Bronze, Glass Filled PTFE, Carbon Graphite Filled PTFE, Titanium as recommended by manufacturer.
  2. The controls shall turn on the pump at the 8-inch water level and turn off the pump at the 2-inch water level.

**4.06 AIR/VACUUM RELEASE VALVES**

- A. The vertical turbine pump shall have an air/vacuum release valve on the discharge of the pump.
- B. Materials of Construction:
  - 1. 304 Stainless steel barrel, tie rods and fasteners.
  - 2. 316 Stainless steel nozzle.
  - 3. Fusion bonded, epoxy coated ductile iron top and bottom flanges with ABS top cover.
  - 4. Floats high density polyethylene.
- C. Valves shall be Vent-O-Mat RBX.

END OF SECTION

**SECTION 15010  
GENERAL MECHANICAL PROVISIONS**

**PART 1 GENERAL**

**1.01 SCOPE**

- A. This Section includes furnishing and installing mechanical accessories and requirements necessary for the completion of the Work whether or not specifically shown or specified.
- B. Items include, but are not limited to:
  - 1. Piping Hangers and Supports.
  - 2. Insulation Fire Retardant Requirement.
  - 3. Accessibility and Access Panels.
  - 4. Power Actuated Anchors.
  - 5. Rotating Equipment Alignment.
- C. Additional requirements are specified in Sections 01350 and 11050.

**1.02 SUBMITTALS**

- A. Submittals shall be in accordance with the requirements of Section 01300 and shall include:
  - 1. Shop Drawings for Review:
    - a. Descriptive information on all mechanical items.
    - b. Drawings locating anchors, inserts, and supports for piping, including vendor data for each component.
  - 2. Information for the Record:
    - a. Alignment procedures and acceptable runout tolerances for each piece of connected equipment.
    - b. Shaft and bore sizes and tolerances for couplings and instructions for coupling installation.
    - c. A report of coupling alignment readings for each coupling and driven machine combination, and sizes of all anchor bolt or equipment base shims.

**PART 2 PRODUCTS**

**2.01 PIPING HANGERS AND SUPPORTS**

- A. The manufacturer's names and catalog numbers shown in the following paragraphs have been used as a guide to type, style, and materials of construction only. Anvill, Unistrut, or equal.



- B. The Contractor shall furnish and install all pipe supports, hangers, harnessing, expansion joints, expansion loops, and inserts required to support the piping and valves. Supports shall be designed and spaced to secure pipe in place without sag or undue stress on any pipe, fitting, equipment, or valve. Piping that is close to the floor may be supported on concrete piers. Piping near walls may be supported by wall brackets. Piping at equipment and valves, etc., shall be supported so that the equipment and valves can be removed without additional pipe supports. Piping shall not introduce any strains or distortion to connected equipment. Overhead lines shall be installed directly on supports, or suspended by hangers or hanger rods. Where piping is supported from the ceiling, inserts shall be poured in the concrete slab flush with the bottom of the slab. Adequate lateral support shall be provided to prevent noticeable lateral movement of the piping either during operation, or from a lateral load of 300 pounds applied at any point. All hanger design, anchoring, support, etc. shall be the responsibility of the Contractor. Design loads shall not exceed the manufacturer's recommended loads.
- C. Types of Supports:
1. All horizontal piping 4-inch and larger with inverts 2-feet or less from a finished floor shall be supported by concrete saddle supports, unless otherwise specified in Part 4 of this Section.
  2. Beam clamps shall be used where piping is supported from steel structure of building. Clamps shall be selected on basis of load to be supported. Beam clamps shall be malleable iron with bolt, nut, and pocket threaded for rod connection as required to fit beams. C-clamp type shall only be hung from truss panel points unless otherwise approved by the Engineer.
  3. In precast slab areas supports shall be hung from tabs. Tabs shall not be overloaded. Contractor shall not drill into precast slabs unless approved by the Engineer.
  4. Cast-in inserts shall be used for suspending hangers from concrete. For heavier loads, insert shall be ceiling type, individual inserts; Anvill CB - Universal concrete inserts, Figure 282, or equal. For lighter loads, inserts shall be Unistrut P-3200 series, or equal. The preformed channel members shall be 1-5/8-inch by 1-3/8-inch with a 12-gauge (0.105 inch) material thickness. Anchors shall be at 4-inch on center maximum, and extend into concrete a minimum of 2-3/4-inch. End caps and/or end cap anchors shall be provided to prevent concrete seepage into channels. All channels shall have a pre-galvanized finish, and all accessories shall be electro-galvanized. Insert shall not be overloaded.
  5. Vertical piping shall be supported at base by hanger placed in horizontal line near riser, or by base fitting set on pedestal or foundation. Risers shall be laterally supported at intermediate points with riser clamps with two-point bearing as required to make rigid. Riser clamps shall be wrought steel, with extension lugs, bolt, and nuts; Anvill Figure 261, or equal. Offset pipe clamps, Anvill Figure 103, or equal, may also be used. Use only in unfinished areas where approved by the Engineer. Anvill Figure CT-121, or equal, shall be used for copper pipe.

6. Unless otherwise noted, hangers shall be as follows:
  - a. Uninsulated piping 2-inch and smaller, Anvill Figure 97, or equal malleable iron adjustable nut and steel band.
  - b. Uninsulated piping 2-inch and larger, Anvill Figure 260, or equal, galvanized steel adjustable clevis type.
  - c. Uninsulated copper tubing, Anvill Figure CT-69, or equal, carbon steel ring and knurled swivel iron adjusting nut completely copper plated.
  - d. Insulated piping, Anvill Figure 260, Elcen, or equal, clevis hangers. An insulation protection shield, Anvill Figure 167, or equal, shall be installed over the insulation in 180-degree segment, minimum 12-inch long. The shield shall be galvanized steel and shall vary in thickness from 18-gauge to 12-gauge, according to pipe size, as required to prevent crushing of the insulation. Anchors and guides shall be installed as required. Where roller supports are required due to expansion or contraction, Anvill Figure 171 roller hangers, Anvill Figure 175 roller chairs, Anvill Figure 271 pipe roll stands, or equal shall be used.
  - e. Brackets shall be Anvill Figure 195, or equal, as required for weight of pipe. Brackets for use with preformed Unistrut or equal channels shall be fabricated from 12-gauge material, compatible with the 1-5/8-inch square channel members. Unistrut or equal brackets shall be galvanized. All fabricated steel brackets used to support piping in or above tanks, channels, and flumes shall be hot dip galvanized after fabrication and all fasteners shall be galvanized.
- D. Anchorage shall be provided to resist thrust due to temperature changes, changes in diameter or direction, or dead ending. Anchors shall be located as required to force expansion and contraction movement to occur at expansion joints, loops, or elbows, and as required to prevent excessive bending stresses and opening of mechanical couplings. Anchors shall be suitable for the location of installation and shall be designed to withstand not less than five times the anchor load. Vertical pipes shall be anchored by means of clamps welded around pipes and secured to wall or floor construction. Anchorage for temperature changes shall be centered between elbows and mechanical joints used as expansion joints. Anchorage for bellow type expansion joints may be located adjacent to the joint.
  1. Pipe guides shall be provided adjacent to bellows type expansion joints. Guides shall be placed on both sides of expansion joints except where anchors are adjacent to the joint. Unless otherwise indicated on the drawings, one guide shall be within four pipe diameters from the joining and a second guide within 14 pipe diameters from the first guide. Pipe supports shall allow adequate movement; pipe guides shall not be used for support. Guide and spider shall be of sufficient size to clear pipe insulation and long enough to prevent overtravel of spider and cylinder. Pipe guides shall be Anvill Figure 255, or equal, and shall be installed as recommended by the manufacturer.

2. Unless closer spacing is indicated on the drawings, the maximum spacing for pipe supports and expansion joints shall be:

Type of Pipe	Pipe Support Max. Spacing, ft	Max Run Without Expansion Joint, Loop, or Bend, Ft	Expansion Joint Max. Spacing, ft	Type of Expansion Joints
Cast Iron/Ductile Iron	10 (Note 4)	80	80	Mechanical Couplings
Steel for hot water heating				
1-1/4-inch and smaller	7	30	100	Note 1
1-1/2- to 4-inch	10	30	100	Note 1
Over 4-inch	15	30	100	Note 1
Steel for other services				
1-1/4-inch and smaller	7	30	100	Note 1
1-1/2- to 4-inch	10	30	100	Note 1
Over 4-inch	15	80	80	Mechanical Couplings
Copper for hot water				
1-inch and smaller	5	20	100	Note 1
Over 1-inch	7	20	100	Note 1
Copper for other services				
1-inch and smaller	5	--	--	None required
Over 1-inch	7	50	100	Note 1
PVC				
1/8- to 1-inch	Continuous Support (Note 2)	20	60	Note 1
1-1/4- to 2-inch	4	20	60	Note 1
Over 2-inch	6	20	60	Note 1
Fiberglass reinforced plastic				
3-inch and smaller	6	60	100	Note 1
Over 3-inch	8	40	100	Note 1
Acid Waste				
Tempered glass	8 (Note 3)	--	--	None required
High silicon iron	15 (Note 4)	--	--	None required
Cast iron soil	10 (Note 4)	--	--	None required

Notes:

1. Expansion joint fittings as specified in the applicable miscellaneous piping section.
  2. Hanger and bracket spacing may be increased where PVC pipe is provided continuous support.
  3. At least two properly padded supports for each pipe section.
  4. At least one support for each pipe section.
3. Pipe expansion joints shall be installed within 5-feet of all structural isolation or expansion joints. Expansion joints shall be as specified in the appropriate Section of this Contract, and submitted for approval.

- E. Expansion Loops - Where fabricated expansion loops are shown on the drawings or deemed by the Contractor to control the system, expansion loops shall be designed by the Contractor and submitted for approval.
- F. Use correct size hanger to allow for increased diameters of line caused by pipe covering. The Contractor will not be allowed to cut or reduce specified covering to allow application of hangers, unless otherwise specified.
- G. Galvanic Protection - A dielectric material shall be placed between pipe and supports when dissimilar metals are used. A flexible elastomer material, Unistrut unicushion P-2600, or equal, may be used. A thermoplastic elastomer cushion, the Unistrut Cush-A-Clamp or equal, may also be used. In general, if galvanized supports are used, all accessories shall be galvanized. If carbon steel supports are used, all accessories shall be carbon steel.
- H. Support mechanical coupling pipe at each joint.
- I. Other means of pipe supports not be used unless approved by the Engineer.
- J. Pipe supports shown on the Drawings shall be provided and do not relieve the Contractor of any of the requirements in this Section.

## 2.02 FIRE RETARDANT INSULATIONS

- A. All insulation material (insulation, jackets, adhesives, cements, mastics, sealers, coatings, and finishes) shall have composite Fire and Smoke Hazard ratings as tested under ASTM E84, NFPA 255, and UL 723, not exceeding as follows: (unless noted otherwise in UBC).
  - 1. Flame Spread 25      Smoke Developed 50
- B. All surfaces shall be clean, dry, and free of oil and grease before insulation, adhesives, or mastics are applied.
- C. All joints shall be tight with insulation lengths and segments tightly butted against each other. Where lengths or segments are cut, cuts must be smooth and square. All insulation shall be continuous through wall and ceiling openings. Insulation shall be continuous through pipe hangers. At pipe hangers, use rigid pipe covering finished the same as the adjacent pipe covering.
- D. Where vapor barrier jackets are used on cold surfaces, insulation must be applied with vapor seal integrity maintained throughout the entire system.
- E. All pipe insulation shall be pre-molded, and be split ready for application.

## PART 3 EXECUTION

### 3.01 ACCESSIBILITY AND ACCESS PANELS

- A. Install work to be readily accessible for operation, maintenance, and repair. Minor deviations from Drawings may be made; however, major changes shall not be made without approval of the Engineer.

- B. Where valves, traps, or other specialties are concealed in the construction or behind a wall or ceiling surface, the Contractor shall furnish and install an access panel of adequate size to permit adjustment or service of concealed device. Panels shall be of a design suitable for installation in the material forming the finished surface in which each is mounted. Provide access doors in ductwork and equipment housing and wherever required for access to internals. Minimum door size shall be 24-inch by 24-inch unless duct is less than 24-inch wide, then door size to be same as duct width.
- C. Wherever practical, the Contractor shall group valves, traps, dampers, etc., in such a way as to be accessible from a single panel and eliminate as many access panels as possible.
- D. Ceiling access shall be required in gypsum wallboard, plaster, and other ceilings, etc., and in all locations as required to gain access or service mechanical components. Frames shall be constructed of 16-gauge steel. Panels shall be of the material used in the ceiling construction in which they are installed.
- E. Access doors in insulated walls, floors, or ceilings shall be insulated equally to their surroundings.

### **3.02 POWER ACTUATED ANCHORS**

- A. Power actuated anchoring devices shall not be used at floors, columns, beams, precast concrete, where so using causes cracking, spalling, or other deformation to these members. In no case, will such anchors be used less than 4-inch from any corner nor change in direction of concrete surface to which anchor is attached.

### **3.03 ROTATING EQUIPMENT ALIGNMENT**

- A. To aid in the field alignment of all equipment base plate mounted rotating equipment, push bolts (jacking bolts) shall be furnished and welded to the base plate.
- B. All rotating equipment shall be field checked for alignment after installation and initial operation. The equipment shall be at operating temperature. The minimum method of indicating alignment will be the "16-point" method. Other proposed methods must be submitted for approval to the Engineer.
- C. The alignment results are to be submitted for record. They are to include the final set of indicator readings and a plan view sketch of the motor and driven machine base, and the thickness of shims for each shimmed anchor bolt. The thickness of shims shall not exceed 0.25 inches.

### **PART 4 SPECIAL PROVISIONS**

Not used.

END OF SECTION

**SECTION 15210  
PIPING**

**PART 1 GENERAL**

**1.01 SCOPE**

- A. This Section includes the furnishing and installing of all pipelines 4-inch diameter and larger shown on the Drawings or as required to complete the Work.
- B. Piping less than 4-inch diameter, will be included under other Sections unless otherwise specified.
- C. Material to be furnished and installed, but not limited to:
  - 1. All pipe, fittings, specials, bends, beveled pipe, adapters, bulkheads, stoppers, plugs, joint restraints, joints, and jointing materials.
  - 2. Pipe supports other than those specified in Section 15010.
  - 3. Granular material for bedding and encasement of pipelines.
  - 4. Class B concrete as specified in Section 03300 for blocking and encasement of pipelines.
  - 5. Make connections to all existing and/or new facilities and provide temporary services.
  - 6. Install temporary plugs and/or stoppers and harnessing.
  - 7. Test and clean pipelines.
  - 8. Sterilize water mains.
- D. The Contractor shall make adequate field measurements before new piping is fabricated.
- E. All wall, floor, and roof penetrations and any building modifications which are required for the installation of the Work under this Section shall be included in this Section.
- F. Instruments which are to be located in pipelines 4-inch in diameter and larger shall be furnished under Division 16 and installed under this Section.

**1.02 QUALITY CONTROL**

- A. Laboratory Services - Laboratory testing services shall be provided as specified under Section 01410 of the Specifications.
- B. Field Inspection:
  - 1. All pipe sections, specials, and jointing materials shall be carefully examined for defects and no piece shall be laid that is known to be defective. Any defective piece discovered installed shall be removed and replaced with a sound one in a

- manner satisfactory to the Resident Project Representative at the Contractor's expense.
2. Defective material shall be marked with lumber crayon and removed from the job site before the end of the following day.
- C. Field Testing:
1. All materials, process of manufacturing, and finished pipe shall be subject to inspection and approval.
  2. The Resident Project Representative may select one sample of pipe on the job site of each production run of each size and type of pipe to be tested by the laboratory. The Contractor shall furnish the first test piece or pipe core and any additional samples required because of failures. Should the sample fail to meet specifications, retests shall be conducted by the laboratory in conformance with the specifications.
- D. To assure uniformity and compatibility of piping components in grooved piping systems, all grooved products utilized shall be supplied by a single manufacturer. Grooving tools shall be supplied by the same manufacturer as the grooved components.

### 1.03 SUBMITTALS

- A. Submit shop drawings in accordance with Section 01300 showing: layout plan and dimensions, schedule of pipe fittings and specials, materials and class for each size and type of pipe, joint details, and any special provisions required for assembly.
- B. Shop drawings shall be drawn to not less than 1/4-inch scale and show the laying length and piece mark for each section of pipe and fitting.
- C. Drawings shall show the position and elevation of valves, pumps, and/or other equipment served by the various pipe systems.
- D. The concrete pipe manufacturer's certificate shall state that the materials have been sampled and tested in accordance with the provision for and meet the requirements of the designated specification. The certificate shall be signed by an authorized agent of the manufacturer.
- E. If directed by the Engineer, each certificate shall be accompanied by a report showing test results compared to specification requirements. Test specimens shall be selected in conformance with the designated specification, except that no less than two tests shall be made for each production run of each size, type, and class of pipe furnished, and further, that in case tests are unsatisfactory, additional tests shall be made to the maximum number in the referenced ASTM Specification.
- F. Before fabrication of any concrete pressure pipe, fittings, or specials, the Contractor shall furnish to the Engineer at least six copies of the design calculations for the pipe showing the calculations to arrive at the gross wrapping stress in wire; initial and resultant stresses in concrete, cylinder, and wire; internal pressure when compression in concrete is zero; compression strength of concrete at time of wrapping; and calculations

to show stress, conditions, and the core and steel when the pipe is simultaneously subjected to the design pressure and external loads. The Contractor shall also furnish the full details of all pipe, specials, and fittings, and a laying schedule showing dimensions, details, and specifications of all pieces.

- G. Submit a schedule of all proposed pipe escutcheons.
- H. Other submittals may appear in Part 4 of this Section.
- I. Any proposed grooved joint couplings and fittings shall be shown on drawings and product submittals, and shall be specifically identified with the applicable style or series number.

## **PART 2 PRODUCTS**

### **2.01 SEWER PIPE AND JOINT MATERIALS**

- A. Sewer pipe shall be of the type specified as shown on the Drawings or as indicated in the Piping Schedule and of quality conforming to the following requirements.
- B. Vitriified Clay Pipe (VCP):
  - 1. Vitriified clay pipe and fittings shall meet requirements of ASTM C700 ES, except that pipe shall be furnished with full inside diameter.
  - 2. Vitriified clay pipe joints shall be bell and spigot joints and shall meet the requirements of ASTM C425.
- C. Non-Reinforced Concrete Pipe (PCP):
  - 1. Non-reinforced concrete pipe and specials shall conform to ASTM C14. Class 3 pipe shall be used unless specified otherwise or shown otherwise on the Drawings.
  - 2. Joints shall be tongue and groove or O-ring as specified or shown on the Drawings.
    - a. Tongue and groove joints shall be sealed with flexible watertight gaskets meeting or exceeding all requirements of FS SS-S-06210 (GSA, FSS Washington, DC) "Sealing Compounds, Preformed Plastic for Pipe Joints," Type 1 Ropeform. Such gaskets may be RAMNEK as manufactured by K. T. Snyder Co., Inc. of Houston, Texas; KENTSEAL No. 2 Joint Sealant as manufactured by Hamilton Kent Mfg. Co. of Kent, Ohio; or equal.
    - b. O-ring joints shall conform to ASTM C443. The gaskets shall conform to material requirements of ASTM C361.
- D. Polyvinyl Chloride Pipe (PVC):
  - 1. Polyvinyl chloride pipe shall be manufactured from rigid polyvinyl chloride compounds conforming to ASTM D1784, Class 12454-B. PVC pipe and fittings



- shall meet the requirements of ASTM D2241, pressure rating 200 psi, and have a standard thermoplastic pipe dimension ratio (SDR) of 21.0.
2. Polyvinyl chloride pipe joints shall be integral bell push-on type meeting the requirements of ASTM D3139. Gaskets shall be rubber ring type meeting the requirements of ASTM F477.
  3. Mechanical joint cast iron fittings with iron pipe transition gaskets, meeting all requirements of ANSI A21.11 (AWWA C111) may be used in lieu of PVC pipe fittings.
- E. Non-shrinking Mortar Material for Joints - Material for non-shrinking mortar used in pointing joints shall be Sauereisen F-100 Grout as manufactured by Sauereisen Cements Co., Pittsburgh, Pennsylvania; Five-Star Grout as manufactured by US Grout Corp., Old Greenwich, Connecticut, or equal.
- F. Flexible Pipe Repair Couplings - Flexible repair coupling used to repair existing pipes shall be an 18-8 Type 304 stainless steel repair coupling. The coupling shall have a full length and diameter rubber gasket, type 304 stainless steel nuts and bolts and be manufactured by Rockwell, Romac, Ford or equal.
- G. Flexible Connection Coupling - Flexible connection couplings shall be made of an elastomeric polyvinyl chloride boot with Series 300 stainless steel connecting clamps. Couplings shall be used as manufactured by Fernco Joint Sealer Co., Mission Day Products Corp., or equal.
- H. Flexible Watertight Connector - Flexible watertight connector used to connect smaller sewers to larger sewers shall be an elastomeric polyvinyl "boot" type sealed to the larger pipe with a stainless steel internal expanding band and around the connecting pipe with a stainless steel external adjusting band. Connector shall be as manufactured by Fernco Joint Sealer Co., Mission Clay Products Corp, or equal. Other types of applicable flexible connectors may be submitted for approval.

## 2.02 UNDERDRAIN PIPE AND JOINTS

- A. Drain pipe shall be of the type specified or shown on the Drawings and of quality conforming to the following requirements.
- B. Perforated Polyvinyl Chloride Pipe (PPVC):
1. Perforated polyvinyl chloride pipe shall be manufactured from polyvinyl chloride compounds conforming to ASTM D1784, Class 1254-B. Pipe and fittings shall conform to the requirements of ASTM F949, shall have a smooth interior and a corrugated profile. Pipe shall be manufactured to 46 psi stiffness when tested in accordance with ASTM D2412.
  2. Joints shall be bell and spigot gasketed connections. Gaskets shall meet the requirements of ASTM F477.
  3. Perforation dimensions shall conform to ASTM F949 Table 5.

4. Pipe shall be Contech A2000, or equal.
- C. Corrugated Polyethylene Tubing (CPT):
1. Corrugated Polyethylene tubing shall conform to ASTM F405 Heavy-Duty Tubing Requirements for sizes 4-inch thru 8-inch and ASTM F667 for tubing sizes 10-inch, 12-inch, and 15-inch.
  2. Tubing shall be a minimum 6-inch in size.
  3. Tubing shall be perforated with two rows of holes nominally 1/4-inch to 3/4-inch in diameter at a maximum 5-inch centers.

### 2.03 PROCESS AND PRESSURE PIPE

- A. Ductile Iron Pressure Pipe (DIP):
1. Ductile Iron Pressure Pipe (DIP) shall conform to ANSI A21.51 or AWWA C151 and shall be class 52 psi for sizes 12-inch and below, and class 52 psi for larger sizes unless otherwise specified herein. Mechanical joint fittings shall be ductile iron and conform to ANSI A21.10 or AWWA C110 and ANSI A21.53 or AWWA C153. Flanged fittings shall be ductile iron and conform to ANSI A21.15 or AWWA C115. All fittings shall have a pressure rating of 250 psi for all pipe sizes unless otherwise specified.
  2. Ductile iron pipe buried underground, unless otherwise specified or shown, shall have rubber gasket (slip-on) type joints in straight runs and mechanical joints with retainer glands each way from bends as shown on the Drawings. The gasket shall be a single molded rubber ring fitted into a specially shaped recess in the bell forming a pressure tight seal. The spigot end of each pipe shall be marked to indicate when the pipe is "home." Fittings shall have mechanical joints with retainer glands unless otherwise specified or shown. Retainer glands shall be ductile iron. The restraining mechanism shall impart multiple wedging action against the pipe. Restraining devices shall be of heat-treated ductile iron. Twist-off nuts shall be used to ensure proper actuation of the restraining device. The mechanical joint retainer gland shall be Ebaa Iron, Inc., Series 1100 Megalug, no substitutions permitted.
  3. Ductile Iron pipe inside buildings or structures shall be joined with flanged, or mechanical joints as shown on the Drawings, or as indicated in the pipe schedule. All mechanical joints shall have retainer glands. Flanges shall comply with ANSI 21.15 or AWWA C115 and shall be ANSI 125-pound drilling, unless otherwise specified. Flanged joints shall have full face 1/8-inch rubber gaskets or of thickness and type approved by the Engineer. The pipe shall not be threaded or flanged in the field. Flanges shall be firmly bolted with machine, stud, or tap bolts of the proper size and number. Within buildings the bolts and nuts shall be of the best quality mild steel, with true threads, meeting the requirements of ANSI B16.1.

4. Flange adapters for plain end pipe (not fittings), where specified, shown on Drawings, or approved by Engineer shall be a restrained flange adapter. The restraining mechanism shall be multiple gripping wedges set against the pipe wall. Twist off nuts shall be used to ensure proper actuation of the restraining device. The restrained flange adapter shall be Series 2100 Megaflange by Ebaa Iron, Inc., no substitutions permitted.
  5. Wherever specified or shown, mechanical joints shall conform to ANSI A21.11 (AWWA C111), except as specified under Subsection Process and Pressure Pipe Nuts and Bolts.
  6. Couplings, if required or permitted, shall be Dresser Style 38, Rockwell, or equal. Restrained coupling shall be Dresser Style 167 Lock Coupling, Rockwell, or equal.
- B. Molecularly Oriented Polyvinyl Chloride Pipe:
1. Pressure pipes and fittings 4 inches to 24 inches in diameter molecularly oriented polyvinyl chloride pipe (PVCO) shall meet the requirements of AWWA C909, and unless otherwise specified, shall be Class 235. Joints for pipe shall be push-on gasketed. Gaskets shall meet the requirements of ASTM F477 for high-head (50 feet of head or higher) applications. Fittings for pipe shall be ductile cast iron and shall conform to ANSI 21.10/AWWA C110 with mechanical joint.
- C. Polyvinyl Chloride Pipe:
1. Pipe shall have integral bell push-on type joints meeting the requirements of ASTM D3139. Gaskets shall be rubber ring type meeting the requirements of ASTM F477 (AWWA C900).
  2. Fittings shall have mechanical joints meeting all requirements of ANSI A21.11 (AWWA C111).
  3. Restrained Joints, where required or shown, shall meet the requirements of the UNI-Bell Plastic Pipe Association Performance Standard UNI-B-13, similar to EBAA Iron Sales, Inc., Series 2000 PV for mechanical joints and Series 1500 for push-on joints.

#### **2.04 PROCESS AND PRESSURE PIPE NUTS AND BOLTS**

- A. Nuts and bolts used on buried pressure pipe and fittings in contact with earth shall be Cor-Blue coated low alloy steel and have a minimum yield strength of 45,000 psi complying with ANSI A21.11 and AWWA C111.
- B. Nuts and bolts encased in grout on concrete pressure pipe shall conform to recommendations of the pipe manufacturer.
- C. All other nuts and bolts shall be low carbon steel in conformance with the chemical and mechanical requirements of ASTM A307, Grade B. Higher strength bolts will be acceptable.

**2.05 PIPE HANGERS AND SUPPORTS**

- A. Pipe hangers and supports shall be as specified in Section 15010.

**2.06 COATINGS AND LININGS OF PROCESS AND PRESSURE PIPE**

- A. Coatings and linings where required shall conform to the following requirements unless otherwise indicated in Part 4 of this Section or on the Drawings.
- B. Ductile Iron Pipe:
1. Ductile iron pipe, and fittings unless otherwise specified, shall be lined on the interior with a standard thickness cement lining meeting ANSI A21.4 and AWWA C104. A seal coat of bituminous material shall be applied in conformance with the above Specifications. Piping used for compressed air shall not receive a cement lining.
  2. All pipe buried underground shall be coated on the outside with a standard coating of coal tar or asphalt, 1 mil thick unless otherwise specified. The finished coating shall be continuous, smooth, neither brittle when cold nor sticky when exposed to the sun, and shall be strongly adherent to the pipe. The coating materials, after drying 48 hours, shall impart no objectionable color, odor, or taste to water standing in contact with the coating for a minimum of 48 hours.
  3. Where approved, the bituminous material used for an interior seal coat may be used for exterior coating of pipe buried underground.
  4. All pipe used within buildings and structures and which are to receive field coats of paint shall not be coated with any black bituminous paint. Such pipe, after proper cleaning, shall be painted with one coat of primer paint that is compatible with the field coats. Painting specifications shall be followed for cleaning and painting.
  5. The outside of all buried steel pipe shall receive a coat of an approved bituminous primer, followed by a coat of coal tar enamel into which shall be bonded a single layer of felt wrap, and finished with a single wrap of craft paper unless otherwise specified. All materials and application procedures to be in full accordance with the pertinent sections of AWWA C203. Protective coatings are to be shop applied.
  6. The outside of steel pipe inside of buildings and structures, and exposed exterior shall be properly cleaned and shop painted with one coat of primer that is compatible with field coats.

**2.07 BEDDING MATERIAL**

- A. Unless otherwise shown on the Drawings or specified herein, all pipe bedding material shall be in conformance with Section 02200.
- B. Concrete bedding and encasement in lieu of standard bedding material shall be installed as shown on the Drawings or specified.

- C. All underdrain pipe shall be bedded in MDOT No. 64 aggregate in lieu of the standard bedding material to a depth shown on the Drawings.

## 2.08 PIPE ESCUTCHEONS

- A. Split-type escutcheons shall be used for piping passing through finished wall, floors, or ceiling. Escutcheons shall be brass plated or chromium plated Model 3A by Ritter, Model 284 by Fee & Mason, or equal.

## 2.09 WALL PIPE AND SLEEVES

- A. Type A Wall Pipe:
  - 1. Cast iron wall pipe shall be used where noted on the Drawings.
  - 2. Wall pipe shall be cast in place with joints as indicated on the Drawings.
  - 3. Where wall pipe is flush with wall, bolt holes shall be tapped for studs.
- B. All wall pipes and sleeves shall be coated or lined in accordance with the appropriate materials for its service.

## 2.10 EXPANSION JOINTS

- A. Expansion joints as specified below shall be installed as per Section 15010.
- B. Expansion joint construction shall include a neoprene inner tube extending through the bore to the outside edge of both flanges. The inner tube shall be covered with a flexible multiple layer fabric carcass of high strength rubber impregnated synthetic fibers with steel wire or reinforcement rings integral with the fabric to assure sufficient rigidity for vacuum service and high pressure. An outer cover coated with Hypalon paint shall cover the carcass and provide full protection against ozone and weathering.
- C. Flange faces shall be neoprene covered and drilled to match drilling in mating flanges. Flange faces shall also be backed by split steel flange retaining rings.
- D. All expansion joints shall be suitable for service temperatures of 225 degrees F.
- E. All expansion joints used for vacuum service shall be capable of withstanding a 30-inch Hg vacuum.
- F. Expansion joints shall have recommended working pressures compatible with the service for which they are installed.
- G. All expansion joints shall be equipped with control units to restrict excess axial compression and elongation. Control units shall consist of plates bolted to pipe flanges on each end of the expansion joint and long control bolts extending between pipe flanges.
- H. Expansion joints on pipes used for digester gas service shall be the open arch type.
- I. Expansion joints on sludge piping shall be of filled arch construction to prevent solids accumulation at the joint.

- J. Expansion joints on pipes used for fuel oil and digester gas service shall have Buna-N tubes.
- K. For those locations where expansion joints are used to replace valves, spool pieces, or other short sections, standard single arch expansion joints may be of insufficient length. At these locations double, triple, and quad arch expansion joints shall be used as required.
- L. Expansion joints shall be Mercer Rubber Company Style 500 to 700, or equal.

## 2.11 ACCESSORIES

- A. Nuts and bolts for buried pipe shall be as follows:
  - 1. Nuts and bolts used in wall castings shall be of stainless steel Type 316.
  - 2. Nuts and bolts encased in grout on concrete pressure pipe shall conform to recommendations of the pipe manufacturer.
  - 3. Nuts and bolts used on buried pressure pipe and fittings in contact with earth shall be Cor-Blue coated low alloy steel and have a minimum yield strength of 45,000 psi complying with ANSI A21.11 and AWWA C111.
  - 4. All other nuts and bolts shall be low carbon steel in conformance with the chemical and mechanical requirements of ASTM A307, Grade B. Higher strength bolts will be acceptable.
- B. Tracing Wire shall be installed on all pipe.
  - 1. Direct Burial No. 12 AWG Solid (0.0808-inch diameter), 21% conductivity copper-clad annealed high carbon steel high strength tracer wire, 1150-pound average tensile break load, 45 mil, high molecular weight, high density polyethylene jacket complying with ASTM D1248, 30 volt rating. SoloShot™ extra high strength No. 1245 as manufactured by Copperhead Industries, LLC, no substitutions permitted. Wire shall be secured to the pipe with tape at intervals not to exceed 10 feet.
    - a. Tracer wire installed on pipe by horizontal directional drilling shall be continuous without any splices.
    - b. Heat shrink splices are permissible only on tracer wire at pipe connection.
  - 2. Tracer wires shall terminate inside all structures including but not limited to, air relief structures, valve box assemblies, indicated on plans. Tracer wire shall extend 4-feet above the opening on structures.
  - 3. Tracer wire shall be tested for continuity after installation and considered acceptable when a continuous read is obtained between terminals.
- C. Utility Markers and Locator stations shall be installed as noted in Part 4 and on the drawings.

1. Utility Markers shall be flexible above ground, impact resistant, UV stabilized fiberglass Reinforce composite material. Utility markers shall be a minimum of 3-3/4 inches wide and 66 inches long. Color shall be integral to the material and selected by the Owner.
2. Locator stations shall be impact resistant, UV stabilized, and fiberglass reinforced composite material, 3 inches in diameter. Locator stations shall have a polycarbonate cap assembly with brass or stainless-steel terminal board for tracer wire. The cap assembly color shall be selected by the Owner.
3. Utility markers and locator stations shall have a 3-inch-wide by 13-inch-long label readable from 100 feet. Label color shall be selected by the Owner. The wording of the label shall be as specified in Part 4.
4. A polypropylene identification tape marked "buried water main" shall be installed 24 inches above all water mains installed by open-cut methods. The tape shall be blue.

#### **2.12 POLYETHYLENE ENCASEMENT FOR DUCTILE IRON PIPE**

- A. Buried ductile iron pipe shall be encased in a loose wrapping of 8 mil minimum polyethylene film at the time of installation. The polyethylene material and method of installation shall meet the requirements of AWWA C105/A21.5.

#### **2.13 SOURCES QUALITY CONTROL**

- A. Pipe Manufacturer's Certification:
  1. The pipe manufacturer's certificate shall state that the materials have been sampled and tested in accordance with the provision for and meet the requirements of the designated specification and shall be signed by an authorized agent of the seller or the manufacturer.
  2. A test results report shall accompany the manufacturer's certificate, if requested by the Engineer. The report shall compare test results to Specification requirements. Test specimens shall be selected in conformance with the designated specification for each production run of each size, type, and class of pipe furnished and further, that in case tests are unsatisfactory, additional tests shall be made to the maximum number in the referenced ASTM Specification.

### **PART 3 EXECUTION**

#### **3.01 COORDINATION**

- A. Construction in Highway Properties:
  1. Construction in highway properties shall conform to the requirements of Section 02200.

### 3.02 PRODUCT HANDLING

- A. Care shall be taken in handling and transporting to avoid damaging pipes and their coatings. Loading and unloading shall be accomplished with the pipe under control at all times and under no circumstances shall the pipe be dropped. Pipe shall be securely wedged and restrained during transportation and supported on blocks when stored in the shop or field.
- B. Store all pipe on a flat surface so as to support the barrel evenly. It is not recommended that pipe be stacked higher than 4-feet. Plastic pipe, if stored outside, shall be covered with an opaque material to protect it from the sun's rays.

### 3.03 PREPARATION OF TRENCH

- A. Trench excavation shall conform to requirements of Section 02200.
- B. Unless otherwise specified or called for on the Drawings, the width of trench at the top of pipe 24-inch in diameter or less shall not exceed the outside diameter of the pipe or encasement, plus 9-inch on each side of the pipe measured to the face of the trench or to the back of the sheeting when used. For pipe having a diameter greater than 24-inch, the width of trenches at the top of the pipe shall not exceed the outside diameter of the pipe or encasement, plus 15-inch on each side of the pipe measured as specified above.
- C. Unless otherwise directed or called for on the Drawings, all pipe trenches shall be excavated below the proposed pipe invert as required to accommodate the depths of pipe bedding material as scheduled on the Drawings.

### 3.04 PIPE INSTALLATION

- A. General:
  - 1. All loose dirt shall be removed from the bottom and the trench backfilled with specified bedding material to pipe laying grade as detailed on the Drawings. Bell holes shall be dug in the bedding where necessary and the pipe shall be placed and supported on bedding material the full length of the barrel. Bedding material shall then be placed 4-inch maximum depth along both sides of the pipe and tamped firmly under the pipe haunches. Additional bedding material shall be placed and compacted in 6-inch layers to the height shown on the Drawings or as directed. A mechanical tamper shall be used when installing bedding material for pipe 24-inch diameter and larger. The remainder of the trench shall be backfilled as specified and called for on the Drawings.
  - 2. All pipe shall be laid to lines and grades in conformance with Section 01800.
  - 3. Wherever piping passes through walls or floors, a wall casting pipe or sleeve of the type indicated on the Drawings shall be installed. Escutcheons shall be provided for pipe passing through finished walls, floors, or ceilings.



4. Pipe Anchoring:
  - a. Disjointing hydrostatic pressure at bends, valves, plugs, tees, and wyes shall be counteracted by restrained joints or reinforced concrete anchorage as directed on the Drawings or specified.
  - b. Thrust blocks shall be installed only where directed or specifically called for on the Drawings, unless otherwise specified. Installation shall be in conformance with Drawings.
  - c. Approved joint restraints shall be installed for the distance from each side of each bend, valve, plug, tee, or wye in locations shown or scheduled on the Drawings.
  - d. Reinforced concrete joint anchorage shall be installed in conformance with the Drawings.
5. Unless shown otherwise on the Drawings, all buried pipe carrying liquids shall be installed with a minimum cover of 5-feet. Pressure piping which carries gases shall be installed with a minimum cover of 4-feet. When new piping crosses existing utilities and other obstructions which force a change in elevation or horizontal alignment, the Contractor shall install the new piping at a deeper elevation, or new alignment to avoid the obstructions unless otherwise instructed by the Engineer. Such changes in elevation or alignment shall be made either by installing fittings or by deflecting joints in accordance with the pipe manufacturer's recommendations. Such Work shall be performed at no additional cost to the Owner. To the extent possible, pressure and process piping shall be installed at a constant grade. All changes in grade and alignment shall be approved by the Engineer.

B. Sewer Pipe:

1. The laying of pipe in finished trenches shall be commenced at the lowest point, with the bell end or groove end laid upgrade. All pipe shall be laid with ends abutting and true to line and grade. They shall be carefully centered to form a sewer with a uniform invert of line and grade shown on the Drawings. Laser beams shall be used to maintain line and grade unless other methods are approved by the Engineer.
2. Where holes are cast in concrete pipe for handling, they shall be completely filled with non-shrinking mortar after the pipe is placed. A metal disc of proper size may be inserted near the bottom of the hole to retain the mortar until hardened. Wood plugs or rocks intended to plug the hole for retention of the mortar will not be permitted.
3. Joints:
  - a. O-Ring and Chemically Welded Joints - Pipe jointing surfaces shall be clean and dry when preparing surfaces for joining. Lubricants, primers, adhesives, etc., shall be used as recommended by the pipe or joint

manufacturer's specifications. The jointing materials or factory fabricated joints shall then be placed, fitted, joined, and adjusted in such a manner as to obtain a watertight joint. Trenches shall be kept water-free and as dry as possible during bedding, laying, and jointing. As soon as possible after the joint is made, sufficient backfill material shall be placed along each side of the pipe to prevent movement of the pipe from any cause.

- b. Non-shrinking Mortar Joints - Where specified or shown on the Drawings, joints of concrete pipe sewers shall be thoroughly pointed full inside circumference with a non-shrinking mortar in conformance with the material manufacturer's instructions. The mortar shall be tightly packed and the interior face of the joint shall be left smooth and continuous with the interior face of the pipe. Pointing shall not be done until the backfill over the pipe is placed and compacted.

4. Connections to Existing Sewers:

- a. Unless otherwise specified, shown on the Drawings, or directed, connections to existing sewers shall be made as follows:
  - 1) Vitrified clay pipe, plain concrete pipe, and asbestos cement pipe, 15-inch diameter and smaller, and larger diameter at the option of the Contractor, shall be connected by removing a section of the existing sewer and inserting connecting fittings using specified flexible connection couplings.
  - 2) Reinforced concrete pipe and larger sizes of asbestos cement pipe and plain concrete pipe, unless otherwise shown on the Drawings, shall be connected by coring the existing sewer pipe wall and inserting a flexible watertight connector to receive the new pipe.
  - 3) Polyvinyl chloride pipe, ABS pipe, and ABS truss pipe shall be connected in conformance with the manufacturer's recommendations as approved by the Engineer.
- b. Connections shall be made in conformance with the jointing materials manufacturer's recommendations and as directed by the Resident Project Representative.

C. Underdrain Pipe:

- 1. Underdrain pipe shall be laid in a manner conforming to the laying of sewer pipe.
- 2. In addition, underdrain pipe shall be laid with perforations on the underside.
- 3. The ends of all pipelines shall be closed with stoppers to prevent entry of soil or other foreign materials.

- D. Process and Pressure Pipe:
1. Pipe and appurtenances shall be installed true to line, grade, and location; with joints centered, spigots home; pipe properly supported and restrained against movement; and all valve stems plumb.
  2. All elbows, tees, plugs, etc., shall be properly anchored, blocked, or otherwise restrained to prevent movement of the pipe in the joints due to internal or external pressure.
  3. The open ends of all pipes and special castings shall be plugged or otherwise closed with a watertight plug to the approval of the Resident Project Representative before leaving the Work for the night, and at other times of interruption of the Work. All pipe ends which are to be permanently closed shall be plugged or capped and restrained against internal pressure.
  4. Where new or existing pipe requires cutting in the field it shall be done in a manner to leave a smooth end at right angles to the pipe centerline. The finished cut must be approved by the Resident Project Representative.
  5. Joints:
    - a. Gaskets - Just prior to joining the pipes, the surfaces of the joint rings shall be wiped clean and the joint rings and rubber gaskets shall be liberally lubricated with an approved type of vegetable oil soap. The spigot end, with the gasket placed in the groove, shall be entered into the bell of the pipe already laid, making sure that both pipes are properly aligned. Before the joint is fully "home," the position of the gasket in the joint shall be determined by means of a suitable feeler gauge supplied by the pipe manufacturer. If the gasket is found not to be in proper position, the pipes shall be separated and the damaged gasket replaced. The pipe is then forced "home" firmly and fully. In its final position, the joint between the pipes shall not be deflected more than 1/2-inch at any point.
    - b. Concrete Pressure Pipe Diapers - A band at least 5-1/2-inch wide shall be placed around the outside of concrete pressure pipe, over each joint as recommended by and available from the pipe manufacturer. This band shall serve as a form for placing a 1:2 cement mortar grout in the external recess formed by the face of the bell and the shoulder of the spigot. If the air temperature is below 40 degrees the spigot, bell, and mortar shall be heated. If a reinforced paper joint band is used, it shall be drawn up tight around the pipe and backfill tamped against it up to the springline before pouring the grout. If a cloth band is used, it shall be wired around the outside of the pipe and the grout poured before backfilling.
    - c. Concrete Pressure Pipe Interior Joints - The interior joint recess of pipe 24-inch and larger shall be pointed using a non-shrinking mortar

specified in Subsection 2.01. The inside surface shall be struck off smooth with the pipe interior. On pipe 20-inch and smaller a rope type mastic or trowellable mastic shall be affixed to the concrete face of the bell socket just prior to pushing the spigot into the bell, such that the mastic material squeezes to fill the internal joint recess. Mastics that are detrimental to rubber gaskets shall not be used. Similarly, primers to be used in conjunction with rope type mastics must be kept off gaskets and sealing surfaces of joint rings.

- d. Bell and Spigot Lead Joints - If used, the spigot of each pipe shall be fully seated in the bell of the adjoining pipe, adjusted to form a uniform annular space which shall be caulked with sterilized pre-molded rubber, forming a solid packing against which molten lead shall be poured and caulked. Lead, after caulking, shall have a depth of at least 2-inch for pipes 14-inch or less in diameter, and 2-1/2-inch for larger pipe. The melting pot shall be kept near the joint which shall be made by one pouring. Dross shall not be allowed to accumulate in the pot. All Work shall be performed by skilled workmen.
- e. Electrical Continuity - Where specified, electrical continuity shall be provided in concrete and steel pressure pipes by welding an insulated #4RR copper cable across joints. The cable shall be welded to the steel of bell and spigot of concrete pressure pipe and across joints including each piece of coupling on jointed steel pipes.
- f. Where new piping is to be connected into an existing joint, said joint shall be cleaned sufficiently to result in a liquid- or gastight seal. If applicable, a new gasket shall be supplied and installed.

### 3.05 SLEEVES AND WALL PIPE

- A. Type A wall pipes shall be provided for all pipes passing through the exterior walls unless other sleeve types or wall pipes are designated on the Drawings. Type C sleeves shall be provided in interior walls unless designated otherwise on the Drawings.
- B. All wall pipes and sleeves shall be coated or lined in accordance with the appropriate materials for its service.

### 3.06 RESERVED

### 3.07 LOW PRESSURE AIR ACCEPTANCE TESTS

- A. Where approved by the Engineer, the Contractor may perform low pressure air acceptance tests in lieu of infiltration or exfiltration tests for pipes 24 inches in diameter or smaller. Test shall be made in accordance with ASTM F1417-Plastic Gravity Sewer Lines; ASTM C924-Concrete (Circular) Sewer Pipe with Gasket.
  - 1. If the air pressure required for the test is greater than 5.0 psig, the low-pressure air acceptance test shall not be used.

- B. The Contractor shall furnish all equipment, materials, and labor, and conduct the tests under observation of the Resident Project Representative.
- C. Safety:
  - 1. The air test may be dangerous if the line is improperly prepared. All plugs shall be installed and braced in such a manner to prevent blowouts. No one shall be allowed in manholes during testing.
  - 2. Pressurizing equipment shall include a regulator set at the maximum pressure.
- D. Line Preparation:
  - 1. Sewers to be air tested shall be prepared and inspected as specified herein for infiltration and exfiltration tests.
  - 2. Where porous pipe materials are used, the pipe walls may be wetted to temporarily reduce the porosity of the material.
  - 3. All pipe outlets shall be plugged, braced, and the joints restrained adequately to prevent blowouts.
- E. Test Procedure:
  - 1. Low pressure air shall be slowly introduced into the sealed line until the internal air pressure reaches 4.0 psig greater than the average back pressure of any groundwater above the invert of the pipe.
  - 2. When a constant pressure of 4.0 psig greater than the average back pressure of any groundwater above the pipe is reached, the air supply shall be throttled to maintain that internal pressure for at least 2 minutes to permit temperature equalization.
  - 3. When temperatures have been equalized and the pressure stabilized at 4.0 psig greater than the average back pressure of any groundwater above the pipe, the air supply shall be shut off or disconnected.
  - 4. Decrease the pressure in the sealed line until the continuous monitoring pressure gauge reads 3.5 psig greater than the average back pressure of any groundwater above the pipe. When this pressure is reached, timing shall commence with a stop watch.
  - 5. Determine the time, as shown on the stop watch, required for the pressure in the sealed line to drop 1.0 psig.
- F. Air Pressure Adjustment for Groundwater:
  - 1. In areas where groundwater is known to exist, the Contractor shall install a one-half inch diameter capped pipe nipple, approximately, 10-inch long, through the manhole wall on top of one of the sewer lines entering the manhole. This shall be done at the time the sewer line is installed. Immediately prior to the performance of the line acceptance test, the groundwater level shall be determined by removing the pipe cap, blowing air through the pipe nipple into

the ground to clear it, and then connecting a clear plastic tube to the pipe nipple. The hose shall be held vertically and a measurement of the height in feet of water shall be taken after the water stops rising in this plastic tube.

2. The air pressure correction, for the average back pressure of the groundwater above the pipe, shall be calculated by subtracting the average invert elevation from the measured groundwater elevation and dividing the difference by 2.31 psi/feet. This correction must be added to the test pressures stated in the test procedure.

### **3.08 RESERVED**

### **3.09 PRESSURE AND LEAKAGE TESTS FOR PROCESS AND PRESSURE PIPE**

- A. After any section of pipe is laid between valves, the pipe shall be filled with water and subjected to a hydrostatic pressure of 150 pounds per square inch for a period of two hours in accordance with AWWA C605 for both ductile iron pipe and PVC pipe. Allowable leakage will be based on 10.5 gallons/inch/mile/24 hours. Tests shall be performed by the Contractor and witnessed by the Engineer. The actual cost of the test shall be borne by the Contractor. All mains to be tested with hydrants in place and with hydrant connection valves open.
  1. Procedure: Each section of pipe line shall be slowly filled with water and the specific test pressure, measured at the point of lowest elevation shall be applied by means of a pump connected to the pipe, in a manner satisfactory to the Engineer. The pump, pipe connection and all necessary apparatus, except gauges and meters, shall be furnished by the Contractor. The owner will furnish gauges and measuring devices for the test. When required, all material and labor necessary to make taps into the pipe shall be furnished by the Contractor at no cost to the City.
  2. Expelling Air Before Test: Before applying the specified test pressure, all air shall be expelled from the pipe. To accomplish this, taps shall be made, if necessary, at points of highest elevation and afterward tightly plugged.
  3. Connection to Existing Mains: When the pipe is to be connected to an existing valve or main, the Contractor shall make the connection only after the new water main pipe has been pressure tested and chlorinated. The Contractor may elect to connect the new water main to the existing pipe or valve prior to pressure testing; however, if such is done, the Contractor shall first verify to his satisfaction G-11 and shall be responsible for insuring that the existing pipe or valve is capable of meeting the pressure test requirements.
- B. AIR TEST: Prior to tapping an existing main for a new main extension, the Contractor shall install the tapping saddle and apply a 90 pound air test for 5 minutes with no loss to insure against leakage of the saddle during the tapping operation.

### 3.10 DISINFECTION OF POTABLE WATER MAINS

- A. Disinfection of new work shall be coordinated with the City of Monroe and their standard disinfection and testing practices shall be followed.
- B. After the pressure test and prior to disinfecting, the lines shall be thoroughly flushed through hydrants, fixtures or by other means as approved by the City.
- C. The Contractor shall furnish required materials and apparatus and perform the Work of disinfections. All temporary and permanent materials, apparatus and appurtenances shall have the same NSF 61 approval as the installed Work.
- D. Before being placed in service and before certification of completion by the Engineer, all new water systems, or extensions to existing systems or valved section of such extension, or any replacement in the existing water system, or any exposed section of the existing system shall be flushed and disinfected in accordance with the current State of Michigan procedures and or AWWA C651. Water mains shall be thoroughly flushed prior to disinfection at a velocity of not less than 2.5 feet per second.
  - 1. Chlorination: The Contractor will perform all necessary work to chlorinate the water mains and its appurtenances. A chlorine solution (Chlorine used shall conform to the NSF Standard 60 or 61) shall be injected into the water main of sufficient strength to create a minimum 50 ppm chlorine solution (maximum 500 ppm) in the main. The type of chlorine used, mixing rates and application rate shall be approved by the Engineer. The strong chlorine solution shall remain in the water main at least 24 hours and maximum of 72 hours prior to flushing. Immediately at the time of flushing the chlorinated water from the main, a water sample for testing the strong chlorine solution shall be taken by the City Water Department. After the main has been thoroughly flushed at a velocity of not less than 2.5 feet per second, another sample shall be taken to test for residual chlorine. Sufficient notification shall be given to the City Water Department by the Contractor as to the date and time such samples are to be taken. The Contractor shall rechlorinate the water main if test conducted on the samples taken do not meet current City Water Department standards. At the time of chlorination, all hydrant valves and intermediate main line valves shall be operated. All cost of chlorination, installation of corporations and related materials and labor shall be at the Contractor's expense.
  - 2. Chemical and Bacteriological Test: Immediately following chlorination, all treated water shall be thoroughly flushed from the main at a velocity of not less than 2.5 feet per second until the replacement water through its length shall, upon test by the City Water Department, both chemically and bacteriologically, be proven equal in quality to the water in the source supply system.

### 3.11 INSTRUMENTATION CONNECTIONS

- A. The Contractor shall make all necessary allowances for and install all controls and instrumentation furnished under any Contract Division and which require in-line connection to process and pressure piping.

- B. The Contractor shall provide all necessary mounting bosses, pipe and boss taps, plugs, tees, and any miscellaneous appurtenances to allow connection of Instrumentation and Controls and their associated piping to process and pressure piping.
- C. Thermowells complete with all appurtenances listed in Division 16 shall be furnished and installed under that Division. Thermowells complete with all appurtenances which are not included in the list in Division 16 and are to be installed in piping under this Section, shall be furnished and installed under this Section.
- D. Instrumentation and Controls are furnished and specified under various Sections including Section 16902. Any schedules shown in Section 16902 are not guaranteed to be complete.

**PART 4 SPECIAL PROVISIONS**

**4.01 PIPING SCHEDULE**

- A. The following letter designations are used in the Piping Schedule:

Material Designation:

- DIP - Ductile Iron Pipe
- VCP - Vitrified Clay Pipe
- PVC - Polyvinyl Chloride
- PPVC - Perforated Polyvinyl Chloride
- FRP - Fiberglass
- Steel - Steel
- SWS - Spiral Welded Steel
- CPP - Concrete Pressure Pipe
- RCP - Reinforced Concrete Pipe
- CPT - Corrugated Polyethylene Tubing

- B. Schedule:

Service	Size	Material	Remarks
Potable Water (Underground)	All	Class 52 DIP or PVC C-900	Restrain all joints
Potable Water (Inside Building)	All	Class 52 DIP	Restrain all joints
Sanitary Sewer (Underground)	All	PVC SDR-35	

- C. Schedules are not guaranteed to be complete. All piping shown on the Drawings or specified shall be furnished and installed by the Contractor whether or not listed in the above schedule.

END OF SECTION



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**SECTION 15211  
SMALL PIPING AND VALVES**

**PART 1 GENERAL**

**1.01 SCOPE**

- A. This Section includes furnishing and installing all pipelines and valves less than 4-inch in diameter as shown on the Drawings or as required for a complete piping system for each service or combination of services except the piping and valves included in Section 15400 and Section 15500.
- B. Each piping system shall be adequate to conduct and control the flow of process water, plant water, non-potable water, instrument air, compressed air, vacuum, natural gas, sewage gas, propane, fuel oil, chemicals, sewage, sludge, sampling, or other uses as specified or shown on the Drawings.
- C. This Section includes, but is not limited to:
  - 1. Securing and bearing the cost of all permits, certificates, and inspection as required by local regulations and state codes.
  - 2. All pipe, fittings, and connections for water supply to equipment and waste to drains.
  - 3. Valves less than 4-inch in diameter, control devices, pipe hangers, anchors, supports, and sleeves for the piping systems covered under this Section.
  - 4. Hose bibbs, sill cocks, and hydrants.
  - 5. Non-potable water supply, drain lines, and connections to boilers, pump priming systems, pump gland seals, valve operating cylinders, or other equipment requiring these services.
- D. The Contractor shall remove all existing pipelines and valves less than 4-inch in diameter that are indicated on the Drawings to be removed except piping and valves included in Section 15400 and Section 15500. Removals shall be done in accordance with the requirements of Section 02110.
- E. The Contractor shall relocate existing piping and valves less than 4-inch in diameter, except piping and valves included in Section 15400 and Section 15500, which interfere with Work under this Section or any Section of the Specifications.
- F. The Contractor shall furnish, install, and remove all temporary piping and valves that are required to maintain processes in operation during construction.
- G. All wall, floor, and roof penetration and any building modifications which are required for the installation of the Work under this Section shall be included in this Section.
- H. Instruments which are to be located in pipelines to be furnished under Division 16 shall be installed under this Section.

## 1.02 SUBMITTALS

- A. Submittals shall be in accordance with the requirements of Section 01300 and shall include:
  - 1. Shop Drawings for Review:
    - a. Drawings shall include plan dimensions to and elevations of sleeves, inserts, and anchors, the size and location of each run of pipe, and the location of valves and unions.
    - b. Manufacturer's literature, catalog data, specifications, and illustrations shall be bound in a brochure which includes a complete bill of materials.
  - 2. Information for the Record:
    - a. Operation and maintenance manual.

## PART 2 PRODUCTS

### 2.01 PIPING MATERIALS

- A. Copper Pipe and Tubing shall be manufactured in accordance with ASTM B88. Type L hard temper shall be used above ground and inside of structures for compressed air, hot and cold potable water, plant water, vacuum, and other services unless another type of pipe is specifically called for. Type K soft temper shall be used where underground piping is installed. Fittings and unions shall be solder joint fittings of cast bronze manufactured in accordance with ASTM B62 and with ends complying to ANSI B16.18 or wrought copper manufactured in accordance with ASTM B75 and with ends complying to ANSI B16.22. Unions shall be cast bronze and shall be installed adjacent to valves and equipment and as required to assemble the piping but not less than one union shall be included in each run. Threaded adapters shall be installed on each side of valves in copper lines. Where joints are made between pipes of different materials, dielectric couplings shall be installed. Pipe nipples shall be standard weight seamless red brass pipe ASTM B43. Solder joints shall be made in conformance with ASTM B828 Flux conforming to ASTM B813 shall be applied. Materials used for solder joints in all potable water services shall contain less than 0.2% lead and comply with ASTM B32.
- B. Cast Iron Soil Pipe for exterior and buried conduits shall conform to ASTM A74 service grade. Rubber gaskets for compression joints and hubless joints shall conform to ASTM C564. Cast iron soil pipe 2-inch diameter and larger shall be used for buried conductors from toilet fixtures; floor, roof, equipment, and area drains; and similar services unless otherwise shown on the Drawings or specified. Buried pipe shall be coated inside and out and interior piping shall be coated inside with nonbrittle coal tar pitch paint. Threaded openings shall not be coated. Double bell fittings shall not be used.
- C. Steel Pipe, unless otherwise noted, shall be used for all aboveground natural gas, digester gas aboveground only, aboveground fuel oil, and scum. Pipe shall be ASTM A53 Schedule 40, unless otherwise noted or where code requirements differ, with standard weld or malleable iron fittings. Unions shall comply with ANSI B16.3.

1. Steel piping installed above ground, unless otherwise noted, shall be Schedule 40 pipe with standard malleable iron screwed fittings. Unions shall be 250 pound screwed malleable iron with iron-to-iron seats. On pipes 2-inch and larger, ASTM A105 companion flanges shall be used in lieu of unions. For natural gas through 2-inch, fittings shall be 3,000-pound forged steel socket weld. For natural gas, digester gas, and fuel oil, pipe 2-1/2-inch and larger, ASTM A234 weld fittings and ASTM A105 flanges shall be used.
  2. Steel piping installed underground, unless otherwise noted, shall be Schedule 40 plastic coated at the factory with Scotchkote 212 by 3M or equal. Pipe fittings through 1-1/2-inch shall be 3000-pound forged steel socket weld, and 2-inch and larger shall be ASTM A234 weld fittings. Joints shall be welded, primed, and wrapped double the manufacturer's recommended thickness with Tapecoat TC Primer and Tapecoat CT, or equal.
  3. Where couplings are called for on gas piping, they shall be Dresser Style 38, or equal. The couplings shall be specifically designed for digester or natural gas, middle ring width shall be 5-inch long.
- D. Stainless Steel Pipe:
1. Stainless steel pipe less than 4-inch in diameter shall be designed and fabricated in accordance with ASTM A312. The interior surface of the pipe shall be smooth with no protrusions, stiffeners, or bracing. The pipe and fittings shall be constructed of 304L stainless steel, or as specified on the Drawings.
  2. Stainless steel pipe shall be minimum Schedule 40S, unless otherwise noted on the Drawings.
  3. Fittings shall conform to ASTM A403 and shall have the same wall thickness and structural properties as the pipe. All bends shall be long radius smooth type. Mitered bends will not be acceptable.
  4. Flanges where required shall be ASTM A182-F304L flanges with full facing gaskets and centering rings. Flange bolts shall be stainless steel.
  5. Wherever possible, butt weld fittings shall be used for field welding. All welds shall be made by a certified welder and shall conform to procedures for which the welder has been certified. The Contractor shall submit certification statements for the welders and the methods employed. Belled end fittings may be used in lieu of butt weld fittings on air lines.
  6. All welds shall have full penetration and be smooth and without protrusions on the interior of the pipe. Weld metal shall be equal to or greater than the parent metal. Any cracks or blow holes appearing on the surface of a welding bead shall be ground away before depositing the next bead.
  7. All stainless-steel surfaces shall be passivated by the following procedures:

- a. All outside weld areas shall be wire brushed to remove weld splatter. Brushes shall be stainless steel and used only on stainless steel.
  - b. All stainless-steel assemblies and parts shall be completely immersed in a pickling solution of 6% nitric acid and 3% hydrofluoric acid at 140 degrees F for a minimum of 15 minutes. Parts shall be free of iron particles or other foreign material after this procedure.
  - c. Previously pickled parts shall be neutralized by immersion in a trisodium phosphate rinse.
- E. PVC Pipe and fittings shall be composed of Class 12454-B rigid PVC compound in conformance with ASTM D1784 (formerly classified Type I, Grade 1). Pipe shall be Schedule 80 with a design stress of 2000 psi in conformance with ASTM D1785. All joints, unless otherwise shown on the Drawings, shall be solvent welded in conformance with ASTM D2855. Joint solvent shall be as recommended by the pipe manufacturer and shall comply with ASTM D2564. In pressure or vacuum lines and in gravity drains 1-inch diameter and less, the fittings shall be Schedule 80 and shall conform to ASTM D2467. For gravity drains greater than 1-inch diameter, the fittings shall conform to the requirements of ASTM D2665. PVC pipe shall be used for acid-resistant services and all lines carrying chlorine solution, sodium hypochlorite, De-ionized (DI) water and other chemicals unless otherwise shown on the Drawings or specified.
- F. CPVC Pipe shall be composed of Class CPVC 23447-B plastic as defined in ASTM D1784 (formerly classified Type IV, Grade 1). Pipe shall be Schedule 80 chlorinated polyvinyl chloride pipe in accordance with ASTM F441. Fittings shall be schedule 80 and shall conform to ASTM F439. All joints, unless otherwise shown on the Drawings, shall be solvent welded in conformance with ASTM D2896. Joint solvent shall be as recommended by pipe manufacturer and shall comply with ASTM F493. CPVC pipe shall be used where designated in Part 4 or on the Drawings.
- G. High Silicon Iron Pipe shall be acid-resistant and have a silicon content not less than 14.5%, chromium 4.5%, carbon 0.90%, and manganese 0.65%. It shall have a minimum tensile strength of 16,000 psi. It shall be used for all laboratory sink drains and acid vent piping. It shall be extended as far as necessary to connect with other acid-resistant drain pipe such as vitrified clay pipe sewer.
- H. Glass Pipe shall be Kimax, Pyrex, or equal with gasketed joint. It shall be an alternative to using high silicon iron pipe for acid-resistant services.
- I. Polyethylene Pipe with heat fusion joints and compression type metal fittings shall be used for underground natural gas service lines and underground digester gas service lines.
1. Piping shall be installed underground only and comply with ASTM D2513, ANSI B31.8, and AGA standards.

2. Fittings shall be approved plastic for making heat fusion joints complying with ASTM D2513, D2683, D3197, D3261, D3350. When applicable, compression fittings shall be Dresser 401 plastic.
3. Outside risers shall be flexible steel casing or rigid noncorrosive steel encased plastic and shall be coated and cathodically protected.
4. All underground pipe shall be traced with No. 12 insulated wire taped and installed as required by the governing authority.
5. Polyethylene Pipe shall be SDR 11 with a working pressure of 100 psi and shall be Phillips Driscopipe 8000 or equal.

## 2.02 VALVES

- A. Unless otherwise specified or shown on drawings, valves installed in pipelines 3-1/2-inch diameter and smaller for process water lines shall be gate valves; for compressed air and vacuum, globe valves; for natural and sewage gas lines, lubricated plug or eccentric nonlubricated plug valves; and for gas lines less than 2-inch diameter tapered nonlubricated plug cocks; for fuel oil, ball valves; for sludge, eccentric nonlubricated plug valves. Valves for other types of services when required will be specified under that Section.
- B. Gate Valves shall be 150-pound, all bronze, rising stem, solid wedge disc furnished with screwed or flanged ends as required. Gate valves shall be Crane No. 431, Jenkins No. 47-U, Powell No. 514/515, or equal.
- C. Quick Opening Gate Valves shall be used at locations as shown on the Drawings. Quick opening gate valve shall be Crane 432, or equal.
- D. Globe Valves shall be 150-pound, all bronze body with renewable plug-type disc of 500 Brinell Hardness Stainless Steel. The seat ring shall be screwed-in and of the same material as the disc. Globe valves shall be Powell No. 2600, Crane No. 14-1/2P, Jenkins No. 2032, or equal.
- E. Ball Valves through 2-inch shall be screwed end bronze, two-piece, 125 psi, Teflon seats, bronze trim, and blowout-proof stem, Nibco No. T-580-BR-Y-20, or equal.
- F. Butterfly Valves shall be AWWA, Class 150 B, wafer body equipped for ANSI 125-pound flanges. Butterfly valves shall provide bubble-tight shutoff to 150 psig cold water pressure. The valve body shall be made from ASTM A126, Grade B cast iron or equal. The valve disc shall be made with nickel-coated cast iron, bronze, or equal. Valve shall have bronze shaft bearings, O-ring shaft seals, and EPDM valve body seat Keystone Figure 239, or equal. Valves shall be hand lever actuated.
- G. Check Valves shall be 200-pound, all bronze body with bronze disc, Y-pattern, with flanged or screwed ends as required. The check valves shall be Crane No. 36, Powell 560-Y/561-Y, Jenkins 762-A, or equal. Non-slam check valves shall be used on all pipelines operating at 25 psig or higher pressure and shall be Valve and Primer Corporation, Series 300, or equal.

- H. Nonlubricated Plug Valves shall be 150-pound, all bronze body and plug, with synthetic rubber faced plugs and have screwed or flanged ends as required. They shall be DeZurik Figure 120, or equal. Valves shall operate with nonremovable lever type handles.
- I. Lubricated Plug valves 3-1/2-inch and smaller shall be 150-pound solid bronze body and plug, lever operated, furnished with screwed or flanged ends as required, and with nonremovable lever operating handles. Lubricated plug valves shall be Rockwell Permaturn Figure 114, or equal. Each valve shall be equipped with a giant button head coupler for use with a hydraulic hand lubrication gun. One gun shall be furnished.
- J. Plug Cocks shall be nonlubricated tapered plug type cocks, furnished with a square operating nut and wrench. Plug cocks 1-inch diameter and smaller shall be all bronze; larger sizes shall be furnished with bronze plug and washer and iron body. Plug cocks shall be designed for 125-pound working pressure, Walworth 554, Hays 1275, or equal.
- K. Sampling Cocks shall be Ernest Gage Co. Fig. 29, Conbeaco, or equal.
- L. Pressure Regulator shall be Watts U5HP, or equal.
- M. Corporation Stops shall be brass and comply with AWWA C800 as manufactured by Ford Meter Box Co., Inc. or equal. Corporation stops shall be provided with inserts, saddles, and curb boxes as required. Saddles shall be brass with double straps and be placed over a molded rubber gasket.

### 2.03 PVC VALVES

- A. PVC Ball Valves shall be used in all PVC lines under this Section. Ball valves shall be PVC body, Hayward TBH Series True Union; or equal.
  - 1. PVC ball valves used for sodium hypochlorite applications shall be of the vented ball design suitable for sodium hypochlorite. Ball valves shall be Hayward TBH Series "Z-Ball", or equal.
- B. PVC Butterfly Valves:
  - 1. Butterfly Valves shall be made of Class 23447-B rigid PVC compound in conformance with ASTM D1/84 (formerly classified Type IV, Grade 1).
  - 2. Shaft shall be 316 stainless steel. Seats and secondary seals shall be Viton.
  - 3. Bearings shall be glass filled Teflon. Butterfly valves shall have a pressure rating of 150 psi at 70 degrees F.
  - 4. Valve bodies shall be the wafer type compatible with 150-pound ANSI flanges.
  - 5. Valves which are scheduled to be motor operated shall be furnished with mounting saddle. Manually operated valves shall be furnished with lever operators.
- C. Check Valves:
  - 1. Check Valves shall be made of Class 12454-B rigid PVC compound in conformance with ASTM D1784 (formerly classified Type I, Grade 1).

2. All check valves shall have Viton seals.
  3. Check valves 4-inch size and smaller shall be true union ball checks.
- D. PVC Pressure Relief Valves shall be Wallace & Tiernan No. U-23655, Fischer & Porter, or equal, with 1-inch female NPT BPV connections. These shall not be used on chlorination systems.

#### **2.04 AIR RELEASE VALVES**

- A. Air release valves shall be used at various high points in the piping systems under constant pressure to exhaust entrapped air while the pipe is under pressure. Valves shall be designed for a working pressure of 150 psi.
- B. Each air release valve shall be of the compound lever type and have a body and cover made of cast iron and a float of stainless steel. The float seat shall be made of Buna-N material while all other internal parts such as lever pins, cotter pins, screws, and linkage shall be made of highest quality stainless steel or bronze.
- C. Each unit shall have female NPT connections in the sizes indicated on the Drawings. A valve shall be furnished and installed to isolate the process from the air release valve.
- D. Discharge shall be piped to 6-inch above nearest drain out of traffic pattern.
- E. Type "A" air release valves shall be Valve and Primer Corp. 200A; Golden Anderson AR Series, or equal.
- F. Type "B" air release valves shall be furnished with a blow-off sewage valve and water inlet valve with 3/4-inch hose adapter to permit back flushing without dismantling the valve.
- G. Type "B" air release valves shall be Valve and Primer Corp., Model 400, Golden Anderson SAR Series, or equal.

#### **2.05 AIR AND VACUUM VALVES**

- A. Air and vacuum valves shall be used at high points in pressurized piping systems subject to cycling to exhaust entrapped air whenever placed under pressure and to allow air to re-enter the line to prevent a vacuum from developing. Normal service pressures will be less than 150 psi.
- B. Each air and vacuum valve shall have a body, cover, and baffle constructed of cast iron and a float made of stainless steel. The float seat shall be made of Buna-N material while all other internal parts such as float guides, bushings, and baffle retaining screws shall be made of high-quality stainless steel or bronze.
- C. Each unit shall have female NPT connections in the sizes indicated on the Drawings. A nonlubricated plug valve of same size as the air and vacuum valve shall be furnished and installed to isolate the process from the air and vacuum valve.
- D. Discharge shall be piped to 6-inch above nearest drain out of traffic pattern.



- E. Equipment shall be Type "AV" or Type "CAV" as manufactured by Valve and Primer Corp., GA Industries, or equal.

## **2.06 HOSE BIBBS**

- A. Hose bibbs inside buildings shall be all bronze angle hose valves with 3/4 by 11-1/2 threads per inch American (National) or Chicago Standard Hose Threads, Mueller Brass Co. No. V-1016, or equal. Hose bibbs shall have nonremovable type vacuum breaker, Watts No. 8A, or equal. Hose bibbs shall be located 3-feet above the floor.

## **2.07 SILL COCKS**

- A. Sill cocks shall be cast bronze non-freeze wall hydrants, Wade W-8620, Zurn Z-1310, or equal, with 3/4 by 11-1/2 threads per inch hose connection, polished face, galvanized wall sleeve, renewable seat, brass, or bronze operating parts, ground joint union elbow adapter with 3/4-inch IPS (or 3/4-inch solder) and removable T-handle.

## **2.08 ELECTRIC VALVE OPERATORS (OPEN-CLOSE)**

- A. Electric operators shall be sized and geared to meet the torques required at a valve opening and closing speed of 2 to 8 seconds per 90-degree rotation. The operator shall be rated for 25% duty cycle at maximum rate output.
- B. Operators shall be powered by 115 v, single phase, 60 Hz current and shall operate in any mounting attitude.
- C. Operators shall have thermal overload protection, reversing magnetic starter, and a NEMA 4 enclosure for all electrical components. The starter shall be capable of receiving contact closures from remote sources to actuate the operator in either direction. The operating motor shall be provided with surge suppression to limit voltage transients. The surge suppression device shall be equal to Electrocube Part No. RC1782, sized as required to suit the motor characteristics.
- D. Adjustable limit switches shall be provided. Two limit switches shall be used for de-energizing operator once the fully open position or fully closed position of the valve is reached. Two limit switches shall be used for remote indication of end positions. Limit switches shall be single pole double throw snap acting totally enclosed and rated at 250 VAC.
- E. Each operator shall be equipped with a manual override feature with manual lockout switch to prevent electrical operation when in the manual mode. Upon completion of manual operation, the operator will automatically return to the electrical mode.
- F. Each operator shall be supplied with local indicator for visual valve position and an electro-mechanical brake to minimize overrun.
- G. Electric motor valve operators that are to be supplied with butterfly valves shall be sized for 1-1/2 times the valves rated torque or a minimum of 400-inch-pound, whichever is greater.

- H. The operators shall be a product of Raymond Control Systems, Worcester Control, or equal. Operators shall have easily identifiable terminal blocks for all external power and control connections.

## 2.09 STRAINERS

- A. Strainers shall be provided where shown on the Drawings and as required to meet local and State codes. Strainers shall also be provided in all water lines ahead of all solenoid valves, pressure regulators, and pilot valves.
- B. Unless otherwise specified or required by code, strainers shall be Leslie Model 7000, Mueller Muessco Model 11, or equal. Strainer shall have a Y-pattern cast iron body and a 40-mesh stainless steel screen.
- C. The Contractor shall provide a plug cock for blow-off purposes.

## 2.10 BACKFLOW PREVENTERS

- A. Reduced pressure type backflow preventers shall conform to ASSE Standard 1013, AWWA C511, and be approved by the State Department of Public Health, the State Plumbing Board, and the State Department of Labor-Construction Code. Preventers shall be Watts No. 909 with strainer, or equal. Relief valve shall be provided with an air gap, Watts Series AG or equal, piped to drain.
- B. All backflow preventers are to include an in-line strainer between the stop valves.

## 2.11 SLEEVES

- A. Type B Sleeve:
  - 1. Type B sleeves are for use in exterior walls.
  - 2. Type B sleeves consist of casting in place a black wrought iron sleeve two sizes larger than the service pipe with couplings on both ends of the sleeve.
  - 3. Service pipe shall be caulked in place with oakum. The oakum shall be covered with a minimum of 1-inch of lead wool on both ends.
- B. Type C Sleeve:
  - 1. Type C sleeves are used in exterior walls and other walls as designated on the Drawings.
  - 2. Type C shall be a modular mechanical type seal of interlocking synthetic rubber links by Link-Seal, or equal.
  - 3. Unless otherwise indicated, the seal shall be suitable for corrosive service in a temperature range of minus 40 degrees F to 250 degrees F. The pressure plates shall be of Delrin plastic for good resistance to organic compounds. The bolts and nuts shall be of 18-8 stainless steel. The sealing elements shall be of EPDM rubber which has high resistance to most organic and inorganic materials.

- C. Type D Floor Sleeve - Type D sleeves consist of casting in place a steel sleeve with four anchors in the floor slab. The sleeve shall be one size larger than the service pipe or 1-inch larger than the flange on the service pipe. The sleeve shall extend 1-inch above the finish floor surface.
- D. Type E Sleeve:
  - 1. Type E wall sleeves shall be used where noted on the Drawings.
  - 2. Type E sleeves consist of casting in place mechanical joint, cast iron wall sleeves meeting the requirements of AWWA C110 and C111.
  - 3. Each Type E sleeve shall be sealed using plain rubber gaskets, follower glands, and mechanical joint studs meeting all requirements of AWWA C111 on both ends.
- E. Type F Sleeve:
  - 1. Type F sleeves shall be used for passing through masonry walls, except as otherwise noted on the Drawings.
  - 2. Type F sleeves shall be constructed as detailed on the Drawings using 15-pound felt paper and sealant.
- F. Type G Sleeve - Type G sleeves used for passing through gastight floors shall be similar to Type C sleeves with the addition of non-shrinking grout as shown on the Drawings.

## 2.12 PIPE ESCUTCHEONS

- A. Split-type escutcheons shall be used for piping through finished walls, floors, or ceilings. Escutcheons shall be of brass or chromium plated Model 3A by Ritter, or equal.

## 2.13 AUTOMATIC TRAP PRIMER

- A. Automatic trap primers shall be furnished and installed as shown on the Drawings.
- B. Automatic trap primers shall prevent the traps from drying out by adding water to the traps to keep the water at a constant level.
- C. Automatic trap primers shall have bronze bodies with integral vacuum breaker, non-liming internal operating assemblies with strainers and gasketed bronze covers.
- D. Automatic trap primers shall be Zurn Z-1022, Sani-Gard, automatic trap primers, or equal.

## 2.14 TAPPED SADDLES

- A. Where specifically called for on the Drawings, service saddles shall be installed to provide a simple, positive, bubble tight tapping connection.
- B. Saddles shall be rated for 150 psi working pressure and be constructed of corrosion resistant materials for long life, and of heavy proportions to withstand the strains of the tapping operations, and to support the service pipe after tapping.

- C. Saddle gasket shall be made of neoprene rubber and assure a positive leak proof service connection.
- D. Tapped saddles shall be Clow Corporation, Style 3408; Dresser Style 91 (double strap); or equal.

### **PART 3 EXECUTION**

#### **3.01 INSTALLATION**

- A. Cutting of all pipe shall be done with sharp tools. The ends of each pipe shall be reamed until all burrs or fins are removed. Full tapered threads shall be used throughout and threaded joints shall turn up perfectly tight without the use of filling substances. A standard pipe joint paste or tape suitable to use of pipe shall be used on the male threads only, and none shall be allowed to accumulate on the inside of the pipes. All connections between pipe, pipe hangers, and equipment shall be made with an approved dielectric insulating material. Dielectric unions or insulated couplings shall be installed between any dissimilar metallic piping materials or at connections between dissimilar metallic pipes and equipment, tanks, etc.
- B. Pipe joints shall conform to respective industry standards.
- C. Expansion and contraction of the piping system shall be provided for by the use of swing joints, right angle loops, or approved expansion joints. Branch connections shall have three elbow spring pieces to allow for movement. Unless specified in Part 4, the piping system shall provide for the expansion as required in Section 15010. An expansion joint is also required at all building isolation or expansion joints.
- D. Interior and exterior pipelines shall be installed and graded in accordance with State and/or Local Codes. Interior pipes shall run at right angles or parallel to building walls, placed as close as practicable to the ceiling and/or walls, and supported according to Section 15010. Drain valves shall be installed at all low points.
- E. Pipe groups shall be run parallel with pipes of other trades, and wherever practicable, all piping shall be supported on common group hangers unless pitch of pipe as hereinbefore mentioned is required.
- F. The piping shall be installed in a workmanlike manner and shall avoid interference with columns, beams, equipment, and other piping or fixed construction. A minimum of 7-feet of headroom shall be maintained at any point including stairs.
- G. Type C wall sleeves shall be provided for all pipes passing through exterior walls unless other sleeve types are noted on the Drawings. Type C sleeves shall also be provided in interior walls where indicated on the Drawings, Type D floor sleeves shall be used where piping passes through floor. Other sleeve types shall be used where shown on the Drawings.
- H. Buried pipe shall be firmly bedded the full length with the exception where bell holes are required. Buried piping located less than 3-feet below a building slab or footing shall be encased in concrete. Where unstable soil conditions occur under buildings, support

shall be made from the underside of the structural slab by an approved type hanging device embedded in the concrete.

- I. Unless shown otherwise on the Drawings, all buried pipe carrying liquids shall be installed with a minimum cover of 42-inch. Pressure piping which carries gases shall be installed with a minimum cover of 3-feet. When new piping crosses existing utilities and other obstructions which force a change in elevation or horizontal alignment, the Contractor shall install the new piping at a deeper elevation or new alignment to avoid the obstructions unless otherwise instructed by the Engineer. Such changes in elevation or alignment shall be made either by installing fittings or by deflecting joints in accordance with the pipe manufacturer's recommendations. Such Work shall be performed at no additional cost to the Owner. To the extent possible, pressure and process piping shall be installed at a constant grade. All changes in grade shall be approved by the Engineer.
- J. Where PVC piping is laid in a trench, the bottom of the trench shall be well graded and compacted to insure even bearing for the full length of the pipe and the pipe shall be snaked at approximate 50-foot intervals to provide for expansion or contraction. Prior to testing the pipe, the pipe shall be center loaded with backfill between joints before testing to prevent the pipe from arching or whipping under pressure. During backfill the line shall be pressurized to 25 psi to minimize impact damage.
- K. All valves shall be installed with their stems horizontal or above. As far as possible, all valves of the same type shall be of the same manufacturer.
- L. Solenoid operated valves shall be installed in horizontal lines with the solenoid mounted vertically and upright.
- M. The T-drill method manufacturing tees in continuous copper tubing is not acceptable.

### **3.02 EQUIPMENT CONNECTIONS**

- A. The Contractor shall make all connections where required between the various piping systems and all pieces of equipment. This shall include adapters, traps, backwater valves, or other fittings required when not furnished with the equipment.
- B. Unions - Provide a union or flange in piping connections to each valve, device, or item of equipment, and elsewhere as required to makeup or disconnect piping. Each union shall be so installed as to permit the removal of parts and equipment for inspection and cleaning, and shall be installed in a position which will permit the valve device or part to be removed without disconnection of any piping except unions. Union and flange shall be installed in such a position as will be accessible for disconnection items which are to be screwed. All ground joint unions on copper lines shall be cast brass or bronze. Wrought copper unions are not to be used. All unions, where possible, shall be brass to MPT type.

### 3.03 INSTRUMENTATION CONNECTIONS

- A. The Contractor shall make all necessary allowances for and install all controls and instrumentation furnished under any Contract Division and which require in-line connection to process and pressure piping.
- B. The Contractor shall provide all necessary mounting bosses, pipe and boss taps, plugs, tees, and any miscellaneous appurtenances to allow connection of Instrumentation and Controls and their associated piping to process and pressure piping.
- C. Thermowells complete with all appurtenances listed in Division 16 shall be furnished and installed under that Division. Thermowells complete with all appurtenances which are not included in the list in Division 16 and are to be installed in piping under this Section, shall be furnished and installed under this Section.
- D. Instrumentation and Controls are furnished and specified under various Sections including Section 16902. Any schedules shown in Section 16902 are not guaranteed to be complete.

### 3.04 PRESSURE AND LEAKAGE TESTS FOR (LIQUID) PROCESS AND PRESSURE PIPE

- A. The Contractor shall furnish the pump, pipe connections, taps, gauges, auxiliary water container, bulkheads, plugs, and other necessary equipment and make pressure and leakage tests of all liquid conducting lines unless otherwise directed by the Engineer.
- B. Tests shall be conducted on all liquid conducting pipelines or valved sections thereof as directed by the Resident Engineer. Testing of pipelines laid in excavation or bedded in concrete shall be done prior to backfilling or placing concrete cover, except restrained sections of pipe which shall be backfilled prior to testing, unless otherwise permitted by the Engineer. Tests on lines anchored or blocked by concrete shall not be conducted until the concrete has taken permanent set.
- C. The line or section thereof to be tested shall be filled slowly with water to expel all air. Hydrostatic pressure shall be applied by pumping water from an auxiliary supply. The test pressure shall be maintained two hours minimum and additional time as required for thorough inspection to find any leaks or defects in the force main and appurtenances. Unless indicated otherwise in Part 4, the test pressure shall be 100 pounds per square inch or 50% above the normal operating pressure, whichever is greater. Should the pipe section fail to pass the tests, the Contractor shall find and correct failures and repeat the tests until satisfactory results are obtained.
- D. Leakage tests shall be made simultaneously with or following completion of pressure tests of all lines or valved sections thereof. Leakage is defined as the quantity of water added to the pipe under test to maintain the required test pressure for a specified time. The leakage test pressure shall be not less than the maximum operating pressure of the section under test. The duration of the leakage test shall be not less than two hours. Allowable leakage for buried piping shall not exceed 50 gallons per inch of pipe diameter per mile of pipe in 24 hours. For piping not buried, any leakage during the test is unacceptable.

- E. Lines that conduct fuel oil, gasoline, or chemicals that would have a deleterious effect upon the pipeline or process when mixed with water shall be purged after the pressure and leakage tests. Purging shall be performed with air or an inert gas such as nitrogen or carbon dioxide. Purging shall be continued for a minimum of two hours after all visible water has disappeared.
- F. Testing of chlorination system piping shall also comply with the provisions of Section 11235.

### **3.05 PRESSURE TESTING FOR (GAS) PROCESS AND PRESSURE PIPE**

- A. All new and reused pipelines conducting gases shall be tested for tightness by the Contractor before final approval. All testing shall be witnessed by the Resident Engineer. Testing of natural gas lines shall meet the requirements of this Section or the governing authority.
- B. All gas conducting pipelines shall be tested at 100 psig or 150% of the normal operating pressure, whichever is greater.
- C. The test medium shall be air or an inert gas such as nitrogen or carbon dioxide. Oxygen, water, and/or natural gas are not to be used. Testing for leaks shall be done with an approved leak detector, or by brushing a soap solution or equivalent on each joint while the system is under pressure.
- D. The Contractor shall provide for proper purging of all natural gas piping. All such purging shall be scheduled to minimize interruptions to the continued use of existing natural gas pipelines. After the piping has been pressure tested, leak tested, and approved, it shall be fully purged or cleared of air at the most distant point from the point of entry of the gas. This involves replacement of the atmosphere within the natural gas conduit by an inert substance in such a manner as to prevent the formation of explosive mixtures. Each major branch line shall be similarly purged at its far end. Purging shall be done only by personnel experienced in this particular operation.
- E. Testing of chlorination system piping shall also comply with the provisions of Section 11235.

### **3.06 DISINFECTION OF WATER MAINS**

- A. Before being placed in service and before certification of completion by the Engineer, all new water systems, or extensions to existing systems or valved section of such extension, or any replacement in the existing water system, or any exposed section of the existing system shall be flushed and disinfected in accordance with the current State of Michigan procedures and or AWWA C651. Water mains shall be thoroughly flushed prior to disinfection at a velocity of not less than 2.5 feet per second.
- B. Chlorination: The Contractor will perform all necessary work to chlorinate the water mains and its appurtenances. A chlorine solution (Chlorine used shall conform to the NSF Standard 60 or 61) shall be injected into the water main of sufficient strength to create a minimum 50 ppm chlorine solution (maximum 500 ppm) in the main. The type

of chlorine used, mixing rates and application rate shall be approved by the Engineer. The strong chlorine solution shall remain in the water main at least 24 hours and maximum of 72 hours prior to flushing. Immediately at the time of flushing the chlorinated water from the main, a water sample for testing the strong chlorine solution shall be taken by the City Water Department. After the main has been thoroughly flushed at a velocity of not less than 2.5 feet per second, another sample shall be taken to test for residual chlorine. Sufficient notification shall be given to the City Water Department by the Contractor as to the date and time such samples are to be taken. The Contractor shall rechlorinate the water main if test conducted on the samples taken do not meet current City Water Department standards. At the time of chlorination, all hydrant valves and intermediate main line valves shall be operated. All cost of chlorination, installation of corporations and related materials and labor shall be at the Contractor's expense.

- C. Chemical and Bacteriological Test: Immediately following chlorination, all treated water shall be thoroughly flushed from the main at a velocity of not less than 2.5 feet per second until the replacement water through its length shall, upon test by the City Water Department, both chemically and bacteriologically, be proven equal in quality to the water in the source supply system.

### **3.07 EQUIPMENT DRAINS**

- A. Seal chamber, base plate drains, and equipment drains shall be piped to the nearest floor or equipment drain with copper lines as directed by the Engineer. All discharges shall provide a 2-inch minimum air gap above the drain.

## **PART 4 SPECIAL PROVISIONS**

### **4.01 POLYETHYLENE PRESSURE TUBING**

- A. Polyethylene pressure tubing shall be furnished and installed for the chemical feed tubing as shown on the Drawings.
- B. Tubing shall meet the requirements of ASTM D2737 and AWWA C901, latest revisions.
- C. Specifications of and marking on the tubing shall be the following with markings spaced at intervals of not more than 5-feet:
  - 1. Nominal tubing size = 3/4-inch.
  - 2. Plastic tubing type = PE2305.
  - 3. Pressure rating for water at 73-degree F = 160 psig.
  - 4. Designation ASTM D2737 or AWWA C901, with which the tubing complies.
  - 5. The Manufacturer's name (or trademark).
  - 6. Testing agency seal.



**4.02 PIPING SERVICE MATERIAL REQUIREMENTS**

A. The following are the material classifications to be used for the piping service identified.

<b>Service</b>	<b>Piping</b>	<b>Gaskets</b>
Plant Water in Buildings	Type L Copper	N/A
Plant Water Buried	Type K Copper	N/A
Chemical Piping	Schedule 80 PVC	N/A
Air Release Discharge	Schedule 80 PVC	N/A
Pump Seal Cavity Drain	Schedule 80 PVC	N/A

**4.03 INSULATION FOR PIPES**

A. Pipe insulation shall be as specified in Section 15504.

END OF SECTION

**SECTION 15250  
VALVES**

**PART 1 GENERAL**

**1.01 SCOPE**

- A. This Section includes the furnishing and installing valves, flap gates, and shear gates 4-inch and larger.
- B. Floor stands, floor boxes; valve boxes; gears, manual, hydraulic, and electric operators; extension stems; stem guides and supports; brackets; gaskets; bolts and nuts; and other accessories shall be provided as necessary to complete the Work.

**1.02 SUBMITTALS**

- A. Submittals shall be in accordance with the requirements of Section 01300 and shall include:
  - 1. Shop Drawings for Review:
    - a. The Contractor shall indicate all variances from the requirements of the Contract Documents.
    - b. Scaled dimensional drawings.
    - c. Wiring schematics with termination point identification.
    - d. Piping schematics.
    - e. Materials of construction.
    - f. Manufacturer's catalog data.
    - g. General Arrangement Drawings.
    - h. Motor information per Section 11050.
  - 2. Information for the Record:
    - a. Operation and maintenance manual.

**PART 2 PRODUCTS**

**2.01 GENERAL**

- A. All valves and appurtenances shall be of standard make approved by the Engineer and shall have the name, monogram, or initials of the manufacturer cast thereon. They shall be built and equipped for the type of operation shown on the Drawings, specified herein, or as directed by the Engineer.
- B. Opening Direction - Unless otherwise specified in Part 4, valves with screw stems shall open by turning counterclockwise, the direction being indicated by an arrow cast where easily visible to operator.

- C. Connections - Valves shall be provided with hubs, spigots, flanges, mechanical groove-type, screw, or other connections compatible with the pipe in which they are installed or scheduled in Part 4.
- D. Unless otherwise specified, a stuffing box packed with O-ring seals shall be used to seal the stem of the valve. The seal system used shall be replaceable without removing bonnet or rotating element. Gaskets shall be of either Buna or a rubber composition.
- E. Bolts and nuts on buried valves shall be a low alloy steel cathodic to the valve body and having a minimum yield strength of 45,000 psi. All other nuts and bolts shall be low carbon steel conforming with the mechanical and chemical requirements of ASTM A307, Grade B.

## 2.02 GATE VALVES

- A. Resilient Seated and Resilient Wedge Gate Valves (3-Inch to 12-Inch): Resilient seated gate valves shall have the following features: ductile or cast-iron body, bronze mounted, non-rising E-17 stem, rubber-covered gate, open left, design operating pressure 250 psi, 2-inch operating nut, and mechanical joint ends as per AWWA C111 (ANSI 21.11). Gate valves shall not be used in water mains with diameters larger than 30 inches. All resilient seated gate valves shall meet the requirements of AWWA C509 in cast iron or ductile iron construction or AWWA C515 ductile iron construction. Acceptable manufacturers for applicable C509 and C515 Resilient Wedge Valves in these sizes are: EJIW, American Flow Control, Mueller, Clow, Kennedy, or as approved. All valve body internal and external surfaces and bonnet shall have a fusion bonded epoxy coating, complying with ANSI/AWWA C550, applied electrostatically prior to assembly. All nuts, washers, and bolts shall be No. 304 stainless steel. Each valve shall be wrapped with a polyethylene encasement with a minimum thickness of 8 mil and installed as per AWWA C105.
- B. Resilient Wedge Valves (14-Inch to 36-Inch): When permitted on the plans, valves 14-inch to 30-inch shall be resilient wedge type rated for 250 psi cold water working pressure. Valve body, bonnet, wedge, and operating nut shall be constructed of ductile iron meeting AWWA C515. The exterior of the ductile iron wedge shall be fully encapsulated with rubber. The wedge shall be symmetrical and seal equally in either direction. The 2-inch operating nut shall be constructed of ductile iron and have four flats at the stem connection to assure even input torque to the stem. All gaskets to be pressure energized O-ring. Stem shall be sealed by three O-rings. The top two O-rings shall be replaceable with the valve fully open and while subject to full rated working pressure. Valves shall have thrust washers located with one above and one below the thrust collar to assure trouble free operation of the valve. All internal and external surfaces of the valve body and bonnet shall have a fusion bonded epoxy coating, complying with ANSI/AWWA C550, applied electrostatically prior to assembly. All nuts, washers and bolts are to be No. 304 stainless steel. Each valve shall be wrapped with a polyethylene encasement with a minimum thickness of 8 mil and installed as per AWWA C105. Acceptable manufacturers for C515 Resilient Wedge Valves in these sizes are: American Flow Control, Kennedy, or as approved.

**2.03 CHECK VALVES**

- A. The booster pump check valve shall be a globe style silent check valve.
- B. Globe Style Silent Check Valve shall be flanged and drilled per ASME B16 with 125/150 flange bolt circles.
- C. Valve plug must be center guided at both ends with a through integral shaft.
- D. Valve spring must be a coil spring, Type 316 Stainless Steel with the ends ground flat for true perpendicular closing force.
- E. Valve seat and plug shall be replaceable in the field for ease of maintenance. Resilient seated valves shall be drip tight.
- F. Flow area through the body shall be equal to or greater than the cross-sectional area of the equivalent pipe size.
- G. Materials of Construction:

Description:	Material:
Body	Cast Iron, ASTM 126, Grade B
Seat	316 Stainless Steel, ASTM A351, GRCF-8M
Plug	Ductile Iron with 316 Stainless Steel Ring
Spring	Stainless Steel, type 316
Bushing	Stainless Steel, type 316
Resilient Seat	EPDM

- H. Valve shall be APCO Series 600, or equal.

**2.04 BUTTERFLY VALVES**

- A. Butterfly valves shall be Kennedy Valve Manufacturing Company Style 4500 or Pratt Model "Ground Hog" having the following features: ductile-iron body, rubber-seated, open left, mechanical joint ends as per AWWA C111 (ANSI A21.11) and 2-inch square operating nut. All butterfly valves shall meet the requirements of AWWA C504, Class 150B. All valves used in 16-inch or larger diameter pipe shall be butterfly valves, unless specified. Equivalent butterfly valves may be accepted upon written approval of the City Engineer before Bid closing date. All valve body internal and external surfaces and bonnet shall have a fusion bonded epoxy coating, complying with ANSI/AWWA C550, applied electrostatically prior to assembly and all nuts, washers, and bolts are to be No. 304 stainless steel. Each valve shall be wrapped with a polyethylene encasement with a minimum thickness of 8 mil and installed as per AWWA C105.

**2.05 RESERVED**

**2.06 RESERVED**

**2.07 RESERVED**

**2.08 RESERVED**

**2.09 RESERVED**

**2.10 RESERVED**

**2.11 RESERVED**

**2.12 TAPPING SLEEVE, VALVE, AND VALVE BOX**

- A. Water main tapping sleeves shall be No. 304 stainless steel including the flange. The shell, lift bar, and flange shall be stainless steel. The flange gasket shall be factory installed virgin SBR compound or equal for water mains. The tapping sleeve shall be provided with a stainless steel ¾-inch NPT test plug for pressure testing the sleeve prior to tapping the main. The tapping sleeve and valve shall be installed and pressure tested at 90 pounds for 5 minutes with no loss to be approved to proceed with tapping the main. The test shall be witnessed by Water Department personnel. The tapping sleeve and valve shall be wrapped with a polyethylene encasement. The polyethylene film shall be a minimum 8 mil thickness and installed as per AWWA C105. Tapping sleeves shall be Romac Industries, Inc., "SST", Power Seal Pipeline Products Corp. Model 3490, or approved equal. Special tapping sleeves for tapping concrete cylinder pipe shall be Romac Industries, Inc., "FTS 435" steel fabricated tapping sleeve with stainless steel (No. 304 minimum) straps and fusion bonded epoxy coating per AWWA C213 or approved equal. All bolts, nuts, and washers shall be No. 304 stainless steel or COR-BLUE, Cor-Ten coated with a ceramic-filled, baked-on fluorocarbon resin as manufactured by Birmingham Fastener 'B' or approved equal. Approved equal tapping sleeves shall be subject to submittal of manufacturer specifications, approval of the Engineer and issuance of contract addendum prior to the bid due date.

**2.13 RESERVED**

**2.14 VALVE BOXES**

- A. Valves boxes shall be Tyler Pipe Series 6860 Box D having the following features: constructed of cast iron, three pieced, 5-1/4-inch shaft, screw type adjustment, adjustable 45-inch – 66-inch extension range, and complete with a lid marked "WATER" in raised letters. Valve boxes shall be furnished with a No. 6 round base for 12-inch and smaller valves and a No. 8 round base or equivalent for 12-inch – 16-inch valves. Valve box base for valves larger than 16-inch shall be as approved by the Engineer. Approved equals are the Bibby-Ste-Croix D valve box and EJIW 8560 valve box D with a No. 6 base.
- B. A valve box shall be provided for each curb stop. A key shall be furnished to operate curb stops.
- C. All parts of valve boxes, bases, and covers shall be coated by dipping in bituminous varnish.
- D. Extension stems shall be provided for buried valves when the operating nut is 3-feet or more below finished grade. Extension stem shall extend operating nut to within 16-inches of the ground surface, shall be provided with spacers which will center the stem in the valve box, and shall be equipped with 2-inch square wrench nut. Extension stems shall meet the requirements of this Section.

**2.15 RESERVED**

**2.16 EXTENSION STEMS AND STEM GUIDES**

- A. Each valve shall be provided with extension stem, when required for ease of operation. Unless otherwise specified, each extension stem shall be made of cold-rolled steel material and the same size as the valve stem of the valve it operates. If the extension is more than 8-feet long, intermediate stem guides shall be installed and supported from the wall by suitable brackets at a maximum spacing of 8-feet. Brackets and stem guides shall be made of cast iron and fully adjustable. The guide block shall be bronze bushed where it contacts the extension stem. Stem guides shall be as manufactured by the Eddy Valve Co., Rodney Hunt, or equal. Secure stem guides to walls with stainless steel 5/8-inch expansion bolts.
- B. All valves which are to be operated by tee wrench shall have 2-inch square operating nut at the top of the extension stem.
- C. Stems for operation of plug valves shall not be less than 1-1/4-inch diameter Schedule 80 galvanized steel pipe with intermediate steady guides. Weld socket for 2-inch valve nuts to bottom of extension stems and pin sockets to nuts with stainless steel 3/8-inch bolts. Provide a permanent lever or a 2-inch square operating nut at top of stems, in accordance with requirements of Drawings.

**2.17 TEE WRENCHES**

- A. Tee wrenches shall be supplied in the number and length specified in Part 4 of this Section. The minimum length shall be 3 feet.

**2.18 MANUAL OPERATION**

- A. Valves shall be equipped with nut, hand wheel crank, chain, gears, floor stand, and other appurtenances as required for manual operation as specified or scheduled. Operators shall be in accordance with AWWA specifications except as modified herein.
- B. Each valve with a manual operator within a building which is more than 5-feet-6-inch above the floor to the rim of the manual operator shall have a chain wheel with galvanized chain looping 3-feet-6-inch from the floor. The valve shall be oriented to permit chain wheel operation or intermediate pulleys shall be installed to facilitate chain operation.
- C. Operation shall be designed so that the effort required to operate the hand wheel, lever, or chain shall not exceed 25 pounds applied at the extremity of the wheel or lever. The hand wheels on valves 4-inch and larger shall not be less than 12-inch in diameter.
- D. Gears for valve operation shall be installed in such a manner that the stuffing box will be accessible for packing.

**2.19 RESERVED**

**2.20 RESERVED**

## 2.21 SHOP PAINTING

- A. All iron parts shall be painted before leaving the shop.
- B. Unless otherwise specified, all internal ferrous surfaces of each valve except finished or bearing surfaces shall be shop painted with two coats of an asphalt varnish.
- C. Unless otherwise specified, all exterior ferrous surfaces of each valve except finished or bearing surfaces shall be shop painted with two coats of a universally compatible primer or in the case of valves buried or submerged, with two coats of an asphalt varnish.

## 2.22 SOURCE QUALITY CONTROL

- A. Each check, gate, butterfly, and ball valve shall be submitted to operation and hydrostatic tests at the manufacturer's plant as specified in applicable AWWA Standards.
- B. Other valves shall be tested in conformance with applicable specifications in Part 4 of this Section.

## PART 3 EXECUTION

### 3.01 INSTALLATION

- A. All valves shall be carefully installed in their respective positions free from distortion and stress. Connecting joints shall conform to applicable requirements of Section 15210.
- B. Stem guides shall be accurately aligned.
- C. Double disc gate valves shall not be installed with the bonnet more than 90 degrees from an upright position.
- D. Accessories:
  - 1. Valve Boxes shall be installed in a plumb position and in alignment with the operating nut.
  - 2. Extensions stems and stem guides shall be in alignment with operating nut and prevent binding and stresses on connecting pins.
  - 3. When there is a change to the grade elevation, valve boxes new and existing shall be adjusted to the new grade elevation.

### 3.02 TAPPING SLEEVE VALVE AND VALVE BOX

- A. The Contractor shall locate the existing water main to be tapped prior to installing pipe directly connecting to the tapping valve to verify the outside diameter of the existing water main pipe.
- B. The Contractor shall perform a hydrostatic test of the tapping sleeve and valve prior to installing the tap connection to the existing water main. The sleeve shall be hydrostatically tested for 15 minutes using test pressures in accordance with tapping sleeve manufacturer's recommendations. Compressed air testing shall not be permitted.
- C. Test pressure shall be 150 psi with no loss.

**3.03 TESTING**

- A. All valves shall be tested in place by the Contractor as far as practicable under the conditions for the pipelines in which they are placed, and defects revealed in valves or connections under test shall be corrected at the expense of the Contractor to the satisfaction of the Project Field Representative.

**PART 4 SPECIAL PROVISIONS**

**4.01 VALVE SCHEDULE**

- A. The following letter designations are used in the Valve Schedule:

<p><b>Type Designation</b> CV - Check Valve GV - Gate Valve BV - Butterfly Valve</p>	<p><b>Connection Designation</b> F - Flanged W - Wafer MJ - Mechanical Joint PE - Plain End TS - Tapping Saddle</p>	<p><b>Operator Designation</b> FB -Floor Box TW - Tee Wrench G - Gear HW - Handwheel L - Lever VB - Valve Box</p>
<p><b>Use Designation</b> CW - City Water</p>	<p><b>Service Designation</b> O-C - Open-Close M - Modulation</p>	<p><b>Location Designation</b> SCBS - South Custer Booster Station</p>

- B. The Schedule is as follows:

Valve Number	Size (in.)	Type	Connection	Operator	Use	Service	Location
GV-1	12	GV	MJ	VB/TW	CW	O-C	SCBS
GV-2	12	GV	MJ	VB/TW	CW	O-C	SCBS
GV-3	12	GV	MJ	VB/TW	CW	O-C	SCBS
GV-4	12	GV	MJ	VB/TW	CW	O-C	SCBS
GV-5	6	GV	F	HW	CW	O-C	SCBS
GV-6	6	GV	F	HW	CW	O-C	SCBS
GV-7	12	GV	MJxMJ (TS)	VB/TW	CW	O-C	SCBS
GV-8	12	GV	MJxMJ (TS)	VB/TW	CW	O-C	SCBS
GV-9	12	GV	MJ	VB/TW	CW	O-C	SCBS
GV-10	12	GV	MJ	VB/TW	CW	O-C	SCBS
GV-11	12	GV	MJ	VB/TW	CW	O-C	SCBS
BV-1	12	BV	F	HW	CW	O-C	SCBS
BV-2	12	BV	F	HW	CW	O-C	SCBS
BV-3	12	BV	F	HW	CW	O-C	SCBS
BV-4	12	BV	F	HW	CW	O-C	SCBS
CV-1	12	CV	F	-	CW	-	SCBS

- C. Schedules are not guaranteed to be complete. All valves shown on the Drawings or specified shall be furnished and installed by the Contractor whether or not listed in the above schedule.

END OF SECTION



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**SECTION 15400  
PLUMBING**

**PART 1 GENERAL**

**1.01 SCOPE**

- A. This Section includes furnishing and installing all necessary plumbing components, connecting piping, and accessories, and a complete plumbing system for each service or combination of services.
- B. Each system shall be adequate to conduct and control the flow of hot and cold potable water, sanitary lines, vents, roof drains, or other uses as specified or shown on the Drawings.
- C. Plumbing is defined to include all potable water and all building sanitary drainage and vents, and all building storm drainage of every size located in all buildings and up to a point, 5-feet -0-inch outside each building.
- D. Work includes, but is not limited to:
  - 1. Securing and bearing the cost of all permits, certificates, and inspection as required by local regulations and state plumbing codes.
  - 2. All pipe, fittings, and connections to sanitary fixtures for potable water supply and waste, including vents, roof drains, floor drains, equipment drains, traps, cleanouts, and backwater valves.
  - 3. Pressure gauges, thermometers, control devices, pipe hangers, anchors, supports, hose bibbs, sill cocks, and sleeves.
  - 4. Potable water supply to boiler makeup water stop valves, or other equipment requiring these services.
  - 5. Pipe insulation complete with jacket as required by Section 15504.
  - 6. Floor and equipment drains, condensate drainage, and accessories.
  - 7. Sanitary fixtures, sinks, lavatories, backflow preventer valves, water coolers, acid neutralizing basins, oil and grease separators, and water heaters.
- E. Additional product requirements are specified in Section 01350.
- F. All equipment, materials, and Work shall comply with Federal, State, and local plumbing codes. Equipment materials and Work specifically required by Federal, State, or local plumbing codes whether or not shown on the Drawings or specified shall be provided by the Contractor at no change in Contract Price.

**1.02 SUBMITTALS**

- A. Submittals shall be in accordance with the requirements of Section 01300 and shall include:

1. Shop Drawings for Review:
  - a. Manufacturer's literature.
2. Information for the Record:
  - a. Material certificates.
  - b. Licenses and permits.
  - c. Operation and maintenance manual.

### **1.03 CONTRACT DRAWINGS**

- A. All Drawings are diagrammatic and are intended to show the approximate location of equipment and piping.
- B. The exact location of apparatus, fixtures, equipment, and piping shall be ascertained by the Contractor in the field, and the Work shall be laid out accordingly. Should the Contractor fail to ascertain such locations, the Work shall be changed at his own expense when so ordered by the Engineer. The Engineer reserves the right to make minor changes in the location of piping and equipment up to the time of installation without additional cost to Owner.

### **1.04 PROTECTION FROM DAMAGE**

- A. Delivery, Handling, and Storage:
  1. Material delivery, handling, and storage shall meet the requirements of Section 01350.
  2. All plastic fixtures and pipe, if stored outside, shall be covered with an opaque material to protect them from the sun's rays.
  3. All plastic fixtures and pipe, if stored outside, shall be covered with an opaque material to protect them from the sun's rays.
- B. After Installation:
  1. Suitable covers and guardrails shall be placed to protect against chipping enamel or denting the surfaces of any equipment after it is installed and during the final days of construction.
  2. Before acceptance, all covers, and protective material shall be removed, and the fixtures and equipment cleaned and ready for use.

### **1.05 PLUMBING PIPE REQUIREMENTS**

- A. Sanitary Drain, Waste, and Vent (DWV): PVC schedule 40 gravity pipe.
- B. Domestic Hot and Cold Potable Water (DHW & DCW): Copper pipe.
- C. Storm Drainage Piping: PVC schedule 40 gravity pipe.

## PART 2 PRODUCTS

### 2.01 PIPING MATERIALS

- A. Copper Pipe and Tubing shall be manufactured in accordance with ASTM B88. Type L hard temper shall be used above ground and inside of structures for hot and cold potable water and other services unless another type of pipe is specifically called for. Type K soft temper shall be used where underground piping is installed. Fittings shall be cast bronze or wrought copper with solder joints. Unions shall be cast bronze solder joint fittings manufactured in accordance with ASTM B62 with ends complying with ANSI B16.18. Unions shall be installed adjacent to valves and equipment and as required to assemble the piping but not less than one union shall be included in each run. Threaded adapters shall be installed on each side of valves in copper lines. Where joints are made between pipes of different materials, dielectric couplings shall be installed. Pipe nipples shall be standard weight seamless red brass pipe ASTM B43. Solder joints shall be made in conformance with ASTM B828 Flux conforming to ASTM B813 shall be applied. Materials used for solder joints in all potable water services shall contain less than 0.2% lead and comply with ASTM B32.
- B. DWV Schedule 40 PVC Gravity Pipe:
1. Pipe: ASTM D2665.
  2. Fittings: PVC.
  3. Joints: ASTM 2855, solvent-weld with ASTM 2564 solvent cement.

### 2.02 VALVES

- A. Unless otherwise specified, valves installed in pipelines 3-1/2-inch diameter and smaller for potable water lines shall be gate valves.
- B. Gate valves shall be 150 pounds, all bronze, rising stem, solid wedge disc furnished with screwed or flanged ends as required. Gate valves shall be Crane No. 431, Jenkins No. 47, Powell No. 514, or approved equal.
- C. Check valves shall be 200 pounds, all bronze body with bronze disc, y-pattern, with flanged or screwed ends as required. The check valves shall be Crane No. 36, Powell 560-Y, Jenkins 762-A, or approved equal. Non-slam check valve shall be used on all pipelines with 25 psi or more pressure and shall be Valve and Primer Corporation, Series 300, or approved equal.
- D. Ball valves through 2-inch shall be screwed end bronze, two-piece, 125 psi, Teflon seats, bronze trim, and blowout-proof stem, Nibco T-580-BR-Y-20, or approved equal.
- E. Plastic Ball Valves for PVC or CPVC Schedule 80 Pressure Pipe:
1. Manufacturers: Chemtrol, Spears Manufacturing, or approved equal.
  2. True Union Ball Valves: All thermoplastic ball valves shall be true union standard type, schedule 80 full-port design, manufactured to ASTM F1970 and constructed from PVC Type I, ASTM D1784 Cell Classification 12454 or CPVC

Type IV, ASTM D1784 Cell Classification 23447. All O-rings shall be EPDM or FKM construction. All union nuts shall have Buttress threads. All EPDM valves shall be certified by NSF International for use with potable water.

- F. Plastic Check Valves for PVC or CPVC Schedule 80 Pressure Pipe:
  - 1. Manufacturers: Chemtrol, Spears Manufacturing, or approved equal.
  - 2. True Union Ball Check Valves: All thermoplastic check valves shall be true union ball type suitable for horizontal or vertical installation, schedule 80 full-port design, manufactured to ASTM F1970 and constructed from PVC Type I, ASTM D1784 Cell Classification 12454 or CPVC Type IV, ASTM D1784 Cell Classification 23447. All O-rings shall be EPDM or FKM construction. Valve stem shall have an O-ring stem seal. All handles shall be of polypropylene construction. All union nuts shall have Buttress threads. All EPDM valves shall be certified by NSF International for use with potable water.
- G. Plastic Unions for PVC or CPVC Schedule 80 Pressure Pipe:
  - 1. Manufacturers: Chemtrol, Spears Manufacturing, or approved equal.
  - 2. Unions: All thermoplastic unions shall be schedule 80, manufactured to ASTM F1970 and constructed from PVC Type I, ASTM D1784 Cell Classification 12454 or CPVC Type IV, ASTM D1784 Cell Classification 23447. All O-rings shall be EPDM or FKM construction. All union nuts shall have Buttress threads. All EPDM valves shall be certified by NSF International for use with potable water.
- H. Curved Bill Check Valves for Pipe Discharge: Check valves shall be Tideflex, Series TF-2, or approved equal. 100 percent elastomer construction of curved bill design with type 316 mounting band clamps. Valves shall slide onto the end of the pipe and held in place with the stainless-steel band clamps. Valves shall eliminate backflow and have low cracking pressure with very low headloss.

### **2.03 STRAINERS**

- A. Strainers shall be provided where shown on the Drawings and as required to meet local and State codes. Strainers shall also be provided in all water lines ahead of all solenoid valves, pressure regulators, and pilot valves.
- B. Unless otherwise specified or required by code, strainers shall be Leslie Mode 7000, Mueller Muessco Model 11, or approved equal. Strainer shall have a Y-pattern cast iron body and a 40-mesh stainless steel screen.
- C. The Contractor shall provide a plug cock for blow-off purposes.

### **2.04 HOSE BIBBS**

- A. Hose bibbs inside buildings shall be all bronze angle hose valves, replaceable hexagonal disc, hose thread spout, handwheel, and integral vacuum breaker, and shall be Woodford Manufacturing Company, Model 24C, or equal, with 3/4-inch standard threaded hose connections.

## 2.05 ROOF DRAINS

- A. Manufacturers: Zurn Model Z100ERC, Josam Manufacturing Co., J.R. Smith Mfg. Co., or equal
- B. Construction: ANSI A112.21.2; latex-coated cast iron with large sump and flange, with screwed or caulk bottom outlet, with removable polyethylene dome.
- C. Accessories: Membrane flange and membrane clamp with integral gravel stop, under deck clamp/escutcheon plate, roof sump receiver, and fixed extension sleeve for roof installation.
- D. Under Deck Clamp/Escutcheon Plate: Constructed of 1/4 inch thick, Type 304 stainless steel plate, to serve both as a clamp and to cover the underside of the exposed pre-cast deck roof opening.
- E. Roof drain conductor pipe shall be cast iron or PVC pipe or as permitted by the governing authority. Pipe sizes and slopes noted on the drawings are minimum requirements.

## 2.06 FLOOR, EQUIPMENT, AND AREA DRAINS

- A. Floor Drains:
  - 1. Manufacturers: Zurn Model ZN511, Josam Manufacturing Co., J.R. Smith Mfg. Co., or equal.
  - 2. Construction: ANSI A112.21.1; round top drain, latex-coated, cast-iron deep sump body with bottom outlet; seepage pan and polished nickel-bronze, anti-tilt, slotted grate, and combination membrane flashing clamp and frame. Provide P-traps for floor drains suitable for connecting to the type of pipe furnished for the respective piping classifications.
  - 3. Floor drainage systems shall be vented where required.
  - 4. All PVC sanitary line components shall be as provided by Plastic Oddities, Shelby, NC, or equal.
- B. Deep Seal Trap with Floor Cleanout:
  - 1. Manufacturers: Zurn Model Z1012FC, Josam Manufacturing Co., J.R. Smith Mfg. Co., or equal.
  - 2. Construction: Latex coated cast iron body for use with bottom outlet floor drain, with cast iron floor cleanout and plug for caulking into top of hub cleanout opening.
  - 3. Adjustable Floor Cleanout: Zurn Model ZN1406, Josam Manufacturing Co., J.R. Smith Mfg. Co., or equal. Adjustable floor cleanout with spigot connection for caulking into hub. Latex coated cast iron body with gas and watertight ABS plug and cast-iron housing with round, scoriated secured polished nickel bronze heavy-duty cover adjustable to finished floor.

## 2.07 SLEEVES

- A. Type C Sleeve:
1. Type C sleeves are used in exterior walls and other walls as designated on the Drawings.
  2. Type C shall be a modular mechanical type of seal of interlocking synthetic rubber links.
  3. Unless otherwise indicated, the seal shall be suitable for corrosive service in a temperature range of 40-degree F to 250-degree F. The pressure plates shall be of Delrin plastic for good resistance to organic compounds. The bolts and nuts shall be of 18-8 stainless steel. The sealing elements shall be of EPDM rubber which has high resistance to most organic and inorganic materials.
- B. Type D Floor Sleeve - Type D sleeves consist of casting in place a Schedule 40 steel sleeve with four anchors in the floor slab. The sleeve shall be one size larger than the service pipe or 1-inch larger than the flange on the service pipe. The sleeve shall extend 1-inch above the finish floor surface.
- C. Type E Sleeve:
1. Type E wall sleeves shall be used where noted on the Drawings.
  2. Type E sleeves consist of casting in place mechanical joint, cast iron wall sleeves meeting the requirements of AWWA C110 and C111.
  3. Each Type E sleeve shall be sealed using plain rubber gaskets, follower glands, and mechanical joint studs meeting all requirements of AWWA C111 on both ends.
- D. Type F Sleeve:
1. Type F sleeves shall be used for passing through masonry walls.
  2. Type F sleeves shall be constructed as detailed on the Drawings using 15-pound felt paper and sealant.

## 2.08 MISCELLANEOUS PRODUCTS

- A. Water Hammer Arresters: Josam "Absorbotron," Zurn, Precision Plumbing Products, or equal, as noted on the Drawings. Conformance with ANSI A112.26.1, sized in accordance with PDI WH-201. Seal bearing approval from Plumbing and Drainage Institute, stainless steel construction with pre-charged suitable for operation in temperature range -40 to 300 degrees F and maximum 250 psig working pressure.
- B. Relief Valves: Crane No. 2606, Kennedy, or equal, all brass construction, pipe relief discharge to floor or nearest floor drain.
- C. Pipe Escutcheons: Split-type escutcheons shall be used for piping through finished walls, floors, or ceilings. Escutcheons shall be of brass or chromium plated.

- D. Cleanouts:
1. Floor: Zurn Model ZN1400, J.R. Smith Series 4020, Josam Series 55000, or equal. Adjustable floor cleanout for installation in interior finished floor areas, latex coated cast iron, two-piece body, with gas and watertight ABS tapered thread plug, and round, scoriated, polished nickel-bronze secured top adjustable to finished floor.
  2. Wall Mount: Zurn Model Z1446, J.R. Smith Series 4531S, Josam 58600-COT, or equal. Cleanout tee for installation in wall, latex coated cast iron body, gas and watertight ABS tapered thread plug, and round, smooth stainless steel wall access cover with securing screw.
- E. Vent Stack Sleeve: Zurn Model Z196, J.R. Smith Series 1740, Josam Series 26450, or equal. Vent stack flashing sleeve, latex coated cast iron body, inside caulk type.

## 2.09 BARRIER-TYPE TRAP SEAL

- A. Manufacturers: Everflow Supplies Green Drain, Sure Seal, or approved equal.
- B. Construction: ASSE 1072 tested and certified, inline floor drain, barrier type trap seal with UV ABS plastic frame, silicone rubber sealing flapper, and four flexible sealing ribs. Trap seal shall open to allow drainage and close when there is no flow. Trap seals shall be in compliance with the Ohio Plumbing Code.

## 2.10 PLUMBING FIXTURES

- A. Plumbing fixtures shall be a product of one of the following manufacturers:

Item	Manufacturer
Water Closets	American Standard, or equal
Lavatories	American Standard, or equal
Lavatory Faucet	American Standard, or equal
Flush valves	Sloan, Delany, or equal
Fittings	Crane, American Standard, or equal

- B. The model numbers and manufacturers listed are to establish the type, style, quality, and materials of construction required. All individual shower mixing valves shall be ANSI/ASSE 1016 approved and be identified as a Type T (automatic water temperature regulations) or a Type P (automatic pressure balancing) regulator. All primary temperature actuated mixing valves shall be ANSI/ASSE 1017 approved.
1. Water Closets (Floor Mounted):
    - a. Construction: ASME A112.19.2, American Standard Model Cadet 2467.016, low-consumption 1.6 gallons per flush, vitreous china, elongated bowl, two bolt caps, pressure-assisted siphon jet flush action, bowl rim at 16-1/2 inches for accessible applications, with metal chrome trip lever.



- b. Seat: American Standard Model 5900.100, white, elongated heavy duty bowl open front seat less cover, constructed injection molded solid polypropylene with large molded-in bumpers, and external check hinge with 304 series stainless steel hinge posts seat 11 degrees beyond vertical.
2. Urinal (Wall Hung):
- a. Construction: ASME A112.19.2, American Standard Model Washbrook 6590.501, ADA compliant, low-consumption 0.5 gallons per flush, vitreous china, ultra-high efficiency, flushing rim, elongated 14-inch rim from finished wall, washout flush action, extended sides, 3/4-inch inlet spud, 2 inch threaded (NPTF) outlet connection, with strainer included. Urinal shall include 2 wall hangers, 3/4-inch I.P.S. angle stop with back-flow protection and vandal-resistant cap, sweat solder kit including cover tube and wall flange, high pressure vacuum breaker with down tube, and spud coupling and flange for 3/4-inch top spud.
  - b. Flush Valve: American Standard Model 6045.051, self-cleaning brass piston with integral wiper spring prevents clogging and reduces maintenance, non-hold open handle, positive seal, durable chrome-plated cast brass construction, chloramine-resistant EPDM seals, adjustable tailpiece, for 3/4-inch top spud, 0.5 gpf.
3. Lavatories (Wall Hung):
- a. Construction: ASME A112.19.2, American Standard Model Decorum 9134004EC, ADA compliant, 21 inches x 20-1/4 inches, white vitreous china, wall hung lavatory, drillings on 4-inch centers, rear overflow, recessed self-draining deck with minimal splash, with concealed arm or wall support.
  - b. Faucet: ANSI A117.1, American Standard Model Monterrey 7500.175, 4-inch centerset faucet, rigid/swivel gooseneck spout, vandal-resistant wrist blade handles, cast brass construction with shank nuts and brass coupling nuts. Water conserving vandal resistant 0.5 gpm, pressure compensating, multi-laminar spray.
  - c. Accessories: Chrome plated 17-gauge brass P-trap with cleanout plug and arm with escutcheon, offset waste with perforated open strainer, wheel handle stops, flexible supplies, with water supplies, trap, and waste insulated to meet ADA compliance.

## 2.11 WATER FILTRATION SYSTEM

- A. Manufacturer: Everpure, System EV926271 with Filter Cartridge H-104, or equal.
- B. Construction: Cartridge head assembly for installation of filter cartridge canister, built-in water shutoff capability, micro-pure filtering material coats the pleated surface inside the cartridge and reduces particles as small as 0.5 micron in size by mechanical means,

preventing lime and scale build up, with a commercial grade metal canister housing filter. System tested to NSF/ANSI Standard 42 & 53.

- C. Specifications:
1. Flow Rate: Controlled at 0.5 gpm.
  2. Temperature Range: Cold water use only 35-100 degrees F.
  3. Pressure Range: 10-125 psi no-shock.
  4. Capacity: 1000 gallons.
  5. Required Space: 5 inches width, 20 inches height, and 5 inches depth.

#### **2.12 ELECTRIC TANKLESS WATER HEATER**

- A. Manufacturer: Stiebel Eltron Model DHC-E 12 Plus, no substitutions.
- B. ANSI ANSI/UL Std. 499 certified. Electric tankless water heater for installing below and adjacent to sink and shall be equipped with a direct coil nichrome heating element housed in a pressure tested, glass-reinforced polyamide heating chamber. Unit housing constructed of high impact polycarbonate plastic. Unit shall include a flow sensor with a miniaturized turbine that feeds the water flow rate information into the main circuit board. Output temperature shall be adjustable via a knob located on the front cover. Unit shall include a safety high-limit switch with manual reset set at 185 degrees F. Advanced flow control automatically adjusts the flow of water to ensure a constant output temperature, even if demand exceeds capacity.
- C. Specifications:
1. Nominal Water Flow Rate: Controlled at 0.5 gpm.
  2. Minimum Water Flow for Unit Activation: 0.264 gpm.
  3. Capacity: 12.0 KW.
  4. Electrical Power (V/PH/HZ): 240/1/60.
  5. Output Temperature Range: Adjustable between 68-140 degrees F.
  6. Inlet/Outlet Water Connections: 1/2 inch.
  7. Maximum Permissible Pressure: 145 psi.

#### **2.13 EXTRA STOCK**

- A. Furnish enough valve washers and strainers to replace all the originals on the project one time and include one set of wrenches required to do the Work.

#### **2.14 PRESSURE AND SUCTION GAUGES**

- A. Pressure gauges shall be 4-1/2-inch in size with fiberglass reinforced polypropylene case, phosphor bronze bourdon tube, 6-inch or 4-1/2-inch dial faces with black lettering,

micrometer type pointers and an accuracy of plus 1% of scale range. Pressure gauge shall be H.O. Trerice No. 450 series, Ashcroft 2462 series, or equal.

- B. Gauges shall read in feet with graduations as listed below.
  - 1. Range: 0 – 300 feet
  - 2. Major Graduation: 50-feet
  - 3. Minor Graduation: 5-foot
- C. All pressure gauges unless otherwise directed shall include a brass pressure snubber and a needle type shut-off valve.
- D. For sanitary sewer applications, pressure gauges shall have diaphragm seals. The gauges, seals, and snubber shall be factory assembled and filled with fluid. The diaphragm seal shall be Type 316 stainless steel with a stainless-steel housing. Diaphragm seal shall be an Ashcroft 101 series, H.O. Trerice 877-2 series, or equal.

### **PART 3 EXECUTION**

#### **3.01 INSTALLATION**

- A. Cutting of all pipes shall be done with sharp tools. The ends of each pipe shall be reamed until all burrs or fins are removed. Full tapered threads shall be used throughout and threaded joints shall turn up perfectly tight without the use of filling substances. A standard pipe joint paste shall be used on the male threads only, and none shall be allowed to accumulate on the inside of the pipes. All connections between pipe, pipe hangers, and equipment shall be made with an approved dielectric insulating material.
- B. Pipe joints shall conform to respective industry standards.
- C. Expansion and contraction of the piping system shall be provided for using swing joints, right angle loops, or approved expansion joints.
- D. Interior and exterior pipelines shall be installed and graded in accordance with State and/or Local Plumbing Codes. Interior pipes shall run at right angles or parallel to building walls, placed as close as practicable to the ceiling and/or walls, and supported by hangers or brackets. All hangers and inserts or other approved method of pipe supports shall be provided. The inserts or anchor bolts shall be located according to Drawings and Specifications and installed in the concrete at the time it is placed.
- E. Drain valves shall be installed at all low points. Vent valves shall be installed at all high points.
- F. Pipe groups for plumbing shall be run parallel with pipes of other trades, and wherever practicable, all piping shall be supported on common group hangers unless pitch of pipe as hereinbefore mentioned is required.

- G. The piping shall be installed in a workmanlike manner and shall avoid interference with columns, beams, equipment, and other piping or fixed construction. A minimum of 7-feet of headroom shall be maintained at any point including stairs.
- H. Type C wall sleeves shall be provided for all pipes passing through exterior walls unless other sleeve types are noted on the Drawings. Type C sleeves shall also be provided in interior walls where indicated on the Drawings, Type D floor sleeves shall be used where piping passes through floor. Other sleeve types shall be used where shown on the Drawings.
- I. Provide a system of vents from each plumbing fixture and drain, extended to drain at the bottom, and through the roof, providing equalized pressure on every trap. As a minimum the system shall be as indicated on the Drawings, but in no case, shall the complete system be less than required by the State and local Plumbing Codes.
- J. Sanitary waste and vent piping indicated may, in some instances, exceed the code requirements. If Drawings indicate individual wastes for each fixture, then the Drawings and Specifications shall hold precedence over the code even though it exceeds the prescribed waste and vent code minimum.
- K. Each vent stack shall be carried through the roof whether in combination with its parallel soil stack or in multiple combination with other vent stacks. Each vent or stack shall be increased one pipe size before passing through roof, but in no case, shall a vent through the roof be less than 4-inch.
- L. All vents through the roof less than 18-inch from an outside wall shall be offset by means of 1/4 bends to permit proper flashing.
- M. Stacks enclosed in wall chases in finished rooms shall have extension pieces placed in tees set to bring the cleanout plugs just back of the finished wall line and finished at the wall line with chromium plated cleanouts, Zurn No. 1440-1, Josam, or approved equal.
- N. Buried pipe shall be firmly bedded the full length with the exception where bell holes are required. Unless shown otherwise on the Drawings, all pipelines shall be installed with a minimum cover of 5-feet. Where unstable soil conditions occur under buildings, support shall be made from the underside of the structural slab by an approved type hanging device embedded in the concrete.
- O. Unless shown otherwise on the Drawings, all buried pipe carrying liquids shall be installed with a minimum cover of 5-feet. Pressure piping which carries gases shall be installed with a minimum cover of 4-feet. When new piping crosses existing utilities and other obstructions which force a change in elevation, the Contractor shall install the new piping at a deeper elevation to avoid the obstructions unless otherwise instructed by the Engineer. Such changes in elevation shall be made either by installing fittings or by deflecting joints in accordance with the pipe manufacturer's recommendations. Such Work shall be performed at no additional cost to the Owner. To the extent possible, pressure and process piping shall be installed at a constant grade. All changes in grade shall be approved by the Engineer.

- P. Extend downspout laterals from each roof drain and riser to storm drainage system. Make direction changes with TY fittings or Y fittings and 1/8 bends as required. Install cleanouts at each direction change, and the base of each riser, and at 50-foot intervals in horizontal straight runs.
- Q. Horizontal piping shall be suspended to a grade of not less than 1/8-inch per-foot wherever possible, and as close to construction as practicable to ensure maintenance of schedule ceiling heights and avoid interferences. Direction changes, junctions, etc., shall be made with TY fittings or Y fittings and 1/8 bends as required. Provide cleanouts at all directions, changes, dead ends, and at 50-foot intervals on straight runs.
- R. Install cleanout fittings at the base of each vertical pipe used for sanitary drains, roof conductors, or vent stacks, and at each change of direction of the building drain greater than 45 degrees F.
- S. The ends of all horizontal drain lines shall be extended to cleanouts as specified above with top of plug set level with the finished floor.
- T. Underground traps, except "P" traps, into which floor drains with removable strainers discharge, shall be provided with accessible and removable cleanouts.
- U. Where PVC piping is laid in a trench, the bottom of the trench shall be well graded and compacted to insure even bearing for the full length of the pipe and the pipe shall be snaked at approximate 50-foot intervals to provide for expansion or contraction. Prior to testing the pipe, the pipe shall be center loaded with backfill between joints before testing to prevent the pipe from arching or whipping under pressure. During backfill the line shall be pressurized to 25 psi to minimize impact damage.
- V. All valves shall be installed with their stems horizontal or above. As far as possible, all valves of the same type shall be of the same manufacturer.
- W. The T-drill method of manufacturing tees in continuous copper tubing is not acceptable.

### 3.02 EQUIPMENT CONNECTIONS

- A. The plumbing contractor shall make all connections where required between the various piping systems and all pieces of equipment. This shall include adapters, traps, backwater valves, or other fittings required when not furnished with the equipment.
- B. Unions - Provide a union or flange in piping connections to each valve, device, or item of equipment, and elsewhere as required to makeup or disconnect piping. Each union shall be so installed as to permit the removal of parts and equipment for inspection and cleaning, and shall be installed in a position which will permit the valve device or part to be removed without disconnection of any piping except unions. Union and flange shall be installed in such a position as will be accessible for disconnection items which are to be screwed. All ground joint unions on copper lines shall be cast brass or bronze. Wrought copper unions are not to be used. All unions, where possible, shall be copper to MPT type.

**3.03 TESTING AND ACCEPTANCE**

- A. Each pressure pipe system shall be tested hydrostatically at 150% of its operating pressure, unless otherwise stated in the Code. Test pressures and durations will be set by the Engineer and each test will be approved only after he has witnessed satisfactory pressures at the end of each test run.
- B. The drains and vent lines shall be tested by filling the entire system with water to the highest point of overflow. After the pipes have stood full for 15 minutes, all joints and connections to fixtures shall be observed.
- C. After all leaks have been repaired and approved, the lines and plumbing fixtures shall be flushed clean with hot water and left in a sanitary condition. The outside surfaces of pipes and equipment shall be cleaned of grease and dirt by a cleaning compound, then washed with water and allowed to dry.
- D. The working temperature and pressure conditions shall be imposed on piping systems for a sufficient length of time to ensure that flanges and bolts or studs have reached a point of constant temperature and have attained such changes in dimensions as will take place, after which all flanged joints and fittings on all equipment shall be retightened by the Contractor.

**PART 4 SPECIAL PROVISIONS**

Not used.

END OF SECTION

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**SECTION 15500**  
**HEATING, VENTILATING, AND AIR CONDITIONING**

**PART 1 GENERAL**

**1.01 SCOPE**

- A. This Section includes furnishing all materials, equipment, labor, and supervision related to the heating, ventilating, air conditioning, and foul air conveyance systems and control necessary for the completion of the Work in accordance with the Contract Documents.
- B. Section included controls, control wiring, and control wiring conduit for HVAC equipment less than 115 volts. Power wiring, power electrical conduit, power distribution panels, and circuit breakers, for HVAC equipment 115 volts and greater is included in Division 16.
- C. Buildings to be served include the following:
  - 1. South Custer Booster Station Expansion.
- D. All Work performed under this Section shall comply and be in accordance with all approved trade practices and manufacturer's recommendations.
- E. This Section shall include but not limited to, all equipment, piping, ductwork, insulation, sleeves, plates, inserts, hangers, brackets, supports required for complete installation.
- F. All wall, roof, and floor penetrations for any building modifications which are required for the installation of the Work under this Section shall be provided by this Section. Sleeves for penetrations for new Work shall be provided by this Section and installed by others.
- G. Equipment with a suitable factory finish shall not be painted unless the finish is damaged, or the color does not match that of adjacent equipment. If the finish is damaged or the color does not match, the equipment shall be field painted under this Section in accordance with the requirements of Section 09900.
- H. Certain electrical starters, disconnects, and wiring will be provided and connected to the electric motors and equipment under Division 16. The Contractor shall refer to the Electrical Drawings and Specifications for Work included under Division 16. All control wiring shall be included in this Section and shall be installed as required in Division 16.
- I. Concrete curbs and bases required for equipment specified herein will be provided under this Section and installed by procedures in Sections 03200, 03300, 03310, and as detailed on the Drawings.
- J. Prefabricated roof curbs and prefabricated duct supports shall be furnished and installed under this Section. Flashing and roofing to be under Section 07800 and/or Section 07600.
- K. Hangers, anchors, and supports provided by this Section shall be in accordance with Section 15010.



- L. Additional equipment and installation requirements in Division 15 as included shall be provided by this Contract.
- M. Provide and install all equipment specified within this Section. The Contractor shall perform all electrical installation for all voltages less than 115 volts.
- N. All electrical work for all voltages, 115 volts and greater, shall be performed under Division 16, including but not limited to, motor operated dampers, motor operated valves, control panels, and line voltage thermostats provided by this Contractor.
- O. Certain equipment furnished under this Section shall be connected to the plant control system by others as shown on the P&ID Drawings. Those connections and any remote-control connections shall be clearly labeled terminal strips within the equipment control panel.
- P. Additional product requirements are specified in Section 01350.

#### **1.02 DESCRIPTION OF SYSTEMS**

- A. South Custer Booster Station Expansion:
  - 1. Pump Room: Ventilated by wall mounted intake louvers and roof mounted exhaust fan. Heat provided by wall mounted electric unit heaters controlled by wall mounted thermostats.
  - 2. Restroom: Exhaust ventilation by a ceiling type exhaust fan ducted to the exterior and interlocked with the room light switch. Heat provided by an electric wall heater with integral temperature controls.

#### **1.03 GENERAL SCOPE**

- A. Contractor to provide all labor, material, apparatus, expendable equipment, and all other services required for the construction of complete systems as outlined above, herein, and within the Drawings.
- B. Although a portion of the equipment described herein and, on the Drawings, may be installed by others, this Contractor shall be responsible for coordinating the Work performed by others so that the system or systems described herein are complete and perform as intended.
- C. The Drawings and Specifications are intended to describe the intent of the Work, and each are both complementary and independent in presenting the Work to be accomplished under this Contract.

#### **1.04 PERMITS AND INSPECTION**

- A. The Contractor shall obtain all necessary permits including the HVAC Permit, shall have all Work inspected by the proper authorities, and shall furnish such certificates of inspection and test as are required by local, State, and Federal regulations. Cost of such permits and inspections shall be included in this Section.

- B. Unless otherwise specified, Contractor shall notify Owner's representative of tests and inspections at least twenty-four hours in advance.

#### 1.05 SUBMITTALS

- A. Submittals shall be in accordance with the requirements of Section 01300 and shall include:
  - 1. Shop Drawings for Review:
    - a. The Contractor shall indicate all variances from the requirements of the Contract Documents.
    - b. Descriptive information of all mechanical and electrical items used in providing a complete job.
    - c. Drawings locating anchors, inserts, and supports.
    - d. Complete list of accessories and appurtenances included with each item, complete with manufacturer's name and model number.
    - e. General arrangement and dimension drawings.
    - f. Section assembly drawings.
    - g. Materials of construction.
    - h. Certified capacity data.
    - i. Manufacturer's schematic wiring diagrams and electrical load requirements.
    - j. Shop Drawings shall include data for all equipment, piping, and valves, controls, accessories, and electrical apparatus to be supplied with equipment.
    - k. For all louvers, provide manufacturer's data on louvers to include the following information: free area chart/table, static pressure loss, air leakage, and water penetration data. Provide and submit catalog information on louver motor operators. Provide and submit a louver color and finish chart.
  - 2. Information for the Record:
    - a. (List material, installation, or calibration certificates).
    - b. (List any other information for the record).
    - c. Operation and maintenance manual.

#### 1.06 DRAWINGS

- A. All Drawings are diagrammatic and are intended to show the approximate location of equipment and piping. Dimensions given on the Drawings shall take precedence over

scaled dimensions and all dimensions whether in figures or scaled, shall be verified in the field.

- B. The exact location of apparatus, fixtures, equipment, and piping shall be ascertained by the Contractor in the field, and the Work shall be laid out accordingly. Should the Contractor fail to ascertain such locations, the Work shall be changed at his own expense when so ordered by the Engineer. The Engineer reserves the right to make minor changes in the location of piping and equipment up to the time of installation without additional cost to Owner.

#### **1.07 ELECTRICAL EQUIPMENT REQUIREMENTS**

- A. All equipment shall be powered electrically and wired as required in Division 16.

#### **1.08 AUTOMATIC TEMPERATURE CONTROL**

- A. Automatic temperature control shall include electric temperature control for heating, ventilating, and air conditioning system. Controls shall include all necessary transformers, thermostats, motor operated dampers, switches, relays, motor operated valves, contactors, control and interlock wiring, conduit, junction boxes, and all required accessories.
- B. All control wires wherever located on the project shall have wire identification on both ends of each control wire.
- C. The Contractor shall perform all electrical work as required by the National Electric Code and Division 16 of this Contract.

#### **1.09 GENERAL REQUIREMENTS**

- A. Fans shall be AMCA certified.
- B. Drawings show general location of ducts, grilles, and registers. The Contractor shall check electrical, architectural, and piping drawings for possible interferences and shall coordinate installation with other contractors.
- C. Equipment shall be indicated in the Specifications and on the Drawings.

### **PART 2 PRODUCTS**

#### **2.01 LOUVERS**

- A. Combination Louvers:
  - 1. Manufacturers: Ruskin Model ELC6375DAX, Arrow, Airo-lite, or equal.
  - 2. Description: Unit consists of drainable stationary blade and an integral adjustable low leak backdraft damper.
  - 3. Construction: 6 inch frame depth, extruded 6063-T6 aluminum alloy frame and blades, 0.125 inch frame wall thickness, 0.081 inch thick front blade wall thickness, 0.070 inch thickness double wall adjustable rear blades not visible when open and drain to the exterior. Linkage concealed in frame with stainless

- steel or nylon bearings. Extruded vinyl blade edge seals and flexible, compressible aluminum jamb seals.
4. Rating: AMCA rated at zero water penetration with the specified airflows and for air leakage of less than 4.0 cfm per square foot of face area at a wind velocity of 30 mph (0.44 inch w.c. pressure) with damper blades closed.
  5. Actuator:
    - a. Two-position, spring return.
    - b. Operator opening time shall not exceed 60 seconds.
    - c. Provide additional or larger motors where required to meet louver torque requirements.
    - d. Electrical Requirements (V/PH/HZ): 120/1/60.
- B. Louver sizes indicated on Drawings are nominal wall opening sizes.
1. All wall louvers shall have removable 1/2-inch square mesh, 0.063-inch aluminum bird screen.
  2. All materials shall be factory finished after assembly with a Kynar 500 or Hylar fluoropolymer coating, minimum 1.2 mils dry film thickness conforming to AA-C12C4421x and AMAA 605.2 or other corrosion-resistant finish appropriate for installation conditions in a color to be selected from manufacturer's color chart.

## 2.02 ELECTRIC UNIT HEATERS

- A. Manufacturers: Chromalox, Type LUH; Q-Mark, Type MUH, or approved equal.
- B. General: Electric unit heater consisting of a heating element assembly, fan and motor assembly, and complete controls, housed in a steel cabinet and suspended above the floor from the wall with a swivel-mount hanger provided by the manufacturer.
  1. Motors: Totally enclosed motors with built-in thermal overload protection.
  2. Heating Control Contactor: Built-in and rated at 120 volts, single- phase, 60 Hz.
  3. Thermostat: Wall-mounted thermostat with metal enclosure, Chromalox Type WR-80, or approved equal. Minimum temperature range of 40 to 80 degrees F.

## 2.03 ELECTRIC WALL HEATERS

- A. Manufacturers: Q-Mark, Type CWH, or equal.
- B. General: Electric wall heater consisting of a heating element assembly, fan and motor assembly, and controls, all housed in a steel cabinet suitable for exposed mounting on a masonry wall.
- C. Wall Box: Provide a steel wall box manufactured by the heater company specifically for mounting in conditions indicated on drawing.
- D. Electrical Power (V/PH/HZ): 120/1/60. Provide with built-in power disconnect switch.

- E. Controls: Built-in thermostat as provided by the manufacturer.

#### 2.04 CONTROLS

- A. Exhaust Fan Thermostats:
  - 1. Exhaust Fan Thermostat:
    - a. Manufacturers: Honeywell T631C, Johnson A19JNC-2, or approved equal.
    - b. Metal enclosure with a minimum range of 70 to 90 degrees F. Line voltage type rated for 10 amperes at 115 VAC and pilot duty at 115 volts, single-phase.

#### 2.05 VIBRATION ISOLATORS

- A. Furnish and install vibration isolators for all mechanical equipment as scheduled below.
- B. Vibration isolation equipment shall be furnished to reduce transmission of vibration between rotating mechanical equipment and the building structure, an isolation efficiency of 90% or more to be provided in all cases. Isolators shall be protected from moisture, oil, or surrounding damaging materials by an approved method of sealing the material.
- C. Vibration isolation equipment shall be as manufactured by Peabody Noise Control Corporation, Korfund, Mason, Vibrating Eliminator Company, or approved equal. Isolators and supporting bases shall be supplied by a single manufacturer. The isolation equipment shall be selected considering equipment, weight, loading, rotating speeds, and size of equipment.
- D. Type 1 - Fiberglass isolators shall be pre-compressed molded glass fibers individually coated with a flexible, moisture impervious elastomeric membrane. Isolator to provide load bearing capacities from 1 to 500 PSI. Isolator pads shall be Peabody Type 1, fiberglass isolation media.
- E. Type 1F - Floor mounted neoprene mount with cast-in tapped steel load plate.
- F. Type 2H - Combination spring and fiberglass hangers incorporating 2-inch thick neoprene jacketed fiberglass inserts in series with springs. Units shall be Peabody Model SFH.
- G. Type 3 - Vertically restrained spring type isolators to be the limiting type to restrain movement caused by reduced weight or wind loads. Units shall have 1-inch thick Type "1" fiberglass noise stop pad bonded to bottom load plate. Units shall be Peabody FLS.
- H. Type 4 - No base required; isolators attached directly to machine.
- I. Type 6 - Reinforced concrete inertia base. Bases shall be large enough to support suction fitting or elbow and discharge elbow. Bases for pumps may be "T"-shaped. Concrete for inertia pad will be under another section of this Specification. Contractor

shall grout in all pumps, fans, etc., as required by the Equipment Manufacturers, with non-shrinking grout.

### **PART 3 EXECUTION**

#### **3.01 GENERAL INSTALLATION**

- A. Heating, ventilation, and air conditioning systems shall be installed complete as shown on the Drawings and as specified.
- B. Details of material and equipment installation shall conform to manufacturer's latest printed instructions, where not covered by the Drawings and Specifications.

#### **3.02 LOUVER INSTALLATION**

- A. Louvers shall be installed as recommended by the manufacturer.
- B. Check location of louvers and make necessary adjustments in position to conform with architectural features.
- C. At rough openings in walls for louvers, provide sheet metal escutcheon to close opening around open louver plenums.
- D. Install flexible connections between fan and ductwork.
- E. Provide sheaves required for final air balance.
- F. Install motorized backdraft dampers on interior face of louver.

#### **3.03 ELECTRIC UNIT AND WALL HEATER INSTALLATION**

- A. Install in accordance with manufacturer's instructions.
- B. Install unit and wall heaters as indicated.
- C. Protect units with protective covers during balance of construction.
- D. Install electric heating equipment including devices furnished by manufacturer but not factory mounted.
- E. Furnish copy of manufacturer's wiring diagram submittal.
- F. Verify that electrical wiring installation is in accordance with manufacturer's submittals and installation requirements of Division 16 Sections.

#### **3.04 CLEANING**

- A. Upon completion of installation, steam, condensate, hot water, and condenser water systems constructed of ferrous materials shall be thoroughly cleaned by circulating 10% caustic solution through systems for four hours after which systems shall be flushed out with clean water and repeated a second time.
- B. Systems shall be washed out, as prescribed, a third time after operation for three weeks and repeated as many more times as may be necessary to remove all oil, dirt, and grease from systems.

- C. Upon completion of installation of water-based systems constructed of copper and brass materials, the systems shall be thoroughly cleaned by circulating a non-corrosive chemical such as Mitco BL-5 furnished by Mitco Water Treatment of Grand Rapids, MI, 616-241-4684, or approved equal, partially drained, and recharged, circulated for six hours, flushed until clear as required by the Vendor.
- D. The system shall be refilled immediately with water and a corrosion inhibitor as prescribed by Mitco, or approved equal.

### **3.05 EQUIPMENT CONNECTIONS**

- A. The Contractor shall make all connections where required between the various piping systems and all pieces of equipment. This shall include adapters, traps, or other fittings required when not furnished with the equipment.
- B. Unions - Provide a union or flange in piping connections to each valve, device, or item of equipment, and elsewhere as required to makeup or disconnect piping. Each union shall be so installed as to permit the removal of parts and equipment for inspection and cleaning and shall be installed in a position which will permit the valve device or part to be removed without disconnection of any piping except unions. Union and flange shall be installed in such a position as will be accessible for disconnection items which are to be screwed. All ground joint unions on copper unions shall be cast brass or bronze. Wrought copper unions are not to be used. All unions, where possible, shall be copper to MPT type.

### **3.06 OPERATING INSTRUCTIONS**

- A. Instruct Owner's representative in proper operation and routine maintenance of equipment. Owner's representative shall be present during equipment start-up and testing.
- B. Mount under glass at locations in each building as directed by Engineer, temperature control and interlock wiring diagrams showing operating sequence.

### **3.07 ACCEPTANCE**

- A. The working temperature and pressure conditions shall be imposed on piping systems for a sufficient length of time to ensure that flanges and bolts or studs have reached a point of constant temperature and have attained such changes in dimensions as will take place, after which all flanged joints and fittings on all equipment shall be retightened by the Contractor.
- B. Where system operating temperature is above 200 degrees F, joints shall be retightened after 200 hours of service at operating conditions.

### **3.08 OPENINGS AND SLEEVES**

- A. All penetrations through an exterior surface above grade level shall be sealed and made watertight as shown on the Drawings. For metal panels, use a sealant around the penetration on both sides of the wall.

- B. All penetrations through the fire resistance rated walls or floors shall be fire stopped as required by the NEC using the approved method as recommended by the manufacturer. Fire stops (e.g., caulk) shall have a 3-hour fire resistance rating and shall be made by the 3M Company, or approved equal.

### **3.09 CONCRETE**

- A. The Contractor shall furnish and install all concrete and reinforcing steel necessary to complete the electrical work, including foundations and all materials for concrete and reinforcing steel work wherever required. All concrete and concrete reinforcement used in the Work shall conform in quality of ingredients, mixture, strength, method of installation and workmanship to the requirements specified in Section 03300 of specifications.
- B. Concrete Slabs for Electrical Equipment - Slabs shall be provided as shown. Unless otherwise indicated, slabs shall be of 12-inch thick, 3,000 psi concrete, project 3-inch above the highest-grade point, have No. 5 reinforcing bars 12-inch on center both ways top and bottom, and set on 12-inch of No. 67 selected stone fill on top of compacted soil.
- C. Where shown on the Drawings, the Contractor shall provide a purchased concrete pad.

### **3.10 MOUNTING AND ATTACHMENT**

- A. The Contractor shall provide all devices and materials such as expansion bolts, foundation bolts, screws, channels, angles, and other attaching means required to fasten all equipment and materials to be installed on or in concrete bases or structures which are existing or provided under other sections of the Contract. Foundation bolts shall be set by using manufacturer's templates.

## **PART 4 SPECIAL PROVISIONS**

### **4.01 NUTS AND BOLTS**

- A. All nuts and bolts used under this Section shall be (Type 304 stainless steel or higher grade) as specified or shown on the Drawings.

END OF SECTION



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**SECTION 15502**  
**TESTING, ADJUSTING, AND BALANCING OF HVAC SYSTEMS**

**PART 1 GENERAL**

**1.01 SCOPE**

- A. This Section includes furnishing all materials, equipment, labor, and supervision to test, adjust, and balance all heating, ventilating, air conditioning, and foul air conveyance systems necessary for the completion of the Work in accordance with the Contract Documents.
- B. All Work performed under this Section shall comply and be in accordance with all approved trade practices and manufacturer's recommendations.

**1.02 ADJUSTMENTS AND BALANCING**

- A. General:
  - 1. The Contractor shall engage the services of an independent test and balance agency, hereinafter called the Balancing Subcontractor, that specializes in and whose business is limited to the testing and balancing of heating, ventilating, and air conditioning systems. The agency selected shall be a fully certified member of the Associated Air Balance Council (AABC), or an independent firm whose principals are registered Professional Engineers.
  - 2. Testing and balancing of all air conditioning and refrigeration systems shall be performed in complete accordance with the AABC "Standards and Instrumentations Form No. 81226, Volume I" as published by the AABC, including all current revisions thereto and/or ANSI/ASHRAE 110.
- B. Workmanship:
  - 1. All Work shall be done by technicians skilled in the particular field involved under the direct supervision of a Registered Professional Engineer and with the best modern practices and equipment.
  - 2. All instruments used for measurement shall be accurate and calibration for each instrument shall be available for examination. The Engineer may request instrument recalibration, or the use of other instruments, where accuracy of readings is questionable.
  - 3. The Balancing Subcontractor shall consult all drawings, construction details, job site, and confer and cooperate with others to avoid interference.
  - 4. The Balancing Subcontractor shall check all control interlocks and cooperate with the control Subcontractor in adjusting and calibration of control equipment.
  - 5. Any ceiling tile that is damaged by the Balancing Subcontractor shall be replaced with new tile identical to that damaged.

### **1.03 RESPONSIBILITY FOR PROPER BALANCING AND TESTING**

- A. The final testing, adjusting, and balancing and the test and balance data shall be witnessed by the Engineer's Project Representative if required by the Owner.

### **PART 2 PRODUCTS**

Not used.

### **PART 3 EXECUTION**

#### **3.01 EVALUATION OF SYSTEM**

- A. The Balancing Subcontractor shall furnish all materials and equipment necessary to properly measure the air capacity of the system, the electrical voltage and current, fan speeds, static pressures, air velocity, water pressure drops, refrigeration pressures, and all other readings normally necessary to evaluate the performance of a system, adjust the quantities to those called for, and test the system.

#### **3.02 COMPONENT IDENTIFICATION**

- A. The Contractor is responsible for the identification of the equipment.

#### **3.03 TESTING ACCESSES**

- A. The Contractor shall provide and/or arrange for all labor and material such as valves, tap holes, and plugs in the location required to perform the Work.

#### **3.04 INITIAL BALANCING - AIR SYSTEMS**

- A. As soon as electrical power is available, the Balancing Subcontractor shall check all equipment for electrical problems, check rotation of motors, read voltage and current in each leg of each motor, heater, etc., and check the readings against the nameplate.
- B. The Balancing Subcontractor shall operate all fan powered units (with filters in place) and adjust the units for maximum air supply by reading motor power supply. Supply outlets shall be adjusted to the required air quantity. If the air quantity at this point does not meet design requirements, the Contractor shall notify the Engineer.
- C. The return air system shall then be adjusted to design capacity with the proper outside air.
- D. Each exhaust system shall be checked and balanced to the design air quantity.
- E. After supply and return air are in balance and the quantity correct, the outside air dampers shall be adjusted to the air quantity shown on the Drawings. If economizer control is specified, check for proper setting of the controls and for proper operation of the dampers (outside air and relief).

#### **3.05 READINGS REQUIRED TO BE REPORTED**

- A. The following readings shall be made and reported to the Engineer after the building is balanced and all equipment is operating properly. Measurement shall be made with a cone with a calibrated outlet and velometer equal to Alnor.

- B. All readings shall be recorded for each supply and return opening, including exhaust hoods and openings. All readings made shall be recorded, and if any readings are invalid, they shall be identified as such. Any invalid readings shall be explained by a note on the print.
- C. Actual air quantity readings shall include:
  - 1. Each supply register outlet.
  - 2. Each return or exhaust grille inlet.
  - 3. Duct system losses based on the supply and the sum of the discharges. The equivalent losses are to be calculated for return duct in each system.
- D. Temperature readings required as above are:
  - 1. Outside air at equipment.
  - 2. Return air at unit.
  - 3. Supply air leaving unit.
  - 4. Mixture of outside and return air before entering the cooling or heating coil or heater. Readings 1, 2, and 4 allow the determination of the outside air/return air ratio.
- E. Electrical readings required are:
  - 1. Measured voltage and amps on each phase of each major motor (compressor), evaporator fan, condenser fan(s), roof exhaust fans, etc.) while the equipment is under maximum normal load.
  - 2. The nameplate voltage and current for each of the above motors.
- F. Refrigeration readings required are:
  - 1. Suction and discharge pressure of each compressor or, in the case of packaged condensing units, the suction and liquid line pressure.

### 3.06 CONTROL SEQUENCE

- A. All control sequencing electrical interlocking shall be tested and verified. This Work shall be accomplished with a representative of the heating, ventilating, and air conditioning Contractor and temperature control Contractor present and assisting.

### 3.07 INSTALLATION TOLERANCES

- A. Air Handling Systems:
  - 1. Adjust system to within  $\pm 5$  percent of design for supply systems.
  - 2. Adjust system to within  $\pm 10$  percent of design for return and exhaust systems.
- B. Air Outlets and Inlets:
  - 1. Adjust total to space within + 10 percent and -5 percent of design to space.

2. Adjust individual outlets and inlets in space to within  $\pm 10$  percent of design.

### **3.08 ADJUSTING**

- A. Ensure recorded data represents actual measured or observed conditions.
- B. Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.
- C. After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.
- D. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.

## **PART 4 SPECIAL PROVISIONS**

### **4.01 BALANCE REQUIREMENTS**

- A. Balance all air systems to the amounts shown in the HVAC equipment schedules, HVAC plans, and airflow schematics.

### **4.02 MISCELLANEOUS TESTS**

- A. The Balancing Subcontractor shall perform building pressure tests with outside temperature and wind velocity noted at points of typical location inside building on both lee and windward side of building. Tests to be made with all supply and exhaust systems in normal operation and with supply systems at minimum outside air at approximately nominal wind velocity outside.

END OF SECTION

**SECTION 15503  
FANS**

**PART 1 GENERAL**

**1.01 SCOPE**

- A. This Section includes furnishing and installing fans as shown on the Drawings, as scheduled in Part 4, and as specified herein.
- B. The fans shall be furnished with all drives, belts, guards, support brackets, curbs, anchor bolts, vibration isolators, dampers, motor and temperature controls, and all other equipment as required on the Drawings and schedules in Part 4 of this Section.
- C. All Work performed under this Section shall comply with and be in accordance with all approved trade practices and manufacturer's recommendations.
- D. The fans required shall serve the systems as described in Section 15500.
- E. Additional product requirements are specified in Section 01350.

**1.02 SUBMITTALS**

- A. Submittals shall be in accordance with the requirements of Section 01300 and shall include:
  - 1. Shop Drawings for Review:
    - a. The Contractor shall indicate all variances from the requirements of the Contract Documents.
    - b. Shop Drawings.
    - c. Shop drawings shall include certified fan curves with specified operating point clearly plotted, sound power levels for both fan inlet and outlet at rated capacity, and electrical characteristics and connection requirements.
    - d. Manufacturer's literature including accessories.
  - 2. Information for the Record:
    - a. Certification that units are licensed to carry the AMCA "A" Seal.
  - 3. Operation and maintenance manual.

**1.03 MOTOR AND EQUIPMENT REQUIREMENTS - WIRING, CONDUIT, AND STARTER**

- A. All wiring, including factory prewired units, shall conform to NEC Standards.
- B. Motors, controls, and disconnects shall be furnished as required in Part 4 of this Section.
- C. All fans and motors required for explosion hazard areas shall be shipped prewired from the factory or shall be able to be connected in the field as required by the National Electrical Code for the NEMA class specified.

## PART 2 PRODUCTS

### 2.01 GENERAL REQUIREMENTS

- A. Fan motor starters and wiring to fan motor and damper operators, including interlocks shall be installed as required under the Division 16.
- B. Prefabricated curbs are to match fan requirements and are as specified in Section 15505.
- C. Vibration isolators shall be provided for all supports.
- D. Provide duct companion flanges for round duct connections to the unit. Provide back-draft dampers of the gravity type for units discharging to the outside or against any pressure from other sources.
- E. Controls shall be installed as specified in Section 15500.
- F. Units in exposed locations shall be provided with weather protection.
- G. Motors required for explosion hazard areas shall meet Class 1, Division 1, Group D classification as required per the NEC.
- H. All fans required for explosion hazard areas shall meet AMCA 99-0401-66, Type A construction.

### 2.02 FANS GENERAL

- A. Fans shall be as indicated in the HVAC equipment schedules on the drawings as manufactured by Loren Cook, Greenheck, Penn, or equal.

### 2.03 CEILING MOUNTED EXHAUST FAN

- A. Manufacturer - Loren Cook Model GC, Greenheck, Penn, or approved equal.
- B. Fan Unit - Direct-driven, ceiling mounted, forward curved fan, centrifugal type. Injection molded from a specifically engineered resin exceeding UL requirements for smoke and heat generation, and motor isolation mounted to a one piece galvanized stamped steel integral motor mount/inlet.
- C. Fan Wheel - Wheel shall be centrifugal forward curved type, injection molded of polypropylene resin. Wheel shall be balanced in accordance with AMCA Standard 204-05, Balance Quality and Vibration Levels for Fans.
- D. Electrical Characteristics and Components:
  - 1. Motor - Follow NEMA MG1. Heavy-duty type with permanently lubricated sealed bearings. Provide built-in overload protection for single-phase fractional horsepower motors.
  - 2. Wiring Terminations - Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box sized to NFPA 70.

3. Disconnect Switch - Provide integral mounted and pre-wired NEMA 1 lockable disconnect switch.
- E. Accessories:
1. Grille - White, high impact styrene injection molded grille.
  2. Backdraft Damper - Integral, gravity-actuated, aluminum frame and multiple-blade construction, felt edged with nylon bearings.
  3. Wall Cap with Damper - Minimum 0.020 aluminum construction with closed cell foam tape and stainless-steel spring on damper door, stainless steel pivot rod, and wind guard for door updraft protection.
  4. Fan Speed Controller - Integrated circuitry, solid state, variable speed, pre-wired, integrally mounted, fan speed controller, for use in balancing proper airflow.
  5. Vibration Isolators - Rubber in shear type for ceiling mounting.

#### **2.04 CENTRIFUGAL ROOF EXHAUST FANS**

- A. Manufacturers - Loren Cook Model ACRU, or equal.
- B. Fan Unit - V-belt or direct-driven with spun aluminum housing of bolted and welded construction; wall mounted, horizontal centrifugal exhaust ventilator; resilient-mounted motor; 1/2-inch mesh, 16 gage aluminum bird screen. Spun aluminum structural components constructed of minimum 16-gauge marine alloy aluminum bolted to a rigid aluminum support structure. Spun aluminum wall flange shall have pre-punched key slot holes and mounting template with wall opening location for ease of installation. Wind band shall have rolled bead for added strength. Two-piece top cap shall have stainless steel quick release latches to provide access into the motor compartment to facilitate wiring connections.
- C. Fan Wheel - Centrifugal backward inclined, constructed of 100 percent aluminum, including a precision machined cast aluminum hub.
- D. Electrical Characteristics and Components:
1. Motor - Follow NEMA MG1. Provide built-in overload protection for single-phase fractional horsepower motors.
  2. Wiring Terminations - Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box sized to NFPA 70.
  3. Disconnect Switch - Provide integral mounted and pre-wired NEMA 3R disconnect switches.
- E. Bearings - Heavy-duty, regreasable, ball-type construction, cast iron pillow block housing selected for minimum L50 life in excess of 200,000 hours at maximum cataloged operating speed.



- F. Roof Fan Accessories:
  - 1. Backdraft Damper: Gravity-actuated, aluminum frame and multiple-blade construction, felt edged with nylon bearings.
  - 2. Roof Curb - 12-inch high, self-flashing of aluminum construction with continuously welded seams, 1-inch-thick insulation and curb bottom, and factory-installed nailer strip.
- G. Sheaves - For V-belt drives, provide cast iron or steel, dynamically balanced, bored to fit shafts and keyed; variable and adjustable pitch motor sheaves selected so required rpm is obtained with sheaves set at mid-position; fan shaft with self-aligning, pre-lubricated ball bearings.
- H. Finish - Electrostatically applied, baked epoxy powder coating. Provide UV resistant topcoat to prevent coating deterioration for outdoor applications. Coating must be resistant to hydrogen sulfide.

### **PART 3 EXECUTION**

#### **3.01 INSTALLATION**

- A. Unit shall be installed as recommended by the manufacturer using the proper supports and isolators for quiet operation.
- B. Proper rotation of the fan shall be verified.
- C. Belts or speed control shall be adjusted to provide the design system air quantity at the system static pressure.
- D. The current draw shall be measured and compared to the nameplate current shown.
- E. The installation is not complete until the system has been balanced to provide the correct air quantity and has been tested to demonstrate the correct system performance. See Balancing and Testing, Section 15502.

### **PART 4 SPECIAL PROVISIONS**

Not used.

END OF SECTION

**SECTION 15504  
MECHANICAL SYSTEMS INSULATION**

**PART 1 GENERAL**

**1.01 SCOPE**

- A. This Section includes furnishing all materials, equipment, labor, and supervision to install insulation work including insulation, cements, mastics, adhesives, attachment pins, studs or clips, covering, lagging, jackets, hardware, flashing and finishes.
- B. Work shall be complete, in full conformance with the material manufacturer's requirements and recommendations, applicable national standards, the National Insulation Contractors Association, National Commercial, and the Industrial Insulation Standards.
- C. All insulation as applied shall meet or exceed the requirements of this Section or ASHRAE/IES 90.1, whichever is greater.
- D. Additional product requirements are specified in Section 01350.

**1.02 SUBMITTALS**

- A. Submittals shall be in accordance with the requirements of Section 01300 and shall include:
  - 1. Shop Drawings for Review:
    - a. The Contractor shall indicate all variances from the requirements of the Contract Documents.
    - b. A complete description of each insulation system.
    - c. Plate submittals for tanks and vessels as identified by NICA, Current Edition.
    - d. Vendor information and catalog data detailing each component of the system including the method of fastening.
    - e. Design information for fiberglass duct systems including size and spacing of reinforcement system proposed.
  - 2. Information for the Record:
    - a. Substantiation of vendor compliance with codes, standards, or test methods noted herein.

**PART 2 PRODUCTS**

**2.01 GENERAL**

- A. Materials furnished under this specification shall be standard, catalogued products, new and commercially available, suitable for service requiring high performance and reliability with low maintenance, and free of all defects.

- B. Materials include insulation materials, accessories (staples, bands, mesh, wire, clips, pins, tape, anchors, corner angles, and similar recommended accessories) and compounds (cements, adhesives, coatings, sealers, protective finishes, and similar items recommended for the applications indicated).
- C. The Contractor, unless clearly otherwise stated, shall supply materials which meet the owner's requirements with respect to the design criteria, thermal conductivity, and standards.
- D. The Contractor shall warrant those materials furnished and installed be free of defects for a period of one year from the time the system is completed.
- E. If a defect occurs in materials, workmanship, or application within the stated time, the Contractor shall promptly repair or replace the defect. Damages caused by others shall be repaired at the expense of the damaging party.
- F. Specified components of the insulation system, including facings, mastics, and adhesives should have a fire hazard rating not to exceed 25 for flame spread, and 50 smoke developed, as tested under ASTM E84.
- G. All accessories and materials (i.e., coatings, adhesives, sealers, etc.) are to be shipped to the job site in marked, unopened containers as received from the manufacturer.
- H. Provide and install insulation, cements, mastics, adhesives, covering, lagging, flashing, and finishes in full conformance with the material manufacturer's requirements and the recommendations, applicable national standards, the National Insulation Contractors Association, and the Industrial Insulations Standards.

## 2.02 PIPING SYSTEMS

- A. Solid foamed closed cell (Insulation Class CG) shall be constructed of closed cell glass bubbles conforming to ASTM C552, Pittsburgh Corning Foamglass, or equal. Conductivity shall be 0.33 Btu-inch per hour-square feet-degrees F.
- B. Flexible foamed plastic closed cell (Insulating Class FP) shall conform to ASTM C534, Armstrong Armaflex II, Manville Rubatex, or equal. Conductivity shall be 0.28 Btu-inch per hour-square feet-degrees F. Outside installation finish shall be two coats of Armaflex Finish or Rubatex 374. Insulation shall not be constructed of polystyrene, polyisocyanurate, or polyethylene/polyolefin materials.
- C. Calcium Silicate (Insulation Class HT) shall conform to ASTM C533, Manville, Owens Corning, Pittsburgh Corning, CertainTeed Manson, or equal. Conductivity shall be 0.45 Btu-inch per hour-square feet-degrees F at 500 degrees F.
- D. Fiberglass (Insulating Class MT) shall conform to ASTM C489, Owens Corning 25, CertainTeed or Manson, or equal. Insulation cement shall conform to ASTM C193. Insulation and adhesives or cements, and finishes shall have composite smoke and fire ratings as tested under ASTM E84, NFPA 255, and UL 723 not exceeding a flame spread of 25 and Smoke Developed rating of 50. Conductivity shall be 0.30 Btu-inch per hour-square feet-degrees F at 200 degrees F. The required jacket shall be ASJ, SSL, or FRJ as specified.

- E. Fiberglass (Insulating Class LT) shall conform to CertainTeed Manson Alley-K Snap-On Fiber Glass Pipe insulation with factory applied all service jacket and self-sealing lap. The insulation shall be one-piece with a k value of 0.23 Btu-inch per hour-square feet-degrees F at 75 degrees F.
- F. Duct insulation (Insulation Class DW3) shall conform to ASTM -1136 and ASTM C612, 3 pounds per cubic foot density, CertainTeed Manson, Malvern, PA.; IB 300, Great Lakes Textiles, Walton Hills, OH; Rigid Wrap, or equal. Interior installations shall be faced with FSK. Conductivity shall be 0.23 Btu-inch per hour-square feet-degrees F at 75 degrees F.
- G. Insulation thickness shall be as specified in Part 4.
- H. Aluminum lagging shall be 0.016-inch thick with banding straps on minimum 18-inch centers and at each joint.
- I. Plastic lagging or jacketing shall be Manville Zeston 2000 PVC, CertainTeed Manson, or equal.

### **2.03 HEATING, VENTILATION AND AIR CONDITIONING INSULATION**

- A. Unless noted on the Drawings, all ducts shall be covered with insulation.
- B. Duct insulation (Insulation Class DW) shall be 1.5 pound per square foot, 3-inch thick fiberglass with reinforced foil vapor barrier facing, Owens Corning All Service Faced Duct Wrap, or equal. Thermal conductivity shall be 0.3 or less as measured by ASTM C518.
- C. Duct insulation (Insulation Class OA) shall be AP Armaflex or AP Armaflex SA and shall conform to ASTM C534, Type II--Sheet. The material shall have a water vapor transmission of 0.10 perm-inches or less. The exterior surface shall be finished with two coats of Armaflex WB or SB Armaflex finish. Thermal conductivity shall be a maximum of 0.27 Btu-inch per hour. Insulation shall not be constructed of polystyrene, polyisocyanurate, or polyethylene/polyolefin materials.
- D. Duct insulation liner (Insulation Class ID) shall be Knauf Duct Liner EM or equal. Thermal conductivity shall be a maximum of 0.25 Btu-inch per square feet hour-degrees F.
- E. Fiberglass duct systems (Insulation Class FG) shall be 1-inch thick rigid fiberglass board with aluminum foil facing, Owens Corning Duct System 475 or Knauf Air Duct System shall be reinforced to extent required by the maximum external static pressure of the system fan. Duct shall meet or exceed requirements of SMACNA Manual 15d, Fibrous Glass Duct Standards. Product shall be UL listed.
- F. Duct insulation (Insulation Class DB) shall be CertainTeed Manson, Malvern, PA., type IB200, or equal and shall conform to ASTM C518 and ASTM C177. Material shall be 2 pounds per cubic foot destiny and shall have a maximum conductivity of 0.35 Btu-inch per square feet-hour-degrees F.

### **2.04 TANK AND EQUIPMENT INSULATION**

- A. Insulation shall be 100% closed-cell insulation, Pittsburgh Corning Foamglass, or equal. Insulation shall be completely non-absorptive, non-combustible, and shall have a

compressive strength of 100 psi, a density of 8.5 pcf, and a thermal conductivity of 0.33 Btu-inch per hour, square feet degrees F at a mean temperature of 50 degrees F.

- B. Support ring for top head insulation shall be aluminum.
- C. Intermediate insulation support ring if required shall be flashed over with aluminum. This ring or rings installation shall be approved by the vessel manufacturer and submitted to the Engineer for review.
- D. Jacketing shall be aluminum or plastic sheeting that is impervious to moisture and sunlight. Submittals shall include the method of attachment.
- E. "S" clips shall be structurally sound with the jacket submitted. Centers and sizes shall be submitted by the Contractor.
- F. Head and shell joints shall be flashed and caulked.
- G. Nozzles shall be insulated, flashed, and caulked.

### **PART 3 EXECUTION**

#### **3.01 GENERAL**

- A. All insulation work shall be performed by skilled mechanics regularly engaged in the insulation trade.
- B. The Contractor shall be responsible for coordination and cooperation with the Owner and other trades so that the installation is performed with minimum interference and conflict.
- C. The final appearance of the insulation work shall be a neat, workmanlike and attractive insulation system.
- D. Progressive testing of systems to be insulated shall have been completed, inspected, and approved by Owner's representative before insulation is applied.
- E. Insulation shall not be applied until all surfaces are clean, dry, free of dirt, dust, grease, frost, moisture, and other imperfections.
- F. Suitable application temperature and conditions shall be provided by others.
- G. Insulation shall be protected from moisture and weather during storage and installation. Applied insulation which has become wet shall be thoroughly dried before it is sealed or jacketed.
- H. The Contractor shall not arc-weld brackets, clips, or other devices to ASME coded pressure vessels or piping. Insulation pins or studs shall be as specified and installed in accordance with acceptable standards.
- I. Insulation, fabric, and jacketing shall be protected from mechanical damage during construction. Damage by the insulator shall be repaired without cost to the Owner.
- J. Contractor is responsible for proper material storage at the Work site.

- K. Work performed prior to receipt of approved documents or submittals, which later proves to be incorrect or inappropriate, shall be promptly replaced by the Contractor without cost to the purchaser.
- L. Insulation shall not be installed until adequate access and clearances at control mechanisms, dampers, sleeves, columns, and walls have been provided.
- M. All insulation at handholes, access doors, or other openings, and adjacent to flanges and valves shall be neatly finished where exposed to view.
- N. Where insulated pipes or ducts pass through sleeves or openings, the full specified thickness of the insulation shall pass through the sleeve or opening.
- O. Vapor barriers shall be continuous through sleeves, hangers, etc. If pierced, vapor barriers shall be covered and suitably resealed.

### 3.02 INSTALLATION

- A. Pipe insulation shall include all fittings, valves, (including bonnets) piping specialties, pumps, tanks, and heat exchangers.
- B. Prior to insulating, all required inspections, examinations, and tests (such as hydrostatic tests, air pressure tests, and heat tracing tests) shall be successfully completed.
- C. All insulation shall be well secured to the item being insulated, by means of wire, clips, studs, or other proven fasteners.
- D. All fittings, flanges and valves shall be insulated with block, preformed or sectional insulation of the same material as adjacent pipe material, except on sizes up to 3-inch, two or more layers cemented in place may be used to obtain the required thickness of insulation.
- E. The insulation and its covering shall be applied free of gaps or voids. All joints, cracks and depressions shall be pointed with cement. When irregular or compound shapes require insulation be cut and fit, all gaps shall be filled. Cut and fit jacketing shall be free of jagged edges and shall provide complete coverage.
- F. Insulation of any pipe line or any other item shall include insulation of all take-off connections (including those for instruments, controls, vents, drains or sampling) and all branch connections, up to and including the first valve in the take-off connection or branch connection.
- G. Double layer insulation shall have staggered joints. Each layer shall be wired in place.
- H. Insulation on vertical pipes shall have provisions which preclude eventual gaps in the insulation as a result of pipe expansion, settling, or shrinking of the insulation, or other causes. The provision may be intermediate supports, insulation "expansion joints" or other means approved by the Engineer.
- I. All welding (including stud welding and other attachment on boiler, pressure vessels, piping systems and equipment) shall conform to applicable codes and standards.

- J. At each pipe hanger or support, the insulation shall accommodate the hanger or supports and its anticipated movement.
- K. Insulation work on all items (including boilers, pumps, vessels, etc.) shall conform to the requirements and recommendations of the respective manufacturers.
- L. Insulation work of all of the following items shall be blankets which are designed to allow removal, reuse and replacement of the insulation work:
  - 1. Flanges, 6-inch NPS or larger.
  - 2. Manholes, handholes, and other access devices.
- M. Insulation on heat traced pipe lines shall be such that the specified nominal thickness of insulation is uniformly maintained around the pipe.
- N. The Contractor shall identify and insulate all Personnel Protection Areas and insulate as necessary in accordance with the following:
  - 1. All points where personnel can easily come in contact with hot surfaces.
  - 2. Areas are to include all hot surfaces within an elevation of 7-feet and with 2-feet of the sides of all access zones, walkways, platforms, working areas, or stairways and ladders.
- O. Insulation Class DW shall be installed as noted in National Commercial & Industrial Insulation Standards - 1988, as published by Midwest Insulation Contractors Association. The method shown on plate 19 shall be used for interior ducts, and that shown on plate 20 shall be used for exterior ducts. Staple - stitching shall not be used.
- P. Roof drain systems shall be insulated when located within any building.
- Q. Ducts carrying 100% outside air from a conditioning unit within 20 feet of the building served are not required to be insulated.
- R. All external lines insulated above ground shall be enclosed with Class CG insulation and aluminum lagging. All external insulated lines belowground shall be enclosed with Class CG insulation and coated with Pittcote 300 and Pitwrap SSII.
- S. The insulation and its covering shall be applied free of gaps or voids. All joints, cracks, ends, and depressions shall be pointed with cement or mastic as recommended.

### **3.03 OWNER'S ACCEPTANCE**

- A. All materials, accessories, and methods of installation and fabrication are subject to the Owner's inspection and approval during any phase of the Work.

## **PART 4 SPECIAL PROVISIONS**

### **4.01 PIPE INSULATION SCHEDULE**

- A. The pipe insulation system requirements schedule is as follows:

PIPE INSULATION SYSTEM REQUIREMENTS SCHEDULE						
Pipe Line	Size	Pipe Class*	Ins. Thickness	Lagging*	Finish	Comments
Domestic and Nonpotable Water, Hot or Cold	to 2"	FP	1"	Plastic	Color by Owner	
Domestic and Nonpotable Water, Hot or Cold	2-1/2" and above	FP	1-1/2"	Plastic	Color by Owner	
Roof Drains	All"	FP	1"	Plastic	Color by Owner	

Note: \* Special conditions, in certain areas, may require a variance for insulation type, thickness, and lagging. Contractor to verify specific requirements on Drawings.

**4.02 PAINTING**

- A. All pipe, equipment, and tank insulation shall be painted as required by Section 09900.

END OF SECTION



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**SECTION 15506  
DUCTWORK**

**PART 1 GENERAL**

**1.01 SCOPE**

- A. This Section includes furnishing and installing all materials, equipment, labor, and supervision related to the heating, ventilation, air conditioning, and foul air ductwork systems necessary for the completion of the Work in accordance with the Contract Drawings.
- B. All Work performed under this Section shall comply and be in accordance with all approved trade practices and manufacturer's recommendations.
- C. Additional product requirements are specified in Section 01350.

**1.02 DESCRIPTION OF SYSTEMS**

- A. Systems shall be as shown on the Drawings.

**1.03 DESIGN OF SYSTEM**

- A. The Contractor shall design the duct to meet the required operating pressure by means of duct material thickness, spacing of joints, and reinforcing and joint construction.

**1.04 SUBMITTALS**

- A. Submittals shall be in accordance with the requirements of Section 01300 and shall include:
  - 1. Shop Drawings for Review:
    - a. The Contractor shall indicate all variances from the requirements of the Contract Documents.
    - b. Descriptive literature, bulletins, or other data describing each item of equipment.
    - c. Complete list of accessories and appurtenances included with each item complete with manufacturer's name and model number.
    - d. General arrangement and dimension drawings.
    - e. Sectional Assembly Drawings.
    - f. Materials of construction.
    - g. Submit sample of duct material, made up into an elbow with turning vanes.
    - h. Certified leak test as required by SMACNA HVAC Duct Leakage Test Manual.

2. Information for the Record:
  - a. Certified design capacity data for each section of duct.
3. Operation and maintenance manual.

## **PART 2 PRODUCTS**

### **2.01 SHEET METAL - RECTANGULAR**

- A. Ductwork, unless otherwise noted, shall be galvanized sheet metal and shall be built as required by HVAC Duct Construction Standards, Metal and Flexible, latest edition as published by SMACNA and diagrammatically shown on the Drawings.
- B. Ductwork 18-inch width and over shall be cross-broken, or ribbed and stiffened, so that it will not "breathe," rattle, vibrate, or sag.
- C. Curved elbows shall have a throat radius equal to the duct width. Provide splitter or turning vane(s) in all elbows.
- D. Square elbows shall have double-thickness turning vanes, unless single-thickness vanes are clearly identified on the Drawings.
- E. Transitions in ductwork shall be made with a slope not exceeding 1 to 5, preferably 1 to 7.
- F. Supply duct splits shall be provided with splitter damper and adjustable locking quadrant. Splitter blade shall be 1.5 times the smaller split width.
- G. Supply duct takeoffs shall include an adjustable air-turning device equal to Carnes No. 1250 Variturn Model 2, 3, or 4, or approved equal.

### **2.02 SHEET METAL - ROUND**

- A. Round sheet metal duct shall be constructed as required in HVAC Duct Construction Standards as published by SMACNA and referred to above. Low pressure duct may be shop fabricated, using good practice. Medium and high-pressure duct shall be manufactured product by a firm regularly engaged in such work and with a catalog listing construction, weight, Specifications, and pressure losses. Flat oval shall be same as medium pressure duct above.
- B. Round duct insulated internally shall be a product of a manufacturer engaged in such production and shall have an internal perforated liner equal to United Acoustic K-27.
- C. Flat oval duct insulated internally shall be same as B. above. Flat oval duct may be used in place of round or rectangular duct, provided the insulation thickness specified, and diffuser neck shall be rectangular to match duct.

### **2.03 GALVANIZED STEEL DUCTWORK**

- A. Duct Material - ASTM A525 and ASTM A527 galvanized steel sheet, lock-forming quality, having G60 zinc coating in conformance with ASTM A90.

#### 2.04 AUXILIARY EQUIPMENT

- A. Duct reinforcing and hangers shall be of the same material as the duct system.
- B. At air handling units, provide flexible collars on all duct connections. Flexible materials to be "Ventglas" 30-ounce material, "Durolon" 26-ounce material, or approved equal, and be rated for pressure service required.
- C. Duct Splitter Dampers - Young Regulator Co., Barber Coleman, Carnes, Hart and Cooley, or approved equal.
- D. Spiral Duct - Young Regulator Co., United Sheet Metal Division, or approved equal.
- E. Turning Devices - Carnes, Barber Coleman, Hart and Cooley, or approved equal.
- F. Turning Devices and splitter damper hardware for fibrous glass duct - Duro Dyne, or approved equal.
- G. Mastics and Sealers - Foster Products, HB Fuller Co., Vadnais Heights, MN, United McGill, or approved equal.
- H. Fasteners: Rivets, bolts, or sheet metal screws.

#### 2.05 FLEXIBLE DUCT CONNECTIONS

- A. Manufacturers - Ductmate Industries, Inc., Proflex, Duro Dyne, Metal Fab, or approved equal.
- B. Fabricate in accordance with SMACNA HVAC Duct Construction Standards – Metal and Flexible, and as indicated.
- C. Connector - Fabric crimped into metal edging strip.
  - 1. Fabric: UL listed, fire-retardant, neoprene-coated, woven glass fiber fabric to NFPA 90A, minimum density 30 ounces per square yard.
  - 2. Net Fabric Width: Approximately 3 inches wide.
  - 3. Metal: 3 inches wide, 24 gage galvanized steel, 0.032-inch-thick aluminum, 24 gage Type 316 stainless steel.

#### 2.06 DUCTWORK FABRICATON

- A. Fabricate and support in accordance with SMACNA HVAC Duct Construction Standards – Metal and Flexible, and as indicated. Provide duct material, gages, reinforcing, and sealing for operating pressures indicated.
- B. Use 45-degree entries for taps or tees. Construct tees, bends, and radius elbows with radius of not less than 1-1/2 times width of duct on centerline. Where not possible and where rectangular elbows are used, provide single thickness turning vanes. Where acoustical lining is indicated, provide turning vanes of perforated metal with glass fiber insulation.

- C. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible; maximum 30 degrees divergence upstream of equipment and 45 degrees convergence downstream.
- D. Fabricate continuously welded round and oval duct fittings two gages heavier than the duct gages as indicated in SMACNA Standard. Joints shall be minimum 4 inches cemented slip joint, brazed or electric-welded. Prime coat welded joints.
- E. Provide standard 45-degree lateral wye take-offs unless otherwise indicated where 90-degree conical tee connections may be used.
- F. Duct Inlet/Outlet Screens: Provide duct inlets or outlets with wire screen, constructed of the same material as the ductwork it is serving, 0.063-inch diameter (16 gauge), 1/4 inch by 1/4-inch mesh (2 mesh).

## 2.07 MANUFACTURED DUCTWORK AND FITTINGS

- A. Manufacture in accordance with SMACNA HVAC Duct Construction Standards – Metal and Flexible, and as indicated. Provide duct material, gages, reinforcing, and sealing for operating pressures indicated.

## PART 3 EXECUTION

### 3.01 INSTALLATION OF DUCT SYSTEMS

- A. Manufacture, install, seal, and insulate all ductwork as shown on the Drawings and as required by SMACNA manuals.
- B. Install ducts to preserve for fire resistance rating of partitions and other elements.
- C. Duct sizes are inside clear dimensions. For lined ducts, maintain sizes inside lining.
- D. Low pressure ductwork and fittings shall be made tight for minimum air leakage. Large or noisy leaks will not be accepted. Duct tape shall not be used to seal joints, to make transitions, or for any other reason except on the outside of wrapped insulation. Duct tape shall not be used on sheet metal.
- E. All ductwork shall have all joints, seams, and laps sealed to Class “C” duct sealing requirements with mastic equal to Hardcast DT-5300 to ensure a completely airtight duct system.
- F. All duct systems shall be at least 95% efficient in volumetric transfer. The Contractor shall demonstrate efficiency by testing.
- G. Hangers for ductwork shall be in accordance with the SMACNA Standards, Plate Nos. 18 and 19, hanger for ducts and upper attachments. Hanger strap material and angles shall be galvanized. With bar joist and roof construction, use welded studs or C-clamp with retaining clip attached to the bar joist. In all cases, the maximum hanger spacing shall not be exceeded and the hangers shall be readily removable as required by SMACNA.
- H. Ducts may be hung from the building construction by strap hangers fastened to the duct in not less than two places and rigidly braced against swaying. Do not fasten any hanger

to metal roof decking. Strap material shall be aluminum, stainless steel, or galvanized to be compatible with the service requirements.

- I. Where ducts pass through walls or floors, sheet metal closures shall be provided to close openings around ducts except where noted by specific detail. All passages shall be airtight to restrict air, moisture, and dust migration.
- J. All ductwork exposed to weather shall have all joints, laps, edges, etc., sealed and coated with duct sealer equal to Hardcast DT-5300 and applied with FTO-20 adhesive or approved equivalent.
- K. All ductwork exposed to weather and not insulated shall have all joints, laps, edges, etc., sealed and coated with duct sealer equal to Hardcast DT-5300 and applied with FTO-20 adhesive or approved equivalent.
- L. At rough-cut openings for fans, louvers, and where exposed ducts pass through walls, floors, or ceilings, provide sheet metal escutcheons to close openings around ducts and wall openings.
- M. During construction provide temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering ductwork system.

### **3.02 INSPECTION**

- A. Subject completed duct system to pressure and leakage test as required in Section 15500 of the Specifications.

## **PART 4 SPECIAL PROVISION**

### **4.01 DESIGN PRESSURE**

- A. Design pressure required is 2-inch WC for all ducts.

### **4.02 DUCTWORK MATERIAL SCHEDULE**

- A. Restroom - Galvanized steel.

END OF SECTION

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**SECTION 16010  
GENERAL ELECTRICAL PROVISIONS**

**PART 1 GENERAL**

**1.01 SCOPE**

- A. This Section includes general administrative and procedural requirements in accordance with the Drawings and as specified herein.
- B. The Contractor shall furnish and install all wire, conduit, disconnects, and related items, for HVAC equipment 120 volts or greater under Division 16. Controls, control wiring, and control conduit for HVAC equipment less than 120 volts shall be furnished and installed under Division 15.
- C. The responsibility for the following equipment items and Work shall be as listed below:
  - 1. Motors, unless indicated otherwise, shall be furnished and installed under other sections, but shall be wired as indicated on the Drawings under Division 16.
  - 2. Controls for motors on mechanical equipment unless indicated otherwise, will be furnished under other sections, but shall be installed and wired under Division 16.
  - 3. Unless otherwise indicated, all electrical and control equipment not furnished under Division 16 shall be installed and wired under Division 16.
  - 4. Electrical and control equipment furnished under Division 16 but which is to be installed under other sections, shall be wired under Division 16 as indicated on the Drawings and Specifications.

**1.02 SUBMITTALS**

- A. Specific submittals will be identified in individual sections of Division 16.

**1.03 QUALITY ASSURANCE**

- A. Work shall comply with the latest edition of NEC as prepared by NFPA, NESC.
- B. Contractor shall comply with applicable local electrical code requirements, where provisions of local codes are modified or supplemented with NEC, the more stringent interpretation shall prevail.
- C. Equipment and materials shall be new and, if of the same type as other performing parts of the same system, shall be the products of the same manufacturer.
- D. The manufacturer of this equipment shall have produced similar electrical equipment for a minimum of five years.
- E. Equipment, materials and installation shall comply with applicable requirements of NEMA, IEEE, and ANSI.
- F. All electrical equipment shall be listed and labeled by UL.



- G. Electrical enclosure requirements shall conform with area classifications, whether designated on the Drawings or not.
- H. Contractor shall provide Owner with all certificates of final inspection from the agency of proper authority prior to receiving final payment.

**1.04 ELECTRICAL CONTROL AND COORDINATION**

- A. Installation of electrical equipment shall be scheduled, sequenced, and positioned to efficiently coordinate the best flow of Work for electrical systems and all other non-electrical construction activities.

**1.05 PRODUCT HANDLING**

- A. Equipment shall be handled and stored in accordance with manufacturer's instructions. A copy of these instructions shall be included with the equipment at the time of shipping.
- B. Equipment damaged in shipment or storage shall not be installed and shall be replaced by the Contractor.

**1.06 GUARANTEE**

- A. Provide complete warranty information for each item. Include the following information:
  - 1. Date of beginning warranty period.
  - 2. Duration of warranty.
  - 3. Warranty options.
  - 4. Name, address, phone numbers, and procedures for filing warranty claims.
- B. The Contractor shall warrant the completed system wiring and equipment to be free from inherent mechanical and electrical defects for a period of one year from the date of substantial completion.

**PART 2 PRODUCTS**

**2.01 NEMA RATINGS**

- A. Equipment and panels shall be NEMA 4X stainless steel unless designated otherwise on the Drawings, or in the electrical or equipment specifications.

**PART 3 EXECUTION**

**3.01 COORDINATION**

- A. Coordinate electrical system, equipment, and materials installations with other building components and building trades.
- B. If the current requirement of any motor or piece of equipment is increased to such an extent that the wiring, conduit, or starter for that motor or equipment must be increased from that shown on the Electrical Drawings, the Contractor shall furnish and

install the larger items under the section the equipment is specified. The increased wiring, conduit, and starter cost shall be included in the motor or equipment cost under the section the equipment is specified and no additional compensation will be allowed.

- C. Certain equipment furnished under the equipment sections shall be connected to the plant control system as shown on the P&ID drawings. Mechanical and electrical components for these connections shall be furnished, under the equipment sections, as required to provide control functions compatible with the plant control system. These connections and any remote-control connections shall be furnished and wired to clearly labeled terminal strips within the equipment control panel.
- D. If the electrical control requirements change from that specified or shown on the Electrical or P&ID drawings due to the requirements of the actual equipment furnished, the Contractor shall perform all necessary modifications under the equipment section and no additional compensation will be allowed. The final installation shall meet the operational intent of that specified and shown on the drawings.

### 3.02 INSTALLATION

- A. Verify dimensions by field measurements.
- B. Coordinate building and wall penetrations with other construction activities.
- C. Coordinate structural support devices and sleeves to be set in cast-in-place concrete and with other structural components as they are constructed.
- D. Coordinate connection of electrical systems with existing overhead and underground systems or utility services. Comply with government regulations, utility company requirements and local codes.
- E. Install electrical equipment to facilitate servicing, maintenance, ease of disconnection, and minimal interference with other installations.
- F. Electrical penetrations, shown on the Drawings or not, through an exterior surface shall be sealed and made water-tight. For metal panels, use a sealant around the penetration on both sides of the wall.
- G. Electrical penetrations, shown on the Drawings or not, through the fire resistance rated walls or floors shall be fire stopped as required by NEC using the approved method as recommended by the manufacturer. Fire stops (e.g., caulk) shall have a 3-hour fire resistance rating, and shall be made by the 3M Company, or equal.
- H. Electrical penetrations, shown on the Drawings or not, to hazardous areas shall be gas-tight and fire-stopped using "Link-Seal" FD or FS seals as manufactured by Thunderline Corporation, or equal.
- I. Multiwire (shared neutral) branch circuits operating at 120 VAC are not acceptable.

### 3.03 CUTTING AND PATCHING

- A. Perform cutting and patching of electrical equipment and materials required to:

1. Uncover Work for the installation of ill-timed Work.
2. Remove or replace defective or damaged Work.
3. Remove or replace Work not conforming to the contract or requiring specified testing.

#### **3.04 DEMOLITION AND CLEANING**

- A. Electrical equipment, conduit, wire and appurtenances that are removed shall remain the property of the Owner and shall be stored at a site selected by the Owner. The Owner reserves the right to require the Contractor to dispose of certain unwanted portions of removed equipment and materials. The Owner shall have the right to reject any or all materials removed during construction, and the Contractor shall haul away and dispose of these materials in a suitable manner at no additional cost to the Owner.
- B. Abandoned conduit and wiring, unless specified or marked as "spare", shall be removed. Before any removal, consult with the Owner if materials are to be disposed of or reused. In situations where a portion of the conduit run back to its source remains in service, the abandoned conduit shall be removed back to the point where the conduit will remain in services. Resulting conduit stubs shall be plugged.
- C. When all Work is completed, tested, and accepted by the Engineer/Owner, the Contractor shall clean all light fixtures, equipment, and exposed surfaces affected by the Work.
- D. Contractor shall at all times keep the Work area in an orderly and clean condition by periodic removal of excess and unused materials.

#### **PART 4 SPECIAL PROVISIONS**

Not used.

END OF SECTION

**SECTION 16020  
GROUNDING AND BONDING**

**PART 1 GENERAL**

**1.01 SCOPE**

- A. This Section includes solid grounding of electrical systems and equipment. It includes basic requirements for grounding for protection of life, equipment, circuits, and systems.

**1.02 SUBMITTALS**

- A. Submittals shall be in accordance with the requirements of Section 01300 and shall include:
1. Shop Drawings for Review:
    - a. Wiring schematics with wire termination points identified.
      - 1) Manufacturer's technical product sheets on each component to be furnished.
    - b. Field testing certificates, signed by the Contractor, certifying that the field tests comply with the requirements specified in Quality Assurance - Part 1.03.
    - c. Furnish manufacturer's name(s) and catalog numbers.
    - d. Manufacturer's recommended method of installation for the products to be furnished.
  2. Information for the Record:
    - a. Manufacturer's qualifications, including a list of similar installations.

**1.03 ELECTRICAL AND CONTROL COORDINATION**

- A. Layout and installation of grounding system and accessories shall be coordinated with other installations.

**1.04 PRODUCT HANDLING**

- A. Deliver ground wire properly packaged in factory fabricated type containers, or wound on NEMA specified type wire reels.
- B. Store grounding materials and ground wire in a clean, dry space in original containers. Protect products from weather, damaging fumes, construction debris, and traffic.
- C. Handle grounding wire carefully to avoid abrading, puncturing and tearing wire insulation. Ensure that dielectric resistance of the cable is maintained.

## PART 2 PRODUCTS

### 2.01 MATERIALS

- A. Grounding materials shall be corrosion-resistant and chemically compatible with the materials with which they come in contact.
  - 1. Conduit shall be as specified in Section 16130.
  - 2. Conductors for equipment grounding shall be stranded THHN/THWN or XHHW-2, color-coded green. Equipment grounding conductor size shall not be less than that provided in the latest edition of the NEC, or as shown on Drawings, whichever is larger.
- B. Use of conduit system for the ground conductor shall not be permitted.
- C. Ground rods shall be copper clad and not less than 3/4 inch in diameter and 10 feet long.
- D. Connections:
  - 1. In readily accessible locations, compression, or bolted connectors of Burndy Engineering Company or equal shall be used.
  - 2. In locations not readily accessible after installation, splices and connections of grounding cable shall be made by exothermic welding process equal to Cadweld.
- E. Where an underground ground ring encircling a building or structure is used, it shall be bare, stranded, copper conductor not smaller than No. 4/0 AWG, unless specified or shown otherwise.
- F. Ground Enhancement Material (GEM) shall be permanent, maintenance-free, and maintain its earth resistance with time. GEM in its set form shall have a resistance of not more than 20 ohm-centimeters. GEM shall be as manufactured by Erico Electrical Products, or equal.

## PART 3 EXECUTION

### 3.01 COORDINATION

- A. Metallic water service pipe, metal frame of a building, concrete encased electrodes, and ground rings surrounding a structure shall be bonded together to form an effective grounding system.

### 3.02 INSTALLATION

- A. System neutrals; secondaries of control power, instrument, metering, and relaying transformers; noncurrent-carrying metallic equipment enclosures; exposed metal structures; and supports shall be effectively bonded to ground grids and busses provided under this Contract.
- B. Noncurrent-carrying metallic parts, electrical equipment and systems including, but not limited to, transformers, motors, lighting, equipment, raceways, control panels,

consoles, panelboards, and cable shields, as well as metallic structures, shall be effectively grounded.

- C. Low-voltage electrical equipment, except as otherwise specified, shall be grounded by means of a separate conductor which shall be included in any multi-conductor cable.
- D. Electrical continuity of equipment grounding circuits such as metallic raceways shall be assured by bonding where necessary; equipment grounding conductors passing through metallic raceways shall be bonded to the raceways where they enter and leave.
- E. Particular care shall be taken to ensure good equipment ground continuity between the conduit system and equipment frames and enclosures. Where necessary, jumper wires shall be installed.
- F. Conduits stubbed-up below a floor mounted electrical apparatus shall be fitted with insulated grounding bushings and connected to the electrical apparatus ground bus or structure. Boxes mounted below floor mounted electrical apparatus shall be bonded to the apparatus ground bus.
- G. Insulated grounding bushings shall be used on the grounding of all conduits, 480 volts and higher, with copper grounding conductors.
- H. Conduits and raceways, regardless of type and material, shall include a separate insulated equipment ground conductor, whether shown on the Drawings or not, sized no less than required by the latest edition of the NEC or by the Drawings, whichever is larger, and connected to the grounding grid. Each circuit grounding conductor shall be dedicated for that circuit.
- I. Connections:
  - 1. Exposed connections shall be made by means of approved grounding clamps. In readily accessible locations, compression or bolted connectors shall be used. Exposed connections between different metals shall be sealed with a synthetic base substance in which zinc particles are suspended such as Burndy Penetrox A-13, Thomas & Betts, (Blackburn) Contax, or equal.
  - 2. All buried connections shall be made by an exothermic welding process, "Cadweld", or equal. The tops of all ground rods shall be at least 12 inches below grade.
  - 3. Terminate insulated equipment grounding conductors for feeders and branch circuits with pressure type grounding lugs. Where metallic raceways terminate at metallic housings without mechanical and electrical connection to the housing, terminate each conduit with a grounding bushing. Connect grounding bushings with a bare grounding conductor to the ground bus in the housing. Bond electrically noncontinuous conduits at both entrances and exits with grounding bushings and bare grounding conductors.

4. Connections at Test Wells: Use compression type connectors on conductors and make bolted and clamped type connections between conductors and ground rods.
  5. Compression Type Connections: Use hydraulic compression tools to provide the correct circumferential pressure for compression connectors. Use tools and dies recommended by the manufacturer of the connectors. Provide embossing die code or other standard method to make a visible indication that a connector has been adequately compressed on the ground conductor.
  6. Insulated grounding conductors connected to ground rods or ground buses shall be insulated over the entire area of the connection and sealed against moisture penetration of the insulation and cable.
  7. Ground rings shall be in direct contact with earth, buried at a depth of no less than 30 inches, and 20 feet long minimum, unless noted otherwise.
- J. Underground Distribution System Grounding:
1. Manholes, Handholes, and Underground Pullboxes: Install a driven ground rod close to the wall and set the rod depth such that 4 inches will extend above the finished floor. Where necessary, install ground rod before the manhole is placed and provide a No. 1 AWG bare tinned copper conductor from the ground rod into the manhole through a waterproof sleeve in the manhole wall. Protect ground rods passing through concrete floor with a double wrapping of pressure sensitive tape or heat shrunk insulating sleeve from 2 inches above to 6 inches below the concrete. Seal floor opening with waterproof, nonshrink grout.
  2. Connections at Manholes, Handholes, and Underground Pullboxes: Connect exposed metal parts, such as inserts, cable racks, pulling irons, ladders, and cable shields within each manhole or handhole to the ground rod or ground conductor. Connect circuit ground wire to ground rod. Make connections with minimum No. 4 AWG stranded hard drawn copper wire. Train conductors plumb or level around corners and fasten to manhole or handhole walls. Connect to cable armor and cable shields by means of tinned terminals soldered to the armor or shield, or as recommended by manufacturer of splicing and termination kits.
  3. Grounding System: Ground noncurrent carrying metallic items associated with manholes, substations, and pad mounted equipment by connecting them to bare underground cable and grounding electrodes arranged as indicated.
  4. Manholes, handholes and underground pullboxes shall have their metal parts bonded to the equipment grounding conductor of circuit(s) passing through them in accordance with NEC Article 250.
- K. Isolated Signal Ground:
1. Where shown on the Drawings, provide a minimum No. 2 AWG stranded, tinned, insulated ground conductor from each control panel or remote I/O panel

to a designated system ground point. Ground conductor shall be routed in 3/4-inch Schedule 80 PVC conduit from panel location to system ground connection point. Terminate ground conductor at an insulated, isolated ground bus and at system ground point. Connection at ground rods shall be via exothermic welds.

- L. The metal parts of the following nonelectrical equipment shall be grounded: frames and tracks of electrically driven cranes; frames of nonelectrically driven elevator cars to which electric conductors are attached; hand operated metal shifting ropes or cables of electric elevators, and metal partitions, grill work, and similar metal enclosures around equipment of over 750 volts between conductors.
- M. All non-current-carrying metal parts of portable equipment and fixed equipment including their associated fences, housings, enclosures, and supporting structures shall be grounded.

### 3.03 GROUNDING APPLICATIONS

- A. Underground grounding conductors shall be bare, tinned, stranded copper except as otherwise indicated.
- B. For telephone, alarm, and communication systems, provide a No. 4 AWG minimum green insulated copper conductor in raceway from the grounding electrode system to each terminal cabinet or central equipment location. All grounds in the telephone system shall be bonded together.
- C. Separately derived systems required by the NEC to be grounded shall be grounded in accordance with the latest edition of the NEC.
- D. Ground metal poles supporting outdoor lighting fixtures to a grounding electrode as indicated in addition to a separate equipment grounding conductor run with supply branch circuit.
- E. For all other equipment grounding conductor applications, comply with NEC for sizes and quantities of equipment grounding conductors, except where larger sizes or more conductors are indicated. Use of conduit system for ground conductor shall not be allowed.
- F. Bond the telecommunications grounding electrode to the power grounding electrode using No. 6 AWG copper wire minimum.

### 3.04 TESTING

- A. Comply with Section 16050.
- B. Testing shall be by independent electrical testing organization to perform tests described below and in Section 16050.
- C. Perform a megger test on the completed grounding system at each location where a maximum ground resistance level is specified, at service disconnect enclosure ground terminals, and at ground test wells.



1. 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.
2. Perform tests by the two-point method in accordance with IEEE 81, "Guide for Measuring Earth Resistivity, Ground Impedance and Earth Surface Potentials of a Grounding System." Simple moisture addition is not acceptable.

**PART 4 SPECIAL PROVISIONS**

Not used.

END OF SECTION

**SECTION 16030  
ELECTRICAL IDENTIFICATION**

**PART 1 GENERAL**

**1.01 SCOPE**

- A. This Section includes the provision of identification of electrical equipment and materials in accordance with the Drawings and as specified herein.

**1.02 SUBMITTALS**

- A. Submittals shall be in accordance with the requirements of Section 01300 and shall include:
  - 1. Shop Drawings for Review:
    - a. Product data for each type of identification product specified.
    - b. Manufacturer's name(s) and catalog numbers.
    - c. Nameplate schedule.

**1.03 QUALITY ASSURANCE**

- A. Applicable Standards:
  - 1. Comply with requirements of ANSI Standard, "Scheme for the Identification of Piping Systems" and "Wiring and Equipment Identification" with regard to type and size of lettering for raceway and cable labels.

**PART 2 PRODUCTS**

**2.01 NAMEPLATES AND LEGENDS**

- A. New equipment shall be identified by means of a laminated phenolic nameplate. Modified equipment shall be identified in the same manner as was the original equipment. Equipment whose designation has been changed shall be relabeled as specified or directed.
- B. Nameplates shall have white background with black engraved lettering identifying function or equipment designation.
- C. Main nameplate on MCC, switchgear, control panel, and other panels shall be 2-inches high by 6-inches wide with 1-inch high letters. Individual nameplates shall be 1-inch high by 3-inches wide with 1/4-inch high letters.
- D. Legends shall be completely worded without abbreviations except as approved by the Engineer.
- E. Blank nameplates shall be included on all unused components.

- F. Nameplates on electrical panels which are fed from a remote source shall include, in addition to their function, where the power originates from (e.g., scum pump panel - fed from MCC-1, MCC-1 fed from main SWG).

**2.02 CONDUCTOR IDENTIFICATION**

- A. Wires and cables, except at lighting and 120 volts convenience outlets, shall be identified by means of tags describing circuit.
- B. Tags shall be on all connections, splices, and terminations, and shall also be applied where entering and leaving common wireways.
- C. Wire tags shall be equal to Thomas & Betts white, self-adhesive wrap or Panduit heat shrink type labels. Tags shall be vinyl, polyester or Polyolefin, resistant to excessive heat, water, cold, dirt, and grease.
- D. The tag type-on-area shall be sufficiently sized to contain five numerals on each line. Wire numbers shall be typed on with Thomas & Betts E-Z Coder Printer, Panduit Dura-Mark Printer or equal.
- E. Insulated conductors No. 8 AWG and larger shall be color coded at each end with a 2-inch wrap of suitable color tape as follows, if integral color is not utilized:

System	Phase Conductors A, B, and C	Neutral Conductors
120 volts, single-phase, 2-wire	Black	White
120/240 volts, single-phase, 3-wire	Black and Red	White
208 volts, 3-phase, 3-wire	Black, Red, Blue	--
208Y/120 volts, 3-phase, 4-wire	Black, Red, Blue	White
480 volts, 3-phase, 3-wire	Brown, Orange, Yellow	--
480Y/277 volts, 3-phase, 4-wire	Brown, Orange, Yellow	White
2400 volts, 3-phase, 3-wire	Black, Red, Blue**	--
2400 volts, 3-phase, 4-wire	Black, Red, blue **	White**
4160 volts, 3-phase, 3-wire	Black, Red, Blue**	--
4160 volts, 3-phase, 4-wire	Black, Red, Blue**	White**
4800 volts, 3-phase, 3-wire	Black, Red, Blue**	--
4800 volts, 3-phase, 4-wire	Black, Red, Blue**	White**
Grounding	Green	

\*\* Apply tape near termination on cable.

Tape shall be Scotch #35 in color required above as manufactured by 3M, or equal.

- F. Direct current conductors shall be identified by the following methods:
  1. Provide self-sticking markers on each direct current conductor.
  2. Marker colors shall be black letters on "alert orange" background.
  3. Each marker shall designate circuit conductor polarity and voltage (e.g., 28 VDC).
  4. Direct current control conductors shall be color-coded dark blue.

- G. On a 4-wire delta-connected system where the midpoint of one phase winding is grounded to supply lighting and similar loads, the conductor or busbar having the higher phase voltage to ground shall be durably and permanently marked by an outer finish that is orange in color or by other effective means. Such identification shall be placed at each point on the system where a connection is made if the grounded conductor is also present.

### **PART 3 EXECUTION**

#### **3.01 COORDINATION**

- A. Submit nameplate schedule for review and approval by the Engineer prior to fabrication of nameplates.

#### **3.02 INSTALLATION**

- A. The Contractor shall furnish and install equipment nameplates, typed panel rosters, wire and cable tags, stenciling, and other identification with text, lettering type, etc., as specified in this Section.
- B. Nameplates shall be fastened by means of 3/16-inch diameter roundhead, stainless steel, self-tapping screws. UL 508 4X enclosure nameplates shall be secured with silicon adhesive.
- C. Pull, terminal, and junction boxes shall be identified by stenciling the names of the feeders and system wires and cables passing through them.
- D. MCCs and power panels of NEMA 3R double-door construction shall have stenciled panel designation at the top and branch designations appropriately spaced in the outer doors. NEMA 4X lighting and power panels shall have designations appropriately placed on them.

### **PART 4 SPECIAL PROVISIONS**

Not used.

END OF SECTION

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**SECTION 16060  
HANGERS AND SUPPORTS**

**PART 1 GENERAL**

**1.01 SCOPE**

- A. Contractor shall furnish all labor, tools, equipment, and materials necessary to provide supporting devices in accordance with the Drawings and as specified herein.

**1.02 SUBMITTALS**

- A. Submittals shall be in accordance with the requirements of Section 01300 and shall include.
  - 1. Shop Drawings for Review:
    - a. Manufacturer's technical product sheets on each component to be furnished.
    - b. Submit a list of materials needed for construction, giving manufacturers' names and catalog numbers.
  - 2. Information for the Record:
    - a. Manufacturer's qualifications.
    - b. Certified copies of factory test procedures and results.
    - c. Manufacturer's recommended method of installation for the products to be furnished.

**1.03 QUALITY ASSURANCE**

- A. Applicable Standards:
  - 1. Manufacturer's Standardization Society (MSS):
    - a. Comply with applicable MSS standard requirements pertaining to fabrication and installation practices for pipe hangers and supports.
  - 2. National Electrical Code (NEC):
    - a. Comply with related sections of NEC requirements for equipment, conduit, and raceways.

**PART 2 PRODUCTS**

**2.01 MATERIALS**

- A. Mounting brackets, bolts, nuts, and washers for items of electrical equipment shall be provided with either an approved zinc plating process, be galvanized, be nonferrous, or be of a non-corrosive metal.

- B. Carbon steel hangers, supports, fastenings, and other devices shall have an approved plating process. Manufactured channel sections shall be P-1000 Unistrut with hot dip galvanizing after fabrication, or equal.
- C. "Shot-in-place" anchors and fastenings shall not be used. Perforated metal strap or wire is not acceptable for hangers or supports.
- D. Unless shown or specified otherwise, fasteners and anchors shall be as follows:

Base Metal	Fastener Metal and Coating
Stainless Steel	Stainless Steel
Aluminum	Stainless Steel
Galvanized Steel	Galvanized or zinc plated carbon steel
Field painted or uncoated carbon steel	Unfinished or zinc plated carbon steel

- E. Where a connection involves dissimilar base metals, fastener shall be as required for most corrosion resistant base metal in connection, or dielectric material shall be installed.
- F. Anchor bolts and fasteners in submerged applications shall be stainless steel.
- G. Non-metallic strut shall be made of pultruded fiberglass with an isophthalic polyester fire-retardant (FR-P) resin.
  - 1. The composite material shall have an ultraviolet light inhibiting chemical additive and meet ASTM E84 for flame spread. It shall have a complete Nexus Veil Coverage (outer surfacing fabric) to provide maximum chemical and UV protection.
  - 2. Non-metallic strut shall be as manufactured by Enduro Composite Systems, or equal.
- H. Hanger rod (all-thread) shall be 3/8-inch minimum diameter round steel rod.

### PART 3 EXECUTION

#### 3.01 COORDINATION

- A. Sequence and coordinate location of hangers and supports to facilitate equipment installation and future access for maintenance.

#### 3.02 INSTALLATION

- A. The Contractor shall provide all devices and materials such as expansion bolts, foundation bolts, screws, channels, angles, and other attaching means required to fasten lighting stands, panelboards, transformers, conduits, and other electrical equipment and materials to be installed on, or in, concrete bases or structures which are existing, or provided under other sections of the Contract. Foundation bolts shall be set by using manufacturer's templates.

- B. Surface mounted equipment shall be installed in such a manner as to permit free circulation of air on all sides. A minimum space of 1/4 inch shall be maintained between the back of equipment and the mounting surface.
- C. Wherever wall, columns, or like structural members are not available for mounting motor starters, push-button stations, and like equipment, hot dip galvanized structural steel sections shall be provided for such mounting, or as shown on the Drawings, shop prime coated, and epoxy finished per Section 09900.
- D. Where galvanized or cadmium plated surfaces or materials are cut, drilled, reamed, or damaged during the course of installation, the exposed metal shall be brush-on coated with 95%- zinc-enriched paint.
- E. Cut ends of non-metallic strut, such as manufactured by Enduro or equal, shall be brush-on coated with the manufacturer's recommended coating to prevent fibers from fraying.

#### **PART 4 SPECIAL PROVISIONS**

##### **4.01 SUPPORT MATERIAL SCHEDULE**

- A. Exterior – All exterior supports shall be 304 stainless steel.
- B. Interior – Carbon steel and painted or galvanized steel.

END OF SECTION



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**SECTION 16220  
DIESEL GENERATOR SYSTEMS (INSTALLATION)**

**PART 1 GENERAL**

**1.01 SCOPE**

- A. This Section includes installing a stationary, engine powered, standby power rated, diesel fueled, generating system(s), complete and in place, ready for service. The generator shall be furnished by the Owner and installed by the Contractor.
- B. Power and control wiring to the generator(s), transfer switch(s), and accessories, except wiring described herein, shall be furnished and installed under other sections of Division 16.
- C. The Owner is completing a procurement of the generator.

**1.02 ELECTRICAL AND CONTROL COORDINATION**

- A. Certain equipment items shall be connected to the plant control system as shown on the Electrical Drawings. Those connections and any remote-control connections shall be wired to clearly labeled terminal strips within the equipment control panel.

**PART 2 PRODUCTS**

Not used.

**PART 3 EXECUTION**

**3.01 COORDINATION**

- A. Examine area for compliance to written installation requirements.

**3.02 INSTALLATION**

- A. The Contractor shall coordinate with the supplier of the generator to schedule delivery.
- B. Engine-Generator:
  - 1. Provide a concrete base pad in accordance with Section 03300.
  - 2. Each engine-generator set shall be installed with galvanized steel anchor bolts as recommended by the manufacturer. Bolts shall be embedded in the concrete pad. Expansion-type anchors are not acceptable.
  - 3. Each engine-generator shall be installed with vibration isolators provided with the set.
  - 4. Provide equipment grounding connection(s) for each engine-generator unit as indicated by the manufacturer. Tighten each connection to comply with the tightening torques specified in UL standards to assure permanent and effective grounding.

5. All connections to the engine, generator and mounting base such as conduits, fuel lines, exhaust piping, etc., must have flexible sections to prevent breakage and isolate vibration to the generator set.

### 3.03 FIELD TESTS

- A. The Contractor shall coordinate with the generator supplier to furnish a qualified representative of the manufacturer to perform inspection, start-up, testing, and training services. The manufacturer's representative shall be experienced in the installation, start-up, operation, maintenance of the equipment, and fuel shelf life.
- B. The representative shall check the installation and supervise final adjustments and initial start-up of the equipment. The representative shall certify that each installation is correct and that the equipment is operating satisfactorily. This service shall be for a minimum period of one trip and three days.
- C. The complete installation including each automatic transfer switch, if applicable, shall be field-tested for compliance with the plans and specifications following completion of all site work. Testing shall be conducted by representatives of the transfer switch supplier, if applicable, and the engine- generator supplier, and the switchgear supplier, if applicable. The Contractor shall supply the load bank and other equipment required for each test. The Owner and inspector shall be notified in advance and shall have the option to witness the tests. The tests shall be repeated until each system performs as specified. The tests to be conducted on site shall be as follows:
  1. Perform a cold start test on each engine-generator using the generator's actual load as a test load. A power failure shall be simulated by opening the normal power source disconnect and the following information shall be recorded for each engine-generator set.
    - a. Time delay on start.
    - b. Cranking on time.
    - c. Time required coming up to speed.
    - d. Voltage and frequency overshoot.
    - e. Time to achieve steady state.
    - f. Voltage, frequency, and amps at standby state.
    - g. Oil pressure, water temperature, and battery charge rate at 5-minute intervals for the first 15 minutes and at 15 minute intervals thereafter for 2 hours.
    - h. Time delay on retransfer after return of normal power.
    - i. Cool down time delay.

2. Immediately after cooling time from cold start test, perform a one-step, four-hour, full load test using a load bank. Record the same data as in the cold start test except for time delays on transfer and retransfer.
  3. Disable each engine-generator from starting by a method approved by the manufacturer and test the crank cycle by switching the engine-generator controls to "Run".
  4. Test each engine-generator safety shutdown mechanism.
- D. The Contractor shall coordinate fuel system pressure testing and approval with the state agency.
- E. After the field-testing, has been successfully completed, the manufacturer's representative shall train the Owner's personnel for one eight-hour day in the proper operation and maintenance of the equipment. The Owner may make a video record of the training.

**PART 4 SPECIAL PROVISIONS**

Not used.

END OF SECTION

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**SECTION 16230  
VARIABLE FREQUENCY DRIVE (VFD)**

**PART 1 GENERAL**

**1.01 SCOPE**

- A. This Section includes all labor, tools, equipment, and materials necessary to furnish and install VFDs in accordance with the Drawings and as specified herein.

**1.02 SUBMITTALS**

- A. Submittals shall be in accordance with the requirements of Section 01300 and shall include:
1. Shop Drawings for Review:
    - a. A list of materials needed for construction, giving quantities, manufacturer's names, and catalog numbers.
    - b. Manufacturer's technical product sheets on each component to be furnished.
    - c. Wiring schematics with wire termination points identified, along with factory wiring and external wiring.
    - d. Furnish motor lead lengths, recommended motors, and filters/ reactors.
  2. Information for the Record:
    - a. Manufacturer's qualifications, including a list of similar installations.
    - b. Certified copies of factory test procedures and results.
    - c. Manufacturer's recommended method of installation for the products to be furnished.
    - d. Manufacturer's recommended spare parts list for components and accessories.
    - e. Operation and maintenance manuals for equipment provided, including accessories, wiring schematics, maintenance instructions, and drive settings, including hard copy and software to access and program drive.
    - f. Provide warranty for review; executed copies shall be submitted when completed with copies included in the operation and maintenance manuals.

**1.03 QUALITY ASSURANCE**

- A. Applicable Standards:
1. UL – Provide VFDs which are listed and labeled by UL and comply with applicable UL standards.

2. NEMA – Comply with all applicable NEMA standards and guidelines pertaining to VFDs.
3. IEEE – Comply with IEEE Standards for VFDs.
4. NEC – Comply with latest edition of the NEC Article 430 related to VFDs.

#### **1.04 PRODUCT HANDLING**

- A. Handle VFDs and components carefully to avoid breakage, impacts, denting, and scratching units. Do not install damaged equipment. Do not store outdoors or without protection from the weather, unless rated for outdoor use.

#### **1.05 GUARANTEE**

- A. VFDs shall be warranted by the manufacturer for a minimum of 2 years.

### **PART 2 PRODUCTS**

#### **2.01 MATERIALS**

- A. VFD enclosures shall be industrial grade, totally enclosed, fused, or circuit breaker disconnecting means and rated 480 volt, 3-phase, and 60 Hz unless otherwise noted.
- B. VFDs located outdoors, in process areas, damp locations, wet locations, and indoors below grade shall be NEMA 4X stainless steel unless noted otherwise on the Drawings or Specifications. VFDs located indoors in dry, non-process areas above grade shall be NEMA 12 unless noted otherwise on the Drawings or Specifications.
- C. The horsepower rating of the VFD shall be determined by the manufacturer and shall be sized to operate the motor to which it is connected at its nameplate full load amperage.
- D. VFD shall have Human Machine Interface (HMI) to be able to check parameters, alarms, and setup. The HMI shall be visible and accessible from the front of the VFD enclosure.
- E. VFD shall have remote control for start/stop/speed etc. as indicated on P&ID Drawings or described in the Specifications Part 4.
- F. VFDs shall be furnished with passive harmonic filters. VFDs shall meet IEEE-519 standard with point of common coupling at the input circuit breaker feeding the VFDs.
  1. Harmonic correction devices for each VFD shall be as specified herein and located as shown on the Drawings.
  2. Input Line Reactors:
    - a. 6-pulse VFD units shall be provided with an input line reactor and/or an integral DC link reactor. Total reactor impedance shall be a minimum of 3% and shall not exceed 5%. Harmonic distortion of the power source shall be reduced to 5% or less.

3. Passive Harmonic Filters:
  - a. Where indicated on the Drawings or where additional harmonic correction is required, 6-pulse VFD units shall be provided with a passive harmonic filter in addition to the integral DC link reactor specified above (if present).
  - b. Passive harmonic filters shall be sized to attenuate harmonics resulting from operation of the VFD-driven motor load to no more than 5% THID when operating at full load, and no more than 8% THID when operating at 30% of full load. The filter shall be equipped with power contactors configured to remove the capacitors from the circuit when the VFD-driven loads are not in operation.
  - c. Passive filters shall be integrated into the VFD enclosure where possible.
- G. VFD shall have a 42,000-amp minimum interrupting capacity when used on a 480 volt system. Ampere and interrupting capacity ratings shall be as shown on the Drawings.
- H. VFD shall be horsepower rated as a minimum to handle motor size as shown.
- I. VFD shall be totally factory assembled and tested before being shipped.
- J. Status and bypass control shall be displayed by LEDs and/or by HMI.
- K. VFD shall have speed control and torque characteristics to match load.
- L. VFD(s) shall be Allen-Bradley Powerflex 750 series or Square D.
- M. VFD shall accept a 4-20 mA DC current input for speed control.
- N. VFD shall provide a 4-20 mA DC current output that is directly proportional to its output frequency.

## 2.02 ACCESSORIES

- A. Provide each disconnect device with a padlockable handle. Each operating handle shall be padlockable with as many as three padlocks with a diameter of 3/8 inch.
- B. Provide each disconnect switch with one Normally Open auxiliary contacts for remote indication. Auxiliary contacts must be indicative of the state of the switch itself. Therefore, the contacts shall be open when the circuit breaker is open or tripped and closed when the circuit breaker is closed. Contacts shall be wired to terminals for customer use.
- C. Provide one 480-120 VAC control power transformer (CPT) with fuses in each primary leg and one secondary leg. The other secondary leg shall be grounded. The CPT shall be sized at least 100 VA larger than the manufacturer's standard size.
- D. Provide a 3-position, maintained-action HAND-OFF-AUTO selector switch mounted on the front of the enclosure. Provide each selector switch with extra contact blocks wired to terminals for customer use. One set of extra contacts shall be closed when the switch



is in the Hand position and one set of extra contacts shall be closed when the switch is in the PLC or Auto position.

- E. Provide a START and a STOP pushbutton switch mounted on the front of the enclosure. The START pushbutton shall be momentary action with Normally Open contacts and a flush head operator colored black or green. The STOP pushbutton shall be maintained action, push off/pull on, with a red mushroom head operator.
- F. Provide a 2-position, maintained action AUTO/MANUAL selector switch on the front of the enclosure. Also, provide a potentiometer on the front of the enclosure for adjusting the output frequency of the VFD when the switch is in the MANUAL position. If the function of this switch and potentiometer can be provided by the interface module provided with the VFD, then the switch and potentiometer will not be required.
- G. Provide an auxiliary control relay with two SPDT contacts and 120 VAC coil. This relay shall be controlled by the START/STOP pushbuttons mounted in the enclosure front and any similar field mounted devices when the 3-position selector switch is in the HAND position.
- H. When the 2-position selector switch is in the AUTO position the output frequency of the VFD shall be controlled by a 4-20 mA DC signal provided by the plant control system. The VFD shall also provide a 4-20 mA DC signal output for remote frequency verification.
- I. The VFD shall provide contacts wired to terminals for customer use for the following signals: VFD RUNNING and VFD FAULT.
- J. The VFD shall accept a START/STOP contact closure signal from the Plant Control System to control its run status when the 3-position selector switch is in the AUTO or PLC position.

### **PART 3 EXECUTION**

#### **3.01 COORDINATION**

- A. Fuses or circuit breaker shall be sized per manufacturer's ratings. The Contractor shall confirm drive size to match with equipment size before ordering. The Contractor shall exercise caution when checking motor rotation (or bumping motor) so as to prevent nuisance fuse blowing or damage to the drive.

#### **3.02 INSTALLATION**

- A. VFDs shall be wall/rack mounted or floor mounted depending on the size of the VFD and the mounting arrangement from the manufacturer. Mount VFD to allow access for incoming feeds, outgoing motor leads, and all equipment in the VFD. Follow manufacturer's installation instructions.
- B. VFDs shall be easily accessible to check fuses and other components for function and continuity.
- C. All floor-mounted VFDs shall be mounted on 4-inch high concrete housekeeping pad provided by the Contractor.

**3.03 TESTING**

- A. Prior to energizing VFDs, test wiring for electrical continuity and for short circuits. Ensure proper polarity of connections is maintained and that fuses are checked for continuity and installed properly. Check motor rotation after checking with Engineer for direction and motor coupling.
- B. Check that grounding is properly installed in accordance with manufacturer's recommendations and the NEC.
- C. The setup and checking of the VFDs shall be included with the drive for the initial field startup, unless otherwise noted. This will include one trip for two days to set up and test drive and include at least 4 hours for training.

**PART 4 SPECIAL PROVISIONS**

Not used.

END OF SECTION

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**SECTION 16251  
SURGE PROTECTIVE DEVICES (SPD)**

**PART 1 GENERAL**

**1.01 SCOPE**

- A. This Section includes furnishing and installing surge protective devices (SPD) and related equipment in accordance with the Drawings and as specified herein.

**1.02 SUBMITTALS**

- A. Submittals shall be in accordance with the requirements of Section 01300 and shall include:
  - 1. Shop Drawings for Review:
    - a. Submit manufacturer's technical product sheets on each component to be furnished, giving conductor size, type and length, dimensions, manufacturer's name, and catalog numbers.
    - b. Submit prototype test results of proposed equipment indicating short circuit current rating (SCCR) and compliance with UL requirements indicating a nominal discharge rating of 20 kA.
  - 2. Information for the Record:
    - a. Manufacturer's recommended method of installation for the products to be furnished.
    - b. Operation and maintenance manuals.

**1.03 QUALITY ASSURANCE**

- A. Materials described herein shall be furnished by a single supplier who shall be responsible for the performance of the equipment in its entirety. The responsibility shall not be split among suppliers of individual components.
- B. The manufacturer of this equipment shall have produced similar electrical equipment for a minimum of five years.
- C. Manufacturer shall provide documentation showing the SPD meets the requirements of UL1449, 3rd Edition.

**1.04 GUARANTEE**

- A. Manufacturer shall provide a minimum of a ten-year replacement warranty for any SPD part failure.

## PART 2 PRODUCTS

### 2.01 EQUIPMENT

- A. Unit shall have an engineered solid-state high performance suppression system, utilizing arrays of fused nonlinear voltage dependent metal oxide varistors with similar operating characteristics.
- B. Suppression system platform shall be balanced to provide equal impedance paths for surge currents to ground, in a seamless low stress manner ensuring maximum performance.
- C. The unit shall have a maximum continuous operating voltage (MCOV) rating of 115% of the system's nominal operating voltage. The MCOV shall be a tested value as defined in Section 377.3 of UL1449, 3rd Edition.
- D. Units for wye configured electrical systems shall have directly connected suppression elements between line-line, line-neutral, line-ground, and neutral-ground.
- E. Units for delta configured electrical systems shall have suppression elements between line-line and line-ground.
- F. Units for Split Phase, 3 wire plus ground configured electrical systems shall have suppression elements between line-line, line-neutral, line-ground and neutral-ground.
- G. Units for 3 Phase, High Leg Delta, 4 Wire plus ground configured electrical systems shall have suppression elements between line-line, line-neutral, line-ground, neutral-ground, high line-neutral and high line-ground.
- H. SPD shall have a high-performance noise rejection filter. Attenuation for electric line noise shall be minimal per UL standards.
- I. Units shall not consist of plug-in type modules or printed circuit boards as surge current conductors. All internal components shall be hardwired with connections using low impedance conductors or copper bus and compression fittings.
- J. Unit shall include solid-state, long-life, externally mounted LED visual status indicators that indicate the on-line status of each phase of the unit. Service Entrance units shall include a surge counter alarm and dry contact output for remote alarm indication.
- K. Service Entrance Unit shall incorporate an integral test point allowing easy off-line diagnostic testing to verify the operational integrity of the unit's suppression/filter system.
- L. Provide enclosure of NEMA 12 rating unless shown otherwise on the Drawings or in Part 4 of this Specification.
- M. SPD shall be as manufactured by Eaton Innovative Technologies, Surge Suppression, Inc., APT, or equal.

### **PART 3 EXECUTION**

#### **3.01 COORDINATION**

- A. Coordinate with other Work, including painting, and electrical boxes and wiring work as necessary to interface orderly installation of all Work.

#### **3.02 INSTALLATION**

- A. Verify that neutral to ground bond is present and voltage from neutral to ground is less than 5 VAC on three phase wye, split phase and high-leg delta systems.
- B. Install SPDs as indicated in the manufacturer's written instructions and other recognized industry practices.
- C. Install SPD as close as practical to the device to be protected in accordance with applicable manufacturer's instructions and local or national code requirements.
- D. Connections shall be with low impedance bus or minimum No. 8 AWG, copper conductor. Leads shall not be any longer than necessary, avoid unnecessary bending of conductors.
- E. Ground SPD per manufacturer's recommendations and in accordance with Section 16020.
- F. If permanently attached leads provided with the SPD need to be extended, in-line butt splices shall be used. Connectors, such as wire nuts, that introduce a pointed connection are not acceptable.

#### **3.03 INSPECTION, STARTUP, AND TRAINING**

- A. Demonstrate that the SPD is installed correctly and functioning properly prior to energizing equipment to be protected.
- B. Contractor shall provide four hours of field training to Owner by a factory trained representative on proper procedures to operate diagnostic test equipment. Coordination of this training shall be made with Owner's schedule.

### **PART 4 SPECIAL PROVISIONS**

#### **4.01 SURGE PROTECTIVE DEVICE SCHEDULE**

- A. The following schedules are intended to aid the Contractor in identifying SPD location and rating. It is intended to supplement the Drawings and Specifications and is not guaranteed to be complete. All SPD shown on the Drawings shall be furnished and installed by the Contractor whether listed in the schedules or not.
- B. The rating of the SPD for the service entrance disconnect shall be rated at least 150,000 amps per Phase. SPD for service entrance overcurrent protective devices rated above 2000 amps shall be based on the table below this Section.

- C. The rating of the SPD for Motor Control Centers, Power Panels or Switchgear downstream of the main service entrance disconnect shall be based on the following tables below this Section.

Main Overcurrent Protective Device	Amps Per Phase
0 – 800 Amps	50 kA
801 – 2000 Amps or Service Entrance	150 kA
2001 – 4000 Amps	200 kA
Greater Than 4000 Amps	300 kA

Location	ID Tag	Voltage	Phase	No. Of Wires	Main Overcurrent Protective Device	NEMA Enclosure*
MCC-2		480V	3	4	800A	

- D. The SPD for Lighting Panels shall have 48,000 Amps per Phase protection and be the Sine Wave Tracking type.

Location	ID Tag	Voltage	Phase	No. Of Wires	Main Circuit Breaker	NEMA Enclosure*
LP-2		120/208	3	4	60	12

- \* SPD's if mounted in separate enclosure inside Motor Control Centers, Power Panels, Lighting Panels or Switchgear by the manufacturer shall have the same enclosure rating as the equipment they are installed in.

END OF SECTION

**SECTION 16347**  
**SHORT-CIRCUIT/COORDINATION STUDY/ARC FLASH HAZARD ANALYSIS**

**PART 1 GENERAL**

**1.01 SCOPE**

- A. The Contractor shall furnish short-circuit and protective device coordination studies as prepared by the low voltage motor control center manufacturer or an approved engineering firm.
- B. The Contractor shall furnish an Arc Flash Hazard Analysis Study per the requirements set forth in NFPA 70E - Standard for Electrical Safety in the Workplace. The arc flash hazard analysis shall be performed according to the IEEE 1584 equations that are presented in NFPA70E-2004, Annex D.
- C. The scope of the studies shall include all new distribution equipment under this contract.

**1.02 REFERENCES**

- A. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
  - 1. IEEE 141 – Recommended Practice for Electric Power Distribution and Coordination of Industrial and Commercial Power Systems.
  - 2. IEEE 242 – Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems.
  - 3. IEEE 399 – Recommended Practice for Industrial and Commercial Power System Analysis.
  - 4. IEEE 241 – Recommended Practice for Electric Power Systems in Commercial Buildings.
  - 5. IEEE 1015 – Recommended Practice for Applying Low-Voltage Circuit Breakers Used in Industrial and Commercial Power Systems.
  - 6. IEEE 1584 – Guide for Performing Arc-Flash Hazard Calculations.
- B. American National Standards Institute (ANSI):
  - 1. ANSI C57.12.00 – Standard General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers.
  - 2. ANSI C37.13 – Standard for Low Voltage AC Power Circuit Breakers Used in Enclosures.
  - 3. ANSI C37.010 – Standard Application Guide for AC High Voltage Circuit Breakers Rated on a Symmetrical Current Basis.
  - 4. ANSI C 37.41 – Standard Design Tests for High Voltage Fuses, Distribution Enclosed Single-Pole Air Switches, Fuse Disconnecting Switches and Accessories.



- C. The National Fire Protection Association (NFPA).
- D. NFPA 70 – National Electrical Code, latest edition.
- E. NFPA 70E – Standard for Electrical Safety in the Workplace.

### 1.03 SUBMITTALS

- A. Submittals shall be in accordance with the requirements of Section 01300 and shall include:
  - 1. Shop Drawings for Review:
    - a. The Contractor shall indicate all variances from the requirements of the Contract Documents.
    - b. Manufacturer’s literature.
    - c. Manufacturer’s warranty.
  - 2. Information for the Record:
    - a. The short-circuit and protective device coordination studies shall be submitted to the engineer prior to receiving final approval of the distribution equipment shop drawings and/or prior to release of equipment drawings for manufacturing. If formal completion of the studies may cause delay in equipment manufacturing, approval from the engineer may be obtained for preliminary submittal of sufficient study data to ensure that the selection of device and characteristics will be satisfactory.
    - b. The results of the short-circuit, protective device coordination and arc flash hazard analysis studies shall be summarized in a final report. Final report shall include all diagrams, spreadsheets etc. and shall be provided on CD in PDF format.
    - c. The report shall include the following sections:
      - 1) Executive Summary.
      - 2) Descriptions, purpose, basis, and scope of the study.
      - 3) Tabulations of circuit breaker, fuse, and other protective device ratings versus calculated short circuit duties.
      - 4) Protective device time versus current coordination curves, tabulations of relay and circuit breaker trip unit settings.
      - 5) Fault current calculations including a definition of terms and guide for interpretation of the computer printout.
      - 6) Details of the incident energy and flash protection boundary calculations.
      - 7) Recommendations for system improvements, where needed.

- 8) One-line diagram.
3. Arc flash labels shall be provided in hard copy and in Excel Spreadsheet electronic format.

#### **1.04 QUALIFICATIONS**

- A. The short-circuit, protective device coordination and arc flash hazard analysis studies shall be conducted under the supervision and approval of a Registered Professional Electrical Engineer skilled in performing and interpreting the power system studies.
- B. The Registered Professional Electrical Engineer shall be a full-time employee of the equipment manufacturer or an approved engineering firm.
- C. The Registered Professional Electrical Engineer shall have a minimum of five years of experience in performing power system studies.
- D. The equipment manufacturer or approved engineering firm shall demonstrate experience with Arc Flash Hazard Analysis by submitting names of at least ten actual arc flash hazard analysis it has performed in the past year.

#### **1.05 COMPUTER ANALYSIS SOFTWARE**

- A. The studies shall be performed using EasyPower, ETAP or SKM software programs that incorporate the latest revisions of the NFPA 70E and IEEE 1584 regarding short circuit and arc flash analysis.

### **PART 2 PRODUCTS**

#### **2.01 STUDIES**

- A. The Contractor to furnish short-circuit and protective device coordination studies as prepared by the low voltage motor control center manufacturer or an Owner approved engineering firm.
- B. The Contractor shall furnish an Arc Flash Hazard Analysis Study per NFPA 70E - Standard for Electrical Safety in the Workplace, reference Article 130.3 and Annex D.

#### **2.02 ELECTRIC UTILITY DATA**

- A. Electric Utility Company:
- B. Utility Contact:
- C. Primary Voltage:
- D. Transformer Primary Fuse:
- E. 3-Phase Fault Current at Primary Voltage:
- F. Line to Ground Fault Current at Primary Voltage:

### 2.03 DATA COLLECTION

- A. The Contractor shall furnish all data as required by the power system studies. The Engineer performing the short-circuit, protective device coordination and arc flash hazard analysis studies shall furnish the Contractor with a listing of required data immediately after award of the contract. The Contractor shall expedite collection of the data to assure completion of the studies as required for final approval of the distribution equipment shop drawings and/or prior to the release of the equipment for manufacturing.
- B. Source combination may include present and future motors and generators.
- C. Load data utilized may include existing and proposed loads obtained from Contract Documents provided by Owner, or Contractor.

### 2.04 SHORT-CIRCUIT AND PROTECTIVE DEVICE EVALUATION STUDY

- A. Use actual conductor impedances if known. If unknown, use typical conductor impedances based on IEEE Standard 141-1993.
- B. Transformer design impedances shall be used when test impedances are not available.
- C. Provide the following:
  - 1. Calculation methods and assumptions. Calculations shall be done using the utility sources only, and with the tie breaker open.
  - 2. Selected base per unit quantities.
  - 3. One-line diagram of the system being evaluated.
  - 4. Source impedance data, including electric utility system and motor fault contribution characteristics.
  - 5. Tabulations of calculated quantities.
  - 6. Results, conclusions, and recommendations.
- D. Calculate short-circuit momentary and interrupting duties for a three-phase bolted fault at the following equipment:
  - 1. Electric utility's supply termination point.
  - 2. 480V Motor Control Centers.
  - 3. Other significant locations throughout the system.
- E. For grounded systems, provide a bolted line-to-ground fault current study for areas as defined for the three-phase bolted fault short-circuit study.
- F. Protective Device Evaluation:
  - 1. Evaluate equipment and protective devices and compare to short circuit ratings.
  - 2. Adequacy of motor control center and panelboard bus bars to withstand short-circuit stresses.

3. Notify Owner in writing, of existing, circuit protective devices improperly rated for the calculated available fault current.

#### **2.05 PROTECTIVE DEVICE COORDINATION STUDY**

- A. Proposed protective device coordination time-current curves (TCC) shall be displayed on log-log scale graphs.
- B. Include on each TCC graph, a complete title and one-line diagram with legend identifying the specific portion of the system covered.
- C. Terminate device characteristic curves at a point reflecting maximum symmetrical or asymmetrical fault current to which the device is exposed.
- D. Identify the device associated with each curve by manufacturer type, function, and, if applicable, tap, time delay, and instantaneous settings recommended.
- E. Plot the following characteristics on the TCC graphs, where applicable:
  1. Low voltage equipment circuit breaker trip devices, including manufacturer's tolerance bands.
  2. Transformer full-load current, magnetizing inrush current, and ANSI through-fault protection curves.
  3. Conductor damage curves.
  4. Ground fault protective devices, as applicable.
  5. Pertinent motor starting characteristics and motor damage points, where applicable.
  6. The main and largest feeder circuit breaker in each motor control center.
- F. Provide adequate time margins between device characteristics such that selective operation is provided, while providing proper protection.

#### **2.06 ARC FLASH HAZARD ANALYSIS**

- A. The arc flash hazard analysis shall be performed according to the IEEE 1584 equations that are presented in NFPA70E-2018, Annex D.
- B. The flash protection boundary and the incident energy shall be calculated at all significant locations in the electrical distribution system (switchboards, switchgear, motor-control centers, panelboards, busway and splitters) where work could be performed on energized parts.
- C. The Arc-Flash Hazard Analysis shall include all significant locations in 240 volt and 208 volt systems fed from transformers equal to or greater than 125 KVA where work could be performed on energized parts. The only exception to this is the 208/120V panelboard fed from a 30KVA transformer, which is to be included.

- D. Arc flash boundary shall be based upon the calculated arc flash boundary considering an incident energy of 1.2 cal/cm<sup>2</sup>. All incident energies shall be calculated at 18 inches. All bus gaps used in calculations shall be per IEEE 1584-2018.
- E. When appropriate, the short circuit calculations and the clearing times of the phase overcurrent devices will be retrieved from the short-circuit and coordination study model. Ground overcurrent relays should not be taken into consideration when determining the clearing time when performing incident energy calculations.
- F. The short-circuit calculations and the corresponding incident energy calculations for multiple system scenarios must be compared and the greatest incident energy must be uniquely reported for each equipment location. Calculations must be performed to represent the maximum and minimum contributions of fault current magnitude for all normal and emergency operating conditions. The minimum calculation will assume that the utility contribution is at a minimum and will assume a minimum motor contribution (all motors off). Conversely, the maximum calculation will assume a maximum contribution from the utility and will assume the maximum amount of motors to be operating.
- G. The incident energy calculations must consider the accumulation of energy over time when performing arc flash calculations on buses with multiple sources. Iterative calculations must take into account the changing current contributions, as the sources are interrupted or decremented with time. Fault contribution from motors and generators should be decremented as follows:
  - 1. Fault contribution from induction motors should not be considered beyond 3-5 cycles.
  - 2. Fault contribution from synchronous motors and generators should be decayed to match the actual decrement of each as closely as possible (e.g., contributions from permanent magnet generators will typically decay from 10 per unit to 3 per unit after 10 cycles).
- H. For each equipment location with a separately enclosed main device (where there is adequate separation between the line side terminals of the main protective device and the work location), calculations for incident energy and flash protection boundary shall include both the line and load side of the main breaker.
- I. When performing incident energy calculations on the line side of a main breaker (as required per above), the line side and load side contributions must be included in the fault calculation.
- J. Mis-coordination should be checked amongst all devices within the branch containing the immediate protective device upstream of the calculation location and the calculation should utilize the fastest device to compute the incident energy for the corresponding location.
- K. Arc Flash calculations shall be based on actual overcurrent protective device clearing time. Maximum clearing time will be capped at 2 seconds based on IEEE 1584-2002

section B.1.2. Where it is not physically possible to move outside of the flash protection boundary in less than 2 seconds during an arc flash event, a maximum clearing time based on the specific location shall be utilized.

## 2.07 REPORT SECTIONS

- A. Input data shall include, but not be limited to the following:
  - 1. Feeder input data including feeder type (cable or bus), size, length, number per phase, conduit type (magnetic or non-magnetic) and conductor material (copper).
  - 2. Transformer input data, including winding connections, secondary neutral-ground connection, primary and secondary voltage ratings, kVA rating, impedance, percent taps and phase shift.
  - 3. Motor contribution data (induction motors and synchronous motors), including short-circuit reactance, rated horsepower or kVA, rated voltage, and X/R ratio.
- B. Short-Circuit Output Data shall include, but not be limited to the following reports:
  - 1. Low Voltage Fault Report shall include a section for three-phase and unbalanced fault calculations and shall show the following information for each applicable location:
    - a. Voltage.
    - b. Calculated fault current magnitude and angle.
    - c. Fault point X/R ratio.
    - d. Equivalent impedance.
  - 2. Momentary Duty Report shall include a section for three-phase and unbalanced fault calculations and shall show the following information for each applicable location:
    - a. Voltage.
    - b. Calculated symmetrical fault current magnitude and angle.
    - c. Fault point X/R ratio.
    - d. Calculated asymmetrical fault currents.
      - 1) Based on fault point X/R ratio.
      - 2) Based on calculated symmetrical value multiplied by 1.6.
      - 3) Based on calculated symmetrical value multiplied by 2.7.
    - e. Equivalent impedance.
  - 3. Interrupting Duty Report shall include a section for three-phase and unbalanced fault calculations and shall show the following information for each applicable location:

- a. Voltage.
  - b. Calculated symmetrical fault current magnitude and angle.
  - c. Fault point X/R ratio.
  - d. No AC Decrement (NACD) Ratio.
  - e. Equivalent impedance.
  - f. Multiplying factors for 2, 3, 5 and 8 cycle circuit breakers rated on a symmetrical basis.
  - g. Multiplying factors for 2, 3, 5 and 8 cycle circuit breakers rated on a total basis.
- C. Recommended Protective Device Settings:
1. Phase and Ground Relays:
    - a. Current transformer ratio.
    - b. Current setting.
    - c. Time setting.
    - d. Instantaneous setting.
    - e. Recommendations on improved relaying systems, if applicable.
  2. Circuit Breakers:
    - a. Adjustable pickups and time delays (long time, short time, ground).
    - b. Adjustable time-current characteristic.
    - c. Adjustable instantaneous pickup.
    - d. Recommendations on improved trip systems, if applicable.
- D. Incident energy and flash protection boundary calculations.
1. Arcing fault magnitude.
  2. Protective device clearing time.
  3. Duration of arc.
  4. Arc flash boundary.
  5. Working distance.
  6. Incident energy.
  7. Hazard Risk Category.
  8. Recommendations for arc flash energy reduction.

## **PART 3 EXECUTION**

### **3.01 FIELD ADJUSTMENT**

- A. Adjust relay and protective device settings according to the recommended settings table provided by the coordination study. Field adjustments to be completed by the engineering service division of the Medium Voltage Metal-Clad Switchgear manufacturer under the Startup and Acceptance Testing contract portion.
- B. Make minor modifications to equipment as required to accomplish conformance with short circuit and protective device coordination studies.
- C. Notify Owner in writing of any required major equipment modifications.

### **3.02 ARC FLASH WARNING LABELS**

- A. The Contractor of the Arc Flash Hazard Analysis shall provide a 3.5 inch by 5 inch thermal transfer type label of high adhesion polyester for each work location analyzed.
- B. All labels will be based on recommended overcurrent device settings and will be provided after the results of the analysis have been presented to the owner and after any system changes, upgrades or modifications have been incorporated in the system.
- C. The label shall include the following information, at a minimum:
  - 1. Location designation (bus name from diagram).
  - 2. Nominal voltage (shock risk when cover removed).
  - 3. Arc flash boundary.
  - 4. Glove class.
  - 5. Incident energy (minimum arc rating at 18 inches).
  - 6. Brief PPE description.
  - 7. Date label was printed.
- D. Labels shall be machine printed, with no field markings.
- E. Arc flash labels shall be based on the recommended overcurrent device settings and provided for the following:
  - 1. For each 208V panelboard, provide one label for the incident energy at the incoming line terminals.
  - 2. For MCC-1, provide labels for the following:
    - a. Incident energy at the line terminals of each main breaker with tie breaker open.
    - b. Incident energy for each main bus with tie breaker open.
  - 3. For the automatic transfer switch, provide one label for the greater incident energy of the two incoming line terminals.



- 4. For MCC-2, provide one label for the incident energy at the main bus.
- F. Labels shall be field installed by the engineering service division of the Medium Voltage Metal-Clad Switchgear manufacturer under the Startup and Acceptance Testing contract portion.

**3.03 ARC FLASH TRAINING**

- A. The Contractor of the Arc Flash Hazard Analysis shall train the owner's qualified electrical personnel of the potential arc flash hazards associated with working on energized equipment (minimum of 8 hours). The training shall be certified for continuing education units (CEUs) by the International Association for Continuing Education Training (IACET) or equivalent.

**PART 4 SPECIAL PROVISIONS**

Not used.

END OF SECTION

**SECTION 16410  
PANELBOARDS**

**PART 1 GENERAL**

**1.01 SCOPE**

- A. This Section includes all labor, tools, equipment, and materials necessary to furnish and install panelboards in accordance with the Drawings and as specified herein.

**1.02 SUBMITTALS**

- A. Submittals shall be in accordance with the requirements of Section 01300 and shall include:
  - 1. Shop Drawings for Review:
    - a. Manufacturer's technical product sheets on each component to be furnished. Submit shop drawings for each panelboard including dimensioned plans and elevations, component and device lists, a single line diagram showing main and branch bus current ratings, and short circuit ratings of panelboard.
    - b. Furnish manufacturer's name(s) and catalog numbers.
  - 2. Information for the Record:
    - a. Operation and maintenance manuals.
    - b. Upon completion of the installation and acceptance by the Owner and Engineer, all electrical (schematic) diagrams, interconnection diagrams, panel layouts, and related support materials shall be corrected and amended to reflect the installed system.

**1.03 QUALITY ASSURANCE**

- A. Work shall be in compliance with applicable requirements of governing agencies having jurisdiction and in accordance with these drawings and specifications.
- B. Equipment and materials shall be new and, if of the same type as other performing parts of the same system, shall be the products of the same manufacturer.
- C. Equipment and material shall be furnished by manufacturer of panelboards whose products have been in satisfactory use in similar service for not less than five years.
- D. Applicable Standards:
  - 1. NEC – Comply with NEC Article 408 as applicable to installation and construction of electrical panelboards and enclosures.
  - 2. UL – Comply with applicable requirements of UL 67, "Standard for Panelboards," and UL Numbers 50, 869A, 486A, 486B, and 1053 pertaining to panelboards, accessories, and enclosures.

- a. Provide panelboard units that are UL listed and labeled.
3. NEMA – Comply with NEMA Standards Pub/No. 250, “Enclosures for Electrical Equipment (1,000 volts Maximum),” Pub/No. PB 1, “Panelboards,” and Pub/No. PB 1.1, “Instructions for Proper Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less.”

#### **1.04 ELECTRICAL AND CONTROL COORDINATION**

- A. Layout and installation of panelboards shall be coordinated with other installations including loads that the panelboard feeds, clearances in front of and above panelboards, and ratings of the panelboard(s).

#### **1.05 PRODUCT HANDLING**

- A. Deliver panelboards properly packaged in factory fabricated type containers or wrappings, which properly protect devices from damage.
- B. Store panelboards in original packaging and protect from weather and construction traffic. Wherever possible, store indoors. Where necessary to store outdoors, store above grade and enclose with watertight wrapping.
- C. Handle panelboards carefully to prevent physical damage. Do not install damaged switches or breakers, remove from Site and replace damaged devices with new.

### **PART 2 PRODUCTS**

#### **2.01 EQUIPMENT**

- A. Except as otherwise specified, low-voltage panelboards shall be factory-finished, dead-front assemblies of individually removable, bolted circuit breakers and NEMA standard copper mains and busses, enclosed in code-gauge, surface-mounting steel cabinets. The backboxes shall be continuously welded and galvanized after fabrication. Panelboards shall not exceed 78-inches in height, and shall be so mounted that height of the top operating handle will not exceed 6-feet, 7-inches from the floor. Shorter panelboards shall be mounted proportionately lower.
- B. Panelboards shall be UL listed and conform to FS W-P115, Type I, Class 1, and all applicable ANSI, IEEE, and NEMA standards.
- C. Panelboards shall be shop tested in accordance with NEMA standards.
- D. All panelboards shall include, whether shown on the Drawings or not, a Surge Protection Device (SPD) as specified in Section 16251.
- E. Panelboards shall be equipped with hinged doors. Doors taller than 30-inches shall have three hinges and doors taller than 42 inches shall have 3-point catches. A directory frame with glass or approved plastic cover shall be provided on the inside of each door and shall contain a typewritten directory listing all active and inactive circuits. Each door shall be equipped with a stainless-steel cylinder lock and hinges. The Contractor shall furnish two panelboard keys with tag identifications per panel to the Owner. Panel

fronts shall not be removable with the door locked. Panelboards shall have a solid copper neutral and a separate copper ground bar.

- F. Metal nameplates shall be secured to dead-front with rivets or screws. Nameplates shall contain system information, catalog number, and factory order number. Sticker or foil nameplates are not permitted. Interior wiring diagram, neutral wiring diagram, UL listed label and short circuit current rating shall be displayed on the interior.

## **2.02 INTERIORS (208Y/120 AND 120/240 VOLTS)**

- A. Continuous main current ratings as indicated on associated Drawings, not to exceed 600 amps maximum. Minimum Short Circuit Current Rating shall be 10,000 RMS symmetrical interrupting capacity. Panelboards rated for 208Y/120 volts or 120/240 volts shall be Type NQOD as manufactured by Square D, or equal.
- B. Provide one copper continuous bus bar per phase. Each bus bar shall have sequentially phased branch circuit connectors suitable for bolt-on branch circuit breakers. The bussing shall be fully rated. Panelboards shall be suitable for use as Service Equipment.
- C. All current carrying parts shall be insulated from ground and phase-to-phase.
- D. Interior trim shall be of dead-front construction to shield user from energized parts.
- E. Interiors shall be field convertible for top or bottom incoming feed. Main and sub-feed circuit breakers shall be vertically mounted. Main lug interiors up to 400 amps shall be field convertible to main breaker. Interior leveling provisions shall be provided for flush mounted applications.

## **2.03 RESERVED**

## **2.04 MAIN CIRCUIT BREAKER IN PANELBOARDS**

- A. Molded case circuit breakers shall have overcenter, trip-free, toggle mechanism which will provide quick-make, quick-break contact action. Circuit breakers shall have a permanent trip unit with thermal and magnetic trip elements in each pole.
- B. Two and three pole circuit breakers shall have an internal common trip crossbar to provide simultaneous tripping. Circuit breakers frame sizes above 100 amps shall have a single magnetic trip adjustment located on the front of the breaker which allows the user to simultaneously select the desired trip level of all poles.
- C. Breaker handle and faceplate shall indicate rated ampacity. Standard construction circuit breakers shall be UL listed for reverse connection without restrictive line or load markings.

## **2.05 BRANCH CIRCUIT BREAKERS IN PANELBOARDS**

- A. Breakers shall be UL listed with amperage ratings and number of poles as indicated on the Drawings.
- B. Molded case branch circuit breakers shall have bolt-on type bus connectors.

- C. Circuit breakers shall have an overcenter toggle mechanism which will provide quick-make, quick-break contact action. Circuit breakers shall have thermal and magnetic trip elements in each pole. Two and three pole circuit breakers shall have an internal common trip crossbar to provide simultaneous tripping.
- D. There shall be two forms of visible trip indication. The breaker handle shall be trip free and reside in a TRIPPED position between ON and OFF. In addition, there shall be a VIS-TRIP indicator appearing in the clear window of the circuit breaker housing.
- E. In addition to standard ON/OFF markings, circuit breaker handle accessories shall provide provisions for locking handle in the ON or OFF position by rivet or bolt. Clip on means will not be permitted.
- F. The exposed faceplates of all branch circuit breakers shall be flush with one another.
- G. All circuit breakers for 120 volts, 277 volts, and fluorescent, LED and HID lighting circuit shall be approved for switching duty, and shall be marked SWD.
- H. Branch circuit breakers for 120/208/240/277-volt circuits shall be Type Q with 10,000-amp minimum interrupting capacity. Breakers shall be operable in any position, shall be bolted to mains, and shall be removable from the front of the panelboard without disturbing adjacent units.
- I. Ground Fault Circuit Interrupters (GFCI) shall be provided where listed in the panel schedules. GFCI shall be Class A, 4-6 mA.
- J. Equipment protection circuit breakers (EPD) with UL Listed 30 mA equipment protection shall be provided where listed in the panel schedules.
- K. GFCI and GFEPD branch circuit breakers shall have "push-to-trip" and "reset" devices for maintenance and testing purposes.

**2.06 RESERVED**

**2.07 RESERVED**

**2.08 RESERVED**

**PART 3 EXECUTION**

**3.01 INSTALLATION**

- A. Locate independently mounted circuit breakers and install in accordance with manufacturer's written installation instructions.
- B. Circuit breakers in distribution equipment shall be factory installed.
- C. Install wiring between circuit breakers and load devices as specified in Section 16120.
- D. Check connectors, terminals, bus joints, and mountings for tightness. Tighten field-connected connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values. Where manufacturer's

torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL Standards 486A and UL 486B.

- E. Provide equipment grounding connections for individually mounted units as indicated and as required by the NEC. Tighten connectors to comply with tightening torques specified in UL Standard 486A to assure permanent and effective grounding.
- F. Upon completion of installation, inspect devices, and remove paint splatters, other spots, dirt, and debris. Touch up scratches and mars of finish to match original finish.
- G. Dead-front trim shall have pre-formed twistouts or plastic inserts designed for the purpose covering unused mounting spaces.
- H. Directory cards shall be typewritten and list all active circuits. Inactive circuits shall be labeled: SPARE.

### 3.02 IDENTIFICATION

- A. Identify components in accordance with Section 16030.

### 3.03 TESTING AND INSPECTION

- A. Verify indicated ratings and settings to be appropriate for final system arrangement and parameters. Where discrepancies are found, test organization shall recommend final protective device ratings and settings. Use accepted revised ratings or settings to make the final system adjustments.
- B. Inspect for defects and physical damage, NRTL labeling, and nameplate compliance with current single line diagram.
- C. Exercise and perform operational tests of all mechanical components and other operable devices in accordance with manufacturer's instruction manual.
- D. Check tightness of electrical connections with calibrated torque wrench. Refer to manufacturer's instructions for proper torque values.

### PART 4 SPECIAL PROVISIONS

Not used.

END OF SECTION

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**SECTION 16421  
MOTOR CONTROL CENTER**

**PART 1 GENERAL**

**1.01 SCOPE**

- A. This Section includes all labor, tools, equipment, and materials necessary to furnish and install Motor Control Center(s) in accordance with the Drawings and as specified herein.
- B. MCC shall be Square D, no substitutions allowed.

**1.02 SUBMITTALS**

- A. Submittals shall be in accordance with the requirements of Section 01300 and shall include:
  - 1. Shop Drawings for Review:
    - a. Furnish manufacturer's product data, test reports, and materials certifications as required.
    - b. Wiring diagrams from manufacturer including single line, elementary control, and schematics showing internal and external wiring. All control schematics shall use ladder type diagram format incorporating line numbers, and format shall be as defined by NFPA 79, Annex D. Independent wire numbers shall be assigned for each circuit.
    - c. Time current characteristic curves for overcurrent protective devices including overloads, circuit breaker trip devices, and fuses.
    - d. Recommended overload device settings.
    - e. Footprint layout, including back-to-back units or front only arrangement with overall dimensions and weights. Also include dimensions for shipping splits and available conduit space.
    - f. Furnish manufacturer's name(s) and catalog numbers.
    - g. Furnish manufacturer's technical product sheets on each component to be furnished with voltage; continuous current and short circuit withstand ratings as applicable.
    - h. Name plate schedule.
  - 2. Information for the Record:
    - a. Operation and maintenance manuals.
- B. Upon completion of the installation all Drawings and related support material shall be corrected and amended to reflect the installed system. All final Drawings and electronic copy (CD) (AutoCAD format) shall be turned over to the Owner.



### 1.03 QUALITY ASSURANCE

- A. Work shall be in compliance with applicable requirements of governing agencies having jurisdiction and in accordance with these Drawings and Specifications.
- B. Equipment and materials shall be new and, if of the same type as other performing parts of the same system, shall be the products of the same manufacturer.
- C. The manufacturer of this equipment shall have produced similar electrical equipment for a minimum of five years.
- D. Applicable Standards:
  - 1. NEC.
  - 2. UL.
  - 3. NEMA.

### 1.04 PRODUCT HANDLING

- A. Deliver Motor Control Centers properly packaged in factory fabricated type containers or wrappings, which properly protect devices from damage. Motor Control Center(s) shall be visually inspected upon delivery from factory. Damaged equipment shall be replaced at no additional cost to Owner.
- B. Store Motor Control Centers in original packaging and protect from weather and construction traffic. Store indoors, above grade and enclose with watertight wrapping.
- C. Handle Motor Control Centers carefully to prevent physical damage. Do not install damaged switches, circuit breakers or starters, remove from Site, and replace damaged devices with new.
- D. Follow manufacturer's recommendations for handling and storage.

## PART 2 PRODUCTS

### 2.01 MAIN AND FEEDER DISCONNECTS

- A. Main and feeder switches and circuit breakers shall have current rating that is shown on the Drawings or described in the Specifications.
- B. Switch handles and faceplates shall indicate rated ampacity. Standard construction switches shall be UL listed.
- C. In addition to standard ON/OFF markings, switch handle accessories shall provide provisions for locking handle in the ON and OFF position by safety lockout hasps and padlocks.
- D. Provide a removable protective barrier to reduce the possibility of contact with the line terminals.

- E. Main Disconnect:
1. The withstand rating of the main switch or circuit breaker shall be greater than or equal to the bus bracing for the MCC.
  2. Provide lugs to accommodate the size and quantity of conductors per phase shown on the Drawings.
  3. If no overcurrent protection is indicated, provide a main incoming lug compartment.
  4. Main Fusible Disconnect as indicated on the Drawings.
    - a. Size fuses as shown on the Drawings. Provide dual element, time delay Class J or dual element, time delay, Class RK5 fuses through 600 amps. Provide time delay Class L fuses above 600 amps.
    - b. Provide one normally open and one normally closed auxiliary contact.
  5. Main circuit breaker disconnect as indicated on the Drawings.
    - a. Size the circuit breaker frame and trip sizes as shown on the Drawings.
    - b. Provide a circuit breaker of either the thermal magnetic or solid-state type.
    - c. Provide one normally open and one normally closed internal auxiliary contact.
  6. For circuit breakers rated 1,000 amps trip and greater, provide integrated ground fault protection with adjustable pick-up and adjustable time-delay as noted on the Drawings.
- F. Feeder Disconnects and Transformer Disconnects:
1. The disconnecting means for feeders, integral MCC equipment, and transformers shall be thermal magnetic circuit breakers or fused disconnects as indicated on the Drawings.
  2. The interrupting capacity rating shall be greater than or equal to the bus bracing requirement.
  3. The minimum circuit breaker frame size shall be 150 amps.
  4. Provide one internally mounted auxiliary contact. This contact shall be closed when the circuit breaker is ON and open when the circuit breaker is OFF or TRIPPED.

**2.02 RESERVED**

### 2.03 SURGE PROTECTION DEVICE (SPD)

- A. Unit shall have an engineered, solid-state, high performance suppression system, utilizing arrays of fused nonlinear voltage dependent metal oxide varistors with similar operating characteristics.
- B. Suppression system platform shall be balanced to provide equal impedance paths for surge currents to ground, in a seamless low stress manner ensuring maximum performance.
- C. The unit shall have a continuous maximum operating voltage rating of 115% of the system's nominal operating voltage.
- D. Units for wye configured, 3 phase, 4 wire electrical systems shall have directly connected suppression elements between line-line, line-neutral, line-ground, and neutral-ground.
- E. Units for delta configured, 3 phase, 3 wire electrical systems shall have suppression elements between line-line and line-ground.
- F. SPD shall have a high-performance noise rejection filter. Attenuation for electric line noise shall be per UL standards.
- G. All internal components shall be hardwired with connections using low impedance conductors or copper bus and compression fittings. Units shall not consist of plug-in type modules or printed circuit boards as surge current conductors.
- H. Unit shall include solid-state, long-life, externally mounted LED visual status indicators that indicate the on-line status of each phase of the unit.
- I. Unit shall incorporate an integral test point allowing easy off-line diagnostic testing to verify the operational integrity of the unit's suppression/filter system.
- J. Provide enclosure of NEMA rating as shown in the schedule.
- K. SPD shall be as manufactured by Eaton Innovative Technologies, or equal.

### 2.04 RESERVED

### 2.05 DIGITAL POWER METER

- A. Where shown on the one-line diagrams, the MCC shall include a microprocessor based Digital Power Meter (DPM). The DPM shall be UL listed for 3-phase measurements including the following:
  - 1. Line-to-line voltage.
  - 2. Line-to-neutral voltage.
  - 3. Current on each phase.
  - 4. Neutral current.
  - 5. Frequency.

6. Real power (kW).
  7. Apparent power (kVA).
  8. Reactive power (kVAR).
  9. Power factor.
- B. The DPM shall include at least two individually programmable Form C relay contacts rated for at least 2 amps at 120 VAC.
- C. The DPM and all auxiliary equipment required for its operation (including but not limited to: overcurrent protective devices, current transformers and potential transformers) shall be provided as an integral part of the MCC.
- D. The DPM shall include the following features:
1. Minimum/Maximum event logs.
  2. Trend log.
  3. Distortion analysis with Total Harmonic Distortion (THD).
  4. Crest factor (current and voltage).
  5. Distortion power factor.
  6. RS-232 communications.
  7. RS-485 communications.
  8. DeviceNet.
  9. Remote I/O.
  10. Multiple channel and cycle oscillographic recordings.

## **2.06 VARIABLE FREQUENCY DRIVES IN MCCS**

- A. Variable frequency drives (VFDs) in MCCs shall be of the pulse-width modulation technology (PWM) type. The input power section shall utilize a 6-pulse bridge rectifier design with line reactors for harmonic mitigation.
- B. The VFD unit shall have an input circuit breaker or fusible switch to provide the necessary branch circuit protection.
- C. Wiring between the VFD and disconnect shall not be disturbed when removing or installing the VFD unit.
- D. VFD units shall be of modular construction so that it is possible to interchange units of the same size without modifications to the MCC structure.
- E. VFD units shall be plug-on units which connect to the vertical bus through a stab-on connector where possible. Units shall otherwise be connected directly to the main horizontal bus with appropriately sized wire or bus.

- F. A full-depth vertical wireway shall be provided within MCC sections containing VFDs. VFD units that require a full vertical section are not required to have vertical wireways.
- G. The VFD unit shall incorporate a self-contained air-based cooling system. Any air exhaust vents shall be louvered to direct air away from operating personnel. Any fans, ductwork, or filters shall be accessible for maintenance.
- H. An internal over-temperature switch shall be provided to detect cooling system failure and shut off the VFD. Cooling system fans shall continue to run to provide a rapid cool down of the VFD.
- I. Power for the cooling fan shall be provided from the unit's control power transformer or a separate transformer dedicated to the cooling system within the unit. All transformers shall have two primary and one secondary fuse. The unfused side of transformer secondary windings shall be grounded.
- J. The VFD shall have a Human Machine Interface (HMI) to check parameters, alarms, and setup. The HMI shall also be capable of starting and stopping the motor and controlling its speed when placed in the manual mode.
- K. The VFD shall have remote control capabilities for start/stop/speed etc. as indicated on the P&ID drawings or described in Part 4 of this Specification.
- L. The setup and checking of the VFDs shall be included in the cost of the drive for the initial field startup, unless otherwise noted. This shall include one round trip for two days to start up and test the VFD and shall include at least 4 hours for training the Owner's personnel.
- M. The VFD shall accept a 4-20 mA DC current input from the Plant Control System for speed control.
- N. The VFD shall provide a 4-20 mA DC current output that is directly proportional to its output frequency.
- O. Provide a 3-position, maintained-action [HAND-OFF-PLC] [HAND-OFF-AUTO] selector switch mounted on the front of the unit. Provide the selector switch with extra contact blocks wired to terminals for customer use. One set of extra contacts shall be closed when the switch is in the HAND and one set of extra contacts shall be closed when the switch is in the PLC or AUTO position.
- P. Provide a START/STOP pushbutton switch mounted on the front of the enclosure. The START pushbutton shall be momentary action with Normally Open contacts and a flush head operator colored black or green with a guard to prevent accidental contact. The STOP pushbutton shall be maintained action, push-off/pull-on, red, mushroom head operator.
- Q. Provide an auxiliary control relay with two SPDT contacts and 120 VAC coil. This relay shall be controlled by the START/STOP pushbuttons mounted in the enclosure front and any similar field mounted devices when the 3-position selector switch is in the HAND position.

- R. The VFD shall accept a START/STOP contact closure signal from the Plant Control System to control its run status when the 3-position selector switch is in the AUTO or PLC position.
- S. The VFD manufacturer shall provide two voltage-free Form C relay output contacts. One of the contacts shall indicate VFD fault status; the other contact shall indicate VFD run status. Contacts shall be wired to terminal blocks for customer use.
- T. The VFD shall be provided with capability for remote communication between Plant Control System and VFD using an Ethernet protocol compatible with the Plant Control System. Remote communication will be used for plant predictive maintenance function.

**2.07 RESERVED**

**2.08 GENERAL ASSEMBLY FOR MOTOR CONTROL CENTERS**

- A. Motor Control Centers shall be dead front, fully bussed, front accessible, with one or more vertical sections bolted together to form a rigid free-standing assembly. Sections shall have covered, full width horizontal and full height vertical wireway. Sections containing full height units shall not require vertical wireways. Wireways shall be isolated from all bussing and unit interiors. Wiring shall be NEMA Type 1B as a minimum.
- B. Enclosure shall be NEMA 12 rated for general indoor units unless noted otherwise and NEMA 4X for outdoor units. Indoor units in areas having open channel flow shall be NEMA 4X.
- C. Bussing shall be 3 phase, 4 wire tin plated copper unless otherwise noted.
- D. Motor Control Centers shall include tin plated copper ground bus, which is rated at a minimum per the main service feed to the unit.
- E. Motor Control Centers shall have 42,000-amp minimum interrupting capacity when used on 480 volt systems. Amp and interrupting capacity ratings shall be as shown on the Drawings.
- F. Motor Control Centers shall be factory assembled and tested before being broken down into shipping splits. Maximum shipping split width shall be 60 inches.
- G. Each unit primary disconnect shall employ an operating mechanism interlocked with the unit door that will prevent access unless the disconnect handle is in the OFF position. The operating mechanism shall be interlocked with the unit door to prevent switching disconnect operating handle to the ON position while the door is open. A defeater mechanism shall be provided to bypass these interlocks.
- H. The operating mechanism shall be interlocked with each unit such that the unit cannot be inserted or withdrawn while the disconnect handle is in the ON position. This interlock feature shall be non-defeatable.
- I. Motor Control Centers shall be manufactured by Allen-Bradley, Square D, or equal.

## 2.09 LABELS

- A. Provide products that are listed and labeled. The terms “listed” and “labeled” shall be defined as they are in the NEC, Article 100.
- B. Install label inside enclosure identifying the type and NEMA size of motor starter installed, its overcurrent rating, its interrupt rating and the UL class. Where applicable, trip settings and time delays should be provided on permanent labels.
- C. Provide arc flash warning labels wherever live parts may be accessed.

## PART 3 EXECUTION

### 3.01 INSTALLATION

- A. Layout of starters, breakers and switches shall be matched with the front layouts and single line diagrams on the Drawings or as specified and shall be coordinated with other equipment installations for size adjustments if required. This includes Contractor checking of motor horsepower, current and voltage ratings during installation to confirm actual size.
- B. Locate shipping split sections and hardware to reassemble the Motor Control Centers and install in accordance with manufacturer’s written installation instructions. In the absence of specific manufacturer’s requirements install Motor Control Centers in accordance with NEMA publication Number ICS 2.3 “Instructions for the Handling, Installation, Operation and Maintenance of Motor Control Centers.”
- C. All loose supplied equipment shall be installed in the Motor Control Centers and adjusted if necessary.
- D. Check connectors, terminals, bus joints, and mountings for tightness. Tighten field-connected connectors and terminals, including screws and bolts, in accordance with equipment manufacturer’s published torque tightening values. Where manufacturer’s torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL Standards 486A and UL 486B.
- E. Provide equipment grounding connections for individually mounted units as indicated and as required by the NEC. Tighten connectors to comply with tightening torques specified in UL Standard 486A to assure permanent and effective grounding.
- F. All Motor Control Centers shall be mounted on 4-inch high concrete housekeeping pads provided by the Contractor.
- G. Upon completion of installation, inspect devices. Remove paint splatters and other spots, dirt, and debris. Touch up scratches and mars of finish to match original finish.
- H. Surge Protection Device (SPD):
  - 1. Install surge protection devices as indicated in the manufacturer’s written instructions and the NEC.

2. Install SPD as close as practical to the Motor Control Center main bus in accordance with manufacturer's instructions and local and national code requirements.
  3. Connections shall be with low impedance bus or minimum No. 8 AWG, copper conductor. Leads shall not be any longer than necessary, avoid unnecessary bending of conductors.
  4. Ground SPD per manufacturer's recommendations and in accordance with NEC Article 250.
  5. If permanently attached leads provided with the SPD need to be extended, in-line butt splices shall be used. Connectors, such as wire nuts, that introduce a pointed connection are not acceptable.
  6. Contractor shall provide eight hours of field training to Owner by a factory trained representative on proper procedures to operate diagnostic test equipment. Coordination of this training shall be made with Owner's schedule.
- I. Variable Frequency Drive:
1. The VFD manufacturer shall provide a factory certified representative to supervise the Contractor's installation, testing and start-up of the VFD units furnished under this specification for a maximum of two days. The start-up service shall be quoted as a separate item.
  2. An on-site training course of one training day shall be provided by a representative of the VFD unit manufacturer to the Owner's maintenance personnel and quoted as a separate item.

### **3.02 IDENTIFICATION**

- A. Identify components in accordance with Section 16030 Electrical Identification.
- B. Individual nameplates shall be labeled to match single lines along with the main Motor Control Center nameplate.

### **3.03 TESTING AND INSPECTION**

- A. Verify indicated ratings and settings to be appropriate for final system arrangement and parameters. Where discrepancies are found, test organization shall recommend final protective device ratings and settings. Use accepted revised ratings or settings to make the final system adjustments.
- B. Inspect for defects and physical damage, NRTL labeling, and nameplate compliance with current single line diagram.
- C. Exercise and perform operational tests of all mechanical components and other operable devices in accordance with manufacturer's instruction manual.
- D. Check tightness of electrical connections with calibrated torque wrench. Refer to manufacturer's instructions for proper torque values.



- E. Prior to energization of Motor Control Center(s), check for phase-to-phase and phase-to-ground insulation resistance levels to be up to standards. Also, check for electrical continuity and any short circuits or grounded circuits.
- F. Check all motors for correct rotation and change phases of motor leads as required to correct the rotation.
- G. Check harmonics on all variable frequency drives and provide filtering if causing electrical load or signal problems.
- H. Demonstrate that the TVSS is installed correctly and functioning properly prior to energizing Motor Control Center bus to be protected.
- I. Perform pertinent tests and inspections listed in Section 16050.

#### **PART 4 SPECIAL PROVISIONS**

##### **4.01 SPARE PARTS**

- A. Contractor shall provide a minimum of 10% spare fuses of each size installed with at least 3 of each size to be the minimum. This includes the control power transformer primary and secondary fuses.
- B. Contractor shall provide at least 3 spare indicating lights of each type installed.

##### **4.02 SURGE PROTECTION DEVICE SCHEDULE**

- A. The rating of the SPD for non-service entrance rated Motor Control Centers shall be based on the table and schedule in specification 16251.
  - \* SPD mounted inside Motor Control Centers, by the manufacturer shall have the same, or better, enclosure rating as the equipment they are installed in.

END OF SECTION

**SECTION 16430  
DISCONNECT SWITCHES**

**PART 1 GENERAL**

**1.01 SCOPE**

- A. This Section defines the requirements necessary to furnish and install circuit and motor disconnect switches in accordance with the Drawings and as specified herein.

**1.02 SUBMITTALS**

- A. Submittals shall be in accordance with the requirements of Section 01300 and shall include:
  - 1. Shop Drawings for Review:
    - a. Manufacturer's technical product sheets on each component to be furnished.
    - b. Furnish manufacturer's name(s) and catalog numbers.
  - 2. Information for the Record:
    - a. Manufacturer's recommended method of installation for the products to be furnished.
    - b. Operation and maintenance manuals.
    - c. Manufacturer's recommended spare parts list for the components and accessories.
    - d. Provide warranty for review; executed copies shall be submitted when completed with copies included in the operation and maintenance manuals.

**1.03 ELECTRICAL AND CONTROL COORDINATION**

- A. Layout and installation of disconnect switches and accessories shall be coordinated with other trades and with motor horsepower ratings.

**1.04 PRODUCT HANDLING**

- A. Deliver disconnect switches properly packaged in factory fabricated type containers or wrappings, which properly protect devices from damage.
- B. Store disconnect switches in original packaging and protect from weather and construction traffic. Wherever possible, store indoors. Where necessary to store outdoors, store above grade and enclose with watertight wrapping.
- C. Handle disconnect switches carefully to prevent physical damage. Do not install damaged disconnect switches, remove from Site and replace damaged devices with new.

## PART 2 PRODUCTS

### 2.01 FUSED SAFETY SWITCHES

- A. Provide individual fused switches as specified, shown on the Drawings, or as directed.
- B. Fused switches shall have a minimal short-circuit rating of 100,000 amps, RMS symmetrical.
- C. Where shown on the drawings, provide fused switches that lock in the ON position. Field modifying to provide this feature shall not be permitted. Where the service disconnect is locked in the ON position, branch circuit overcurrent devices shall be located in a readily accessible location and shall be of a lower amp rating than the LOCKED-ON service overcurrent device per the NEC.
- D. Disconnect switches located outdoors, in process areas, damp locations, wet locations, and indoors below grade shall be NEMA 4X stainless steel unless noted otherwise on the Drawings. Disconnect switches located indoors in dry, non-process areas above grade shall be NEMA 12 unless noted otherwise on the Drawings. Provide switches that can be locked in the OFF position. Enclosures shall be mechanically interlocked to prevent the opening of the cover with the switch in the ON position.
- E. Fused switches shall be quick-make, quick-break, motor-rated, load-break, heavy duty (HD) type having external marking clearly indicating ON and OFF positions.
- F. Provide fuses of the current ratings indicated and types specified in Section 16432 on fuses. Utilize rejection fuse clips that accept only Class RK1/RK5 fuses.
- G. Disconnect switches for motors driving process equipment shall have two normally open auxiliary contacts. One shall be wired to disable the motor controller when the switch is open. The other shall be wired to signal the Plant Control System (PCS) that the equipment is "In Service." Disconnect switches for motors driving utility equipment shall have one normally open auxiliary contact. It shall be wired to disable the motor controller when the switch is open.
- H. Switches shall be UL listed and horsepower rated for 250 VAC or DC or 600 VAC as required. Lugs shall be UL listed for copper cable. All fused switches shall include equipment grounding bar.
- I. Where required by the NEC, fused safety switches shall be rated for use as service entrance equipment.
- J. Disconnect switches shall be Square D, Crouse-Hinds, Cutler-Hammer, or equal.

### 2.02 NON-FUSED SAFETY SWITCHES

- A. Provide non-fused switches with the same provisions as for fused switches but without fuse clips.
- B. Disconnect switches for motors driving process equipment shall have two normally open auxiliary contacts. One shall be wired to disable the motor controller when the switch is open. The other shall be wired to signal the Plant Control System (PCS) that the

equipment is "In Service." Disconnect switches for motors driving utility equipment shall have one normally open auxiliary contact. It shall be wired to disable the motor controller when the switch is open.

- C. For applications in which all of the conditions listed in the following (1 thru 4) are met, the safety disconnect switch shall be a Crouse-Hinds NSSC manual motor starting switch, or equal, with a high-impact, fiberglass-reinforced polyester, corrosion-resistant, dust-tight, watertight, weatherproof enclosure rated NEMA 3, 4X, and 12 containing a two or three pole switch, as required by the application. Each switch shall have provisions to be pad locked in the off position. Each switch shall be UL listed and horsepower rated for 250 VDC or VAC, or 600 VAC as required. Lugs shall be UL listed for copper cable. Each switch shall include an equipment grounding plate for 3/4-inch and 1-inch conduit.
1. Auxiliary contacts are not required for interlocking or remote monitoring.
  2. The driven equipment is not process related; e.g., overhead door operator, electric hoist, HVAC equipment, etc.
  3. The motor is three-phase rated 10 hp or less at 460 VAC, 7-1/2 hp or less at 230 VAC, or single-phase rated at 2 hp or less at 230 VAC, or 1 hp or less at 115 VAC.
  4. Motor overload protection is not required, or is provided separately by a separate device in the motor circuit.

### **PART 3 EXECUTION**

#### **3.01 INSTALLATION**

- A. Install disconnect switches for use with motor driven equipment, motors, and controllers, within sight of the motor position where indicated.
- B. Provide suitable means for mounting disconnect switches.

#### **3.02 TESTING**

- A. Subsequent to completion of installation of electrical disconnect switches, energize circuitry and demonstrate capability and compliance with requirements. Where possible, correct malfunctioning units at Site, then retest to demonstrate compliance; otherwise, remove and replace with new units and retest.

### **PART 4 SPECIAL PROVISIONS**

#### **4.01 FUSES**

- A. Provide and install fuses for all fused disconnect switches along with a minimum of 3 spare fuses of each size supplied.

END OF SECTION

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**SECTION 16431  
CIRCUIT BREAKERS**

**PART 1 GENERAL**

**1.01 SCOPE**

- A. This Section defines the requirements necessary to furnish and install circuit breakers in accordance with the Drawings and as specified herein.

**1.02 SUBMITTALS**

- A. Submittals shall be in accordance with the requirements of Section 01300 and shall include:
  - 1. Shop Drawings for Review:
    - a. Manufacturer's technical product sheets on each component to be furnished showing dimensions and ratings for voltage, amperage and maximum interruption.
    - b. Furnish manufacturer's name and catalog numbers.
  - 2. Information for the Record:
    - a. Manufacturer's recommended method of installation for the products to be furnished.
    - b. Operation and maintenance manuals.
    - c. Manufacturer's recommended spare parts list for the components and accessories.
    - d. Manufacturer shall provide time/current characteristic trip curves ( $I_p$  and  $I_{2t}$  let-through curves for true current limiting circuit breakers only) for each type of circuit breaker.

**1.03 QUALITY ASSURANCE**

- A. Equipment and materials shall be new and, if of the same type as other performing parts of the same system, shall be the products of the same manufacturer.
- B. The manufacturer of this equipment shall have produced similar electrical equipment for a minimum of five years.
- C. Equipment shall meet applicable standards of NEC, NRTL, OSHA, UL, and NEMA.

**PART 2 PRODUCTS**

**2.01 MAIN CIRCUIT BREAKER IN LIGHTING AND POWER PANELBOARDS**

- A. Molded case circuit breakers shall have overcenter, trip-free, toggle mechanisms which will provide quick-make, quick-break contact action. Circuit breakers shall have a permanent trip unit with thermal and magnetic trip elements in each pole.

- B. Two and three pole circuit breakers shall have an internal common trip crossbar to provide simultaneous tripping of all poles.
- C. Breaker handle and faceplate shall indicate rated ampacity. Standard construction circuit breakers shall be UL listed for reverse connection without restrictive line or load markings.
- D. Lugs shall be UL listed to accept solid or stranded copper conductors. Lugs shall be suitable for 75 degrees C rated wires. Lug body shall be bolted in place. Snap-in designs are not acceptable.

## **2.02 BRANCH CIRCUIT BREAKERS IN LIGHTING AND POWER PANELBOARDS**

- A. Breakers shall be UL listed with amperage ratings and number of poles as indicated on the Drawings.
- B. Plug-in type circuit breakers that are backfed and used as main circuit breakers in "Main Lugs Only" panelboards shall be secured in place by an additional fastener that requires other than a pull to release the device from the bus bar assembly.
- C. Circuit breakers shall have an overcenter toggle mechanism which will provide quick-make, quick-break contact action. Circuit breakers shall have thermal and magnetic trip elements in each pole. Two and three pole circuit breakers shall have an internal common trip crossbar to provide simultaneous tripping.
- D. There shall be visible trip indication. The breaker handle shall be trip free and reside in a TRIPPED position between ON and OFF.
- E. In addition to standard ON/OFF markings, circuit breaker handle accessories shall provide provisions for locking handle in the ON or OFF position by rivet or bolt. Handle accessories shall be by the same manufacturer as the circuit breaker. Clip on locking means will not be permitted.
- F. The exposed faceplates of all branch circuit breakers shall be flush with one another.
- G. All circuit breakers for 120 volts, 277 volts, and fluorescent and HID lighting circuits shall be approved for switching duty, and shall be marked SWD.
- H. Branch circuit breakers for 120/208/240/277-volt circuits shall have a minimum of 10,000-amp interrupting capacity. Breakers shall be operable in any position, and shall be removable from the front of the panelboard without disturbing adjacent units.
- I. Ground Fault Circuit Interrupters (GFCI) shall be provided where listed in the panel schedules. GFCI shall be Class A, 4-6 mA.
- J. Ground Fault Equipment Protection Devices (GFEPD) shall be provided where listed in the panel schedules. GFEPDs shall have a trip setting of 30 mA.
- K. Arc Fault Circuit Interrupters (AFCI) shall be provided where listed in the panel schedules. AFCIs shall meet or exceed the requirements of UL Standard 1699. AFCIs shall trip if they detect a line to neutral arcing fault of 75 amps or greater. They shall also trip for line to ground faults of 5 Amps or greater.

- L. GFCI, AFCI, and GFEPD branch circuit breakers shall have a “push-to-trip” device for maintenance and testing purposes.
- M. Lugs shall be UL listed to accept solid or stranded copper conductors. Lugs shall be suitable for 75 degrees C rated wire, unless noted otherwise.

**2.03 RESERVED**

**2.04 RESERVED**

**2.05 MOTOR CIRCUIT PROTECTORS**

- A. Motor Circuit Protectors (MCP) are intended for use in combination with motor starters with overload relays for the protection of motor circuits from short circuits. They also serve as the disconnecting means for the motor circuit.
- B. MCPs shall contain a magnetic trip element in each pole with the trip point adjustable from the front. There shall be a common adjustment screw or knob to set the trip point of all three poles with one operation.
- C. The magnetic trip point on the MCP shall be adjustable from three to ten or eleven times the continuous current in at least eight steps to permit the motor to start without nuisance tripping due to inrush current.
- D. MCPs shall be recognized components under UL489 (Molded Case Circuit Breakers) and tested for short-circuit protection in equipment listed under UL508 (Industrial Control Equipment) and UL845 (Motor Control Centers).
- E. MCPs shall have a minimum of 65,000 amp interrupting rating at 480 VAC.
- F. MCPs shall be 3-pole devices with an internal common trip crossbar to provide simultaneous tripping of all three poles.
- G. Select the amp rating of the MCP based on the full load current of the motor to be protected and the MCP manufacturer’s recommendations or sizing table.
- H. MCPs shall be as manufactured by Cutler-Hammer, Square D, or equal.

**2.06 RESERVED**

**2.07 LABELS**

- A. Provide products that are listed and labeled. The terms “listed” and “labeled” shall be defined as they are in the NEC, Article 100.

**2.08 IDENTIFICATION**

- A. Identify components in accordance with Section 16030.

**2.09 MANUFACTURER**

- A. Circuit breakers shall be as manufactured by Square D, Cutler-Hammer, or equal.



## **PART 3 EXECUTION**

### **3.01 COORDINATION**

- A. Locate independently mounted circuit breakers and install in accordance with manufacturer's written installation instructions.
- B. Install wiring between circuit breakers and control/identification devices as specified in Section 16120.

### **3.02 INSTALLATION**

- A. Check connectors, terminals, bus joints, and mountings for tightness. Tighten field-connected connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL standards.
- B. Provide equipment grounding connections for individually mounted units as indicated and as required by the NEC.
- C. Tighten connectors to comply with tightening torques specified in UL standards to assure permanent and effective grounding.
- D. Upon completion of installation, inspect devices. Remove paint splatters and other spots, dirt, and debris. Touch up scratches and mars of finish to match original finish.
- E. Install labels inside enclosure identifying the type of circuit breaker installed, its overcurrent rating, its interrupt rating and the UL class. Where applicable, trip setting and time delay information shall be provided on permanent labels.
- F. The MCP trip setting for all motors, except Design E motors, shall be at least 115% but not more than 1300% of the full load current shown on the motor's nameplate. However, settings up to 1700% of the motor's full load current are permitted for Design E motors.

### **3.03 INSPECTION, STARTUP, AND TRAINING**

- A. On circuit breakers with adjustable trip settings, the contractor shall coordinate with the circuit breaker manufacturer, or their authorized agent, verification that the ratings and settings are appropriate for proper coordination with other system protection devices. All settings shall be identified and adjusted before circuit breaker is energized.
- B. Where discrepancies are found, Contractor or the manufacturer's representative shall recommend final protective device ratings for approval by the Owner and Engineer.
- C. Inspect for defects and physical damage, NRTL labeling, and nameplate compliance with current single line diagram.
- D. Exercise and perform operational tests of all mechanical components and other operable devices in accordance with manufacturer's instruction manual.

- E. Check tightness of electrical connections with calibrated torque wrench. Refer to manufacturer's instructions for proper torque values.

**3.04 PROTECTION**

- A. Panelboards and installed circuit breaker equipment shall be covered and protected from physical damage and construction dirt and debris until ready to be placed into service.

**PART 4 SPECIAL PROVISIONS**

Not used.

END OF SECTION

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**SECTION 16440**  
**AUTOMATIC TRANSFER SWITCHES (INSTALLATION)**

**PART 1 GENERAL**

**1.01 SCOPE**

- A. This Section includes all labor, tools, equipment, and materials to installing a complete and functional automatic electrical load transfer system.
- B. System shall connect partial or the entire facility electrical load to either the normal electrical utility source or to a standby electrical power source, which may be an alternate feed from the electric utility company or an engine-generator set.
- C. Transfer switch shall be delivered to the Site completely equipped, tested, and ready for installation.
- D. Power and control wiring to the generator, transfer switch, and accessories, except wiring described herein, shall be furnished and installed under other sections of Division 16.
- E. The Owner is completing a procurement of the automatic transfer switch.

**1.02 QUALITY ASSURANCE**

- A. All Work shall be in compliance with applicable requirements of governing agencies having jurisdiction and the NEC.
- B. Automatic transfer switch(es) and all components shall be tested in accordance with the latest applicable standards of UL, NEMA, and NFPA as follows:
  - 1. UL 50 - Cabinets and Boxes.
  - 2. UL 489 - Molded Case Circuit Breakers, Molded Case Switches.
  - 3. UL 508 - Industrial Control Systems.
  - 4. UL 1008 - Transfer Switches.
  - 5. NEMA ICS - Industrial Control and Systems.
  - 6. NFPA 101 - Life Safety Code.
  - 7. NFPA 110 - Emergency and Standby Power Systems.

**PART 2 PRODUCTS**

Not used.

**PART 3 EXECUTION**

**3.01 COORDINATION**

- A. Coordinate with other electrical work, including normal feeds, standby feeds, and locations, as necessary to interface installation of transfer switch with other Work.

### 3.02 INSTALLATION

- A. The Contractor shall coordinate with the supplier of the automatic transfer switch to schedule delivery.
- B. Automatic transfer switch and associated control devices shall be installed in accordance with the manufacturer's written instructions.
- C. Provide and install housekeeping pads for all floor mounted transfer switches.
- D. Power wiring shall be anchored to withstand short circuit current conditions.
- E. Provide equipment grounding connection(s) as indicated by the manufacturer.
- F. Tighten electrical connectors and terminals in accordance with manufacturer's published torque tightening values. Where such values are not published, comply with tightening values specified in UL Standards.

### 3.03 INSPECTION, STARTUP, AND TRAINING

- A. The Contractor shall coordinate scheduling a qualified representative of the manufacturer to perform inspection, testing, and training services. The manufacturer's representative shall be experienced in the installation, operation, and maintenance of the equipment.
- B. The representative shall check the installation and supervise final adjustments of the equipment. The representative shall certify that each installation is correct and that the equipment has been tested and is operating satisfactorily.
- C. If the automatic transfer switch is used with an engine-generator system, testing shall be conducted by representatives of the engine-generator supplier and the automatic transfer switch.
- D. The Owner and Engineer shall be notified in advance and shall have the option to witness the tests.
- E. After the field testing, has been completed, the manufacturer's representative shall train the Owner's personnel for one eight-hour day in the proper operation and maintenance of the equipment. The Owner may make a video record of the training.

### PART 4 SPECIAL PROVISIONS

Not used.

END OF SECTION

**SECTION 16510  
LIGHTING**

**PART 1 GENERAL**

**1.01 SCOPE**

- A. Under this Section, the Contractor shall provide all labor, material, services, and appurtenances necessary to make a complete operating lighting system.
- B. The Work specified in this Section includes but shall not be limited to, furnishing, installing, connecting, and testing lighting fixtures, lamps, hangers, structural supports, wiring, outlets, connections, and controls as shown on the Drawings or specifications.
- C. All Work, services, wiring, devices, equipment, and systems described herein shall conform to appropriate Sections of Division 16.

**1.02 SUBMITTALS**

- A. Submittals shall be in accordance with the requirements of Section 01300 and shall include:
  - 1. Shop Drawings for Review:
    - a. A list of materials giving manufacturer's name and catalog numbers.
    - b. Manufacturer's Literature on lighting photometrics.
  - 2. Information for the Record:
    - a. Manufacturer's recommended method of installation for the products to be furnished.
    - b. Operation and maintenance manual.
    - c. Manufacturer's recommended spare parts list for components and accessories.
    - d. Provide warranty for review; executed copies shall be submitted when completed with copies included in the operation and maintenance manuals.

**PART 2 PRODUCTS**

**2.01 LIGHTING FIXTURES**

- A. All lighting fixtures, exit lighting fixtures and emergency lighting fixtures shall be of the size and type designated in the "Lighting Fixture Schedule" and as indicated on the Drawings.
- B. All lighting fixtures shall be equipped with accessories, special finishes, or modifications as required, and with hangers and end caps. Continuous rows of ceiling mounted or stem mounted fluorescent lighting fixtures shall have couplers. Flush mounted lighting

fixtures shall be furnished with all mounting accessories required for complete installation in the particular ceiling system involved.

- C. All vapor tight and hazardous area fixtures shall include an approved cast iron or malleable box.
- D. All recessed lighting fixtures shall be equipped with a suitable gasket to prevent light leakage. Where the specific fixture catalog number or type does not include the gasket, it shall be provided by the Contractor at no additional expense to the Owner.
- E. Ballasts - All fluorescent or HID type fixtures shall use two-lamp ballasts whenever possible and shall be supplied with -20 degrees F ballasts when located outdoors or in unheated buildings. All HID ballasts shall be constant wattage type. Fluorescent lighting fixture ballasts shall be protected GE UltraMax, Lithonia Highly efficient electronic ballast or equal.
  - 1. Ceiling mounted fluorescent lighting fixtures shall be provided with high power factor, CBM approved, UL listed, ETL certified ballasts, with thermal overload and automatic reset, premium Class P, sound rating "A".
  - 2. Recessed fluorescent lighting fixtures shall be provided with high power factor, CBM approved, UL listed, ETL certified ballasts with the thermal overload and automatic reset, super premium Class P, sound rating "A+".
  - 3. Stem mounted fluorescent lighting fixtures shall be provided with high power factor, CBM approved, UL listed, ETL certified ballasts, with thermal overload and automatic reset, Class P, sound rating "A".
  - 4. High pressure sodium lighting fixtures shall have high power factor ballasts, regulated type with electronic starter.
  - 5. Metal halide lighting fixtures shall be provided with proper and suitable ballasts of the lead peaked circuit type, compatible with the particular type of lamp selected, providing high power factor, low line starting current, allowable line voltage range plus or minus 10%.
  - 6. LED drivers shall be electronic-type, labeled as compliant with radio frequency interference (RFI) requirements of FCC Title 47 Part 15, and comply with NEMA SSL 1 Electronic Drivers for LED Devices, Arrays, or Systems. LED drivers shall have a sound rating of A, have a minimum efficiency of 85%, and be rated for a THD of less than 20% at all input voltages.
  - 7. Dimmable LED drivers shall be 0-10V type. Dimmable LED drivers shall be capable of dimming without LED strobing or flicker across their full dimming range.
- F. LED fixture shall comply with UL Standard 8750 Light Emitting Diode Equipment for use in Lighting Products, IES Standard LM-79 Electrical and Photometric Measurements of Solid-State Lighting Products, IES Standard LM-80 Measuring Lumen Maintenance of LED Light Sources.

1. Provide LED fixtures with a DesignLights Consortium® (DLC) listing, a US Department of Energy (DOE) LED Lighting Facts label, or a US Environmental Protection Agency (EPA) ENERGY STAR label, which have demonstrated third-party testing verification.
2. Recessed lighting fixtures shall be thermally protected.
3. LED fixtures shall be modular and allow for separate replacement of LED lamps and drivers.
4. Dimmable LED fixtures shall have either a 0-10 volt, 3-wire dimming driver, or a two-step (50% - 100%) line voltage, two switch controlled dimming driver.

## 2.02 LAMPS

- A. All lighting fixtures shall be provided with the proper number and types of new lamps of the correct size as shown on the Drawings, as specified, or as required for the particular fixture type. Only the number of lamps required to provide adequate lighting for Work yet to be done in each area and acceptable temporary lighting elsewhere shall be installed at the time lighting fixtures are installed and tested. Remaining lamps are to be installed not more than 10 days prior to acceptance of the project by the Owner.
- B. All lamps shall be in working order at the time of final acceptance of the Work by the Owner. All defective lamps shall be replaced until the Work is finally accepted.
- C. All incandescent fixtures shall be provided with 125 to 130 volt inside frosted 2,500 hour guaranteed minimum life lamps. Fluorescent lamps shall be cool white. Lighting fixtures requiring special lamps such as reflector type shall be provided with the proper type. All fluorescent lamps shall be GE Wattmiser, Sylvania SuperSaver, Philips Econowatt or equal. In general, metal halide lamps shall be phosphor-coated ANSI Type O. High pressure sodium lamps shall be as manufactured by G. E., Philips, or Sylvania.
- D. LED lamps shall have a minimum color temperature of 4,000 degrees K, CRI of 80 minimum, and a lumen maintenance L70 rating of 50,000 hours minimum.

## 2.03 LIGHTING CONTROL, GENERAL

- A. In addition to the conduit and wiring, the lighting control systems for the exterior lighting systems, certain indoor lighting systems, entrance ways, vestibules and canopies shall consist of the following components:
  1. 120 Volt separate mount photoelectric cell units shall be provided and wired as indicated or shown. Units shall be Contractor located for operation free of background light.
  2. Photoelectric cell units shall:
    - a. Be weatherproof.
    - b. Have light level adjustment.
    - c. Have 1/2-inch stem mounting with swivel.



- d. Have contacts rated to handle 15 amps of incandescent light at 120 VAC and 8.3 amps of ballast load at 120 VAC.
  3. Photoelectric cell units shall be Intermatic K4221, or equal.
  4. Exterior LED lighting shall have surge protective devices (SPD) for each luminaire. SPD shall be UL-1499 recognized for all phases.
- B. Lighting contactors shall be UL approved and provided as required or shown on the drawings.
1. Lighting contactors shall be installed in NEMA 4X stainless steel enclosures unless noted otherwise on the Drawings.
  2. Lighting contactors shall have contacts rated for a minimum 30 amps of ballasted lighting/20 amps of incandescent (tungsten) lighting at 277 VAC (480 VAC if connected 2 poles to load on 1 phase or 3 poles to load on 3 phase circuits). For resistive loads the contacts shall be rated for a minimum of 30 amps at 600 VAC. Contacts shall be normally open unless noted otherwise on the Drawings.
  3. Lighting contactors shall be electrically held unless noted otherwise on the Drawings.
  4. The coil operating voltage of lighting contactors shall be 120 volts, 60 Hz unless noted otherwise on the Drawings.
  5. A HAND-OFF-AUTO selector switch shall be provided in the door of the lighting contactor enclosure. There shall be an extra set of contacts that close when the switch is in the AUTO position for connection to the Plant Control System.
  6. The following accessories shall be included with the lighting contactor:
    - a. Control circuit fuse.
    - b. Control circuit transformer with 2 primary and 1 secondary fuses.
    - c. Solid neutral terminal block.
    - d. Press-to-test pilot light wired in parallel with the contactor coil.
    - e. Lightning arrester.
    - f. 24-hour time clock.
    - g. 7-day time clock.
  7. Lighting contactors shall be Square D Class 8903 Type L, or equal.

## 2.04 ROADWAY AND YARD LIGHTING

- A. All luminaires for the roadway and yard lighting systems shall be of the sizes and types designated on the Drawings.

- B. All luminaires shall be equipped with accessories as required for proper workmanlike installation.
- C. All luminaires shall be equipped with the poles as indicated on the Drawings.
- D. All HID luminaires shall be provided with lamps and integral proper ballasting, permitting lamp starts down to -20 degrees F, and be weatherproofed.
- E. All pole mounting shall be complete with prefabricated anchor bolt assembly, leveling shims, pole base cover, grounding lug, and reinforced handhole.

## **2.05 OCCUPANCY SENSOR SYSTEM**

- A. Occupancy sensors shall have both infrared and ultrasonic detection circuits.
- B. Occupancy sensors shall be wall or ceiling mounted as shown on the drawings.
- C. Wall-mounted occupancy sensors shall have a 110-degree minimum coverage band.
- D. Occupancy sensors and control units shall be UL Listed.
- E. Operating temperature range shall be 32 to 104 degrees F with rate of change not exceeding 20 degrees F per hour. Relative humidity range shall be 0% to 95% non-condensing.
- F. Once triggered, occupancy sensors shall maintain their ON state for at least 20 minutes. Time delay may be fixed or adjustable.
- G. Control units for occupancy sensors shall operate on 120 VAC and provide the required DC voltage and current to at least three sensors.
- H. Load capacity of occupancy sensor system shall be 1800 watts incandescent or 2400 watts on 120 VAC ballasts. For higher capacity or loads on multiple circuits, use an expansion relay or lighting contactor.
- I. Occupancy sensor system shall be Hubbell ATD1600 series sensors with CU series control unit, or equal.

## **PART 3 EXECUTION**

### **3.01 LIGHTING FIXTURES**

- A. All lighting fixtures shall be securely supported with hangers approved for the purpose and the particular ceiling involved. Fixture support methods shall meet the fixture manufacturer's recommendations.
- B. Box mounted fixtures shall be mounted directly to the mounting ears of the box.
- C. Fixtures shall be supported from structural ceilings or structural supports, not suspended ceiling supports. Fixtures shall not be hung from metal deck.
- D. Installation of lay-in or recessed type fluorescent lighting fixtures, in acoustical ceilings, must be coordinated to assure that each fixture is supported at the four corners of the fixture. Support shall be capable of supporting twice the weight of the fixture.

- E. Where exposed type fluorescent lighting or track type fixtures mounted on acoustical ceiling are not hung with a main "T" runner placed in the center of the fixture, all necessary supports to transfer load to structure above shall be provided.
- F. Installation shall conform to "Specifications for Acoustical Tile and Lay-In Panel Ceiling Suspension Systems" published by the Acoustical Materials Association.
- G. Suspended fixtures shall be suspended by means of rigid conduit stems, not by chains or cords, unless noted otherwise. Wherever the stem length in hazardous locations exceeds 1 foot, lateral bracing shall be provided within 1 foot of the fixture.
- H. Fixtures shall be installed with due regard for structural systems, doors, piping, ductwork, and other mechanical equipment and related Work. Any fixture obscured with other Work shall be relocated at the Contractor's expense.
- I. Unless the mounting height of fixtures is shown on the Drawings or designated in the Project Specifications, fixtures shall not be mounted less than 9 feet above the floor unless the ceiling height will not permit such height.
- J. Job Site Conditions:
  - 1. Surfaces and structures to, and on which products will be placed and installed shall be inspected before the Work of this Section begins, and shall be capable of supporting the products. Surfaces which will be concealed by products shall be finished before products are installed. Sources of permanent power shall be connected to products only after the products have been installed, inspected, tested, and approved.
- K. Emergency fixtures shall be wired to the same branch lighting circuit as normal fixtures in the same area, but to the line side of any switch or control device.
- L. Multiwire, (shared neutral), branch circuits may be used for lighting fixtures containing ballasts when the fixture includes a switch capable of simultaneously opening all supply conductors to the ballast.
- M. Provide at least two local disconnecting means for areas served by more than one luminaire containing ballasts. The purpose of this is so no person replacing a ballast will have to work in total darkness. This does not apply to luminaires located in hazardous areas, cord and plug connected luminaires or emergency lighting.

### **3.02 ROADWAY AND YARD LIGHTING**

- A. All poles and luminaires shall be assembled and erected in full compliance with manufacturer's recommendations.
- B. Trenching and backfilling for electrical work shall be performed as specified in Section 02200.
- C. All concrete bases for roadway and yard lighting as indicated on the Drawings shall be furnished and installed under this Contract in a manner as specified in Section 03300 of this Specification.

### 3.03 OCCUPANCY SENSOR SYSTEMS

- A. Occupancy sensor control units shall be installed in NEMA rated enclosures appropriate for the area in which they are to be located.
- B. Occupancy sensors shall be mounted on the wall or ceiling in accordance with the drawings and manufacturer's instructions.

### 3.04 TESTS AND INSPECTIONS

- A. General - This Section sets forth the electrical testing procedures required for the acceptance of electrical equipment as described in the sections that follow. The purpose of the specified tests and inspections is to determine that each piece of equipment is in satisfactory condition to successfully perform its intended function. It is the intent of these procedures to ensure that all workmanship, material, the manner and method of erection and installation conform to manufacturer's instructions, IEEE and ANSI standards and NEC, except as modified herein.
- B. Responsibility - The Contractor shall perform and supervise all tests unless specifically noted otherwise herein or on the Drawings. The Contractor shall furnish all equipment required for the test performed by him and shall be responsible for providing such safety measures as are required for each test.
  - 1. The Contractor shall schedule all testing with the Engineer and no testing of any kind shall be performed without the Engineer's approval.
  - 2. The Contractor shall notify all involved parties other than the Engineer prior to test, advising them of the test to be performed and the schedule date and time.
  - 3. The Contractor shall give manufacturers sufficient notice to allow the necessary arrangements to be made and to have their engineer or representative present at tests where their presence is required. Where the manufacturer's responsibility includes both electrical and mechanical performance, the Contractor shall coordinate the tests with the others involved.
- C. Circuits and Devices - The Contractor shall show by demonstration in service that all circuits and devices are in operating condition.
  - 1. Tests shall be provided to determine that each item of control equipment will function not less than 5 times.
  - 2. The Contractor shall test all 600-volt wiring to verify that no short-circuits or accidental grounds exist. Tests shall be made using an instrument that applies 500 volts between conductor and ground.
  - 3. The conduit system shall be tested for continuity to ground.

### 3.05 CLEANING

- A. Prior to requesting final payment, Contractor shall thoroughly clean lighting fixtures and lamps.

**PART 4 SPECIAL PROVISIONS**

**4.01 FIXTURE SCHEDULE**

- A. See Drawings for fixture schedule.

**4.02 SPARE PARTS**

- A. The Contractor shall furnish at least one spare lamp for each type of light fixture installed. If more than 10 units of a type of fixture are installed, an additional spare lamp shall be furnished for each additional 10 units, or portion thereof, installed.

END OF SECTION

**SECTION 16902**  
**METERING AND CONTROL EQUIPMENT**

**PART 1 GENERAL**

**1.01 SCOPE**

- A. Work under this Section includes furnishing and installing all metering and control equipment which is part of the Plant Control System except the programmable controller system and the graphic user interface system.
- B. All Work performed shall comply and be in accordance with all approved trade practices and manufacturer's recommendations.

**1.02 SUBMITTALS**

- A. Submittals shall be in accordance with the requirements of Section 01300 and shall include:
  - 1. Shop Drawings for Review:
    - a. Manufacturer's literature including model number, type, size, materials, quantity, connections, equipment number, mounting hardware, and installation information.
  - 2. Information for the Record:
    - a. Equipment suppliers report that equipment is properly installed and satisfactory operation is obtained.
    - b. Software, cables, etc. for configuration, programming or operation of meters or equipment, minimum of two each is required.
    - c. Operation and maintenance manuals.
    - d. Schedule of Owner's training for all new equipment.

**PART 2 PRODUCTS**

**2.01 PRODUCT REQUIREMENTS**

- A. All metering and control equipment shall be as indicated on the Drawings and as specified, and shall include, but not be limited to those devices hereinafter defined. Should additional devices be required, but not specifically indicated elsewhere, in order to affect the intent of the Contract Documents, such devices shall be furnished.
- B. All metering and control equipment used for similar applications shall be the product of a single manufacturer.
- C. All features and requirements listed in the individual instrument specifications are required.

- D. All field instrument enclosures shall be NEMA 4X construction except in hazardous locations where the enclosures shall be NEMA 7 for Class I, Division 1, Group D service, unless otherwise noted. Equipment in hazardous locations shall indicate temperature rating as specified in the NEC.
- E. All faces of panel mounted instruments shall be NEMA 4X construction except where the panel is located in a protected Control Room environment.
- F. Whenever an "or equal" equipment item is proposed in lieu of that specified it will not be considered equal if it is of non-potted construction and the specified item is potted construction.
- G. All lamps to be LED.

**2.02 PERFORMANCE REQUIREMENTS**

- A. Intrinsically safe equipment shall be Factory Mutual approved for Class I, Division 1, Group D service.
- B. Analog signals for input to a programmable controller system shall be isolated 4-20 mA DC and where required, current to current transducers or other device shall be furnished to produce an isolated signal to the programmable controller analog input modules.
- C. Digital input signal sources shall provide an isolated contact rated at 5-amp minimum, 115 VAC, to the programmable controller system.
- D. Power supplies shall be furnished for two-wire transmitters and other devices requiring DC power. No more than four loops shall be powered from one power supply. Separate power supplies shall be provided for duplicate instruments to ensure failure of one power supply will not inhibit operation of secondary equipment.
- E. The Site is in an area subject to radio frequency activity. Any equipment sensitive to radio frequency interference (RFI) shall be provided with the proper RFI filters, be properly shielded and grounded, or otherwise protected to allow proper operation of the equipment.

**2.03 RESERVED**

**2.04 RESERVED**

**2.05 SIGNAL CONTROL**

- A. Pushbutton ((HN)):

Function:	Manual Operator Control
Type:	Momentary contact pushbutton unit, NEMA rating as required
Contacts:	1 NO and 1 NC minimum
	Provide contact arrangement as required to perform necessary functions
Contact Rating:	10 amps at 120 VAC, 60 Hz

Operator Type:	Momentary, color and designation per function
	Black - (Start, Run, or Open)
	Red - (Stop or Close)
	Green - (Silence)
Mounting:	Panel face, with legend plate
Manufacturer:	Allen-Bradley, or equal
Model:	800H

B. Pushbutton ((HN)):

Function:	Manual Operator Control
Type:	Maintained contact push-pull unit, NEMA rating as required
Contacts:	1 NO and 1 NC minimum
	Provide contact arrangement as required to perform necessary functions
Contact Rating:	10 amps at 120 VAC, 60 Hz
Operator Type:	Maintained, color and designation per function
	Red - (Stop or Close)
	Red Mushroom Head (Emergency Stop)
Mounting:	Panel face, with legend plate
Manufacturer:	Allen-Bradley, or equal
Model:	800H

C. Selector Switch ((HS)):

Function:	Manual Operator Control
Type:	2, 3, or 4 Position Selector Switch Unit, NEMA rating as required
Contacts:	1 NO and 1 NC maintained,
	Provide contact arrangement as required to perform necessary functions
Contact Rating:	10 amps at 120 VAC, 60 Hz
Operator Type:	Knob Lever, all positions maintained unless indicated otherwise
Operation:	Provide 2-3-4 position switch as required
	Where indicated, provide locking cylinder to prevent unauthorized switching
	Where indicated, provide spring return arrangement
Mounting:	Panel face, with legend plate
Manufacturer:	Allen-Bradley, or equal
Model:	800H

D. Selector Switch Station ((HS)):

Function:	Manual Operator Control
Type:	Heavy Duty Operators within enclosure, "Local-Off-PLC" selector switch, "Open," "Close" pushbuttons, UL listed for use in Class I, Division II, Groups A, B, C, and D



Contacts:	Hermetically sealed power reed contact blocks. Provide contact arrangement as required to perform necessary functions.
Contact Rating:	10 amps at 120 VAC, 60 Hz
Operator Type:	Type, color, and designation per function "Local-Off-PLC" - 3-position maintained selector switch Open and Close - Black momentary contact pushbutton unit
Materials:	Stainless steel enclosure, heavy-duty operators
Cable:	Provide separately
Manufacturer:	Square D, or equal
Model:	KYSS enclosure, KS43B selector switch, KR "Open" and "Close" pushbuttons, and KA50 series contact blocks

E. Pushbutton Station ((HN)):

Function:	Manual operator control and status indication
Type:	Heavy Duty Operators within enclosure, "Stop" and "Start" pushbuttons, "Running" and "Alarm" indicator lights, UL listed, NEMA 4X
Contacts:	Hermetically sealed power reed contact blocks. Provide contact arrangement as required to perform necessary functions.
Contact Rating:	10 amps at 120 VAC, 60 Hz
Operator Type:	Type, color, and designation per function Stop - Red Illuminated Mushroom Head maintained contact push-pull unit Start - Black momentary contact pushbutton unit Running - Green transformer style push-to-test pilot light
Materials:	Stainless steel enclosure, heavy-duty operators
Cable:	Provide separately
Manufacturer:	Square D, or equal
Model:	KYSS enclosure, KR "Start" pushbutton, K2LR "Stop" mushroom button, KA5 contact blocks, and KT pilot lights

F. Pushbutton Station ((HN)):

Function:	Manual operator control
Type:	NEMA 6 and 7 for temporary submergence in Class I Division 2 Group D areas
Contacts:	Factory sealed 10 Amp 600 VAC
Operator Type:	Type, color, and designation per function Two button with "Start" and "Stop" indicator plates
Features:	Safety cushioned-neoprene encapsulation to protect internal switches and connectors from damage. Built in stress relief for cable
Materials:	Steel reinforced neoprene body and cover Stainless steel strain relief and reinforcement plates and exterior hardware
Strain Relief:	Accommodates cables 0.31 – 0.75 inches diameter
Cable:	Provide separately

Manufacturer:	Crouse-Hinds, or equal
Model:	D2X8635-210

G. Manual Operating Station ((HIC)):

Function:	Auto/Manual Control Station to Display, Retransmit, and Adjust Process Variables
Type:	Electronic-Solid State
Input Signal:	Three Analog Inputs
Value:	Two configurable to provide mV, Volts, mA or resistance; plus, One- mV or mA
Impedance:	mA: 100 ohm mV, V: 10 MOhm
Input Protection:	Common mode rejection > 120 dB at 50/60 Hz with 300 Ohm imbalance resistance
Accuracy:	Linear inputs, 0 – 50 mA, 0.2%
Output Signals:	Two analog outputs and two relay outputs, SPCO rated 5A at 115/230 VAC
Analog Value:	Programmable from 0-20 ma
Impedance:	750 ohm (maximum)
Isolation:	Inputs/outputs to earth, 500 Vdc; Analog/digital outputs to rest of circuitry, 500 Vdc for 1 minute
Operating Limits:	32 to 130 degrees F, 5 to 95% RH (non-condensing)
Temperature Stability:	<0.02% per degree C, (<0.011% per degree F) Long term drift, <0.02% of reading, 20µV annually
Power Supply:	120 volt- 60 Hz
Consumption:	15 Watts (maximum)
Power Interruption Protection:	up to 60ms
Housing:	Front face NEMA 4X (IP66)
Manufacturer:	ABB, or equal
Model:	COMMANDER 351 (C3510001STD)
Accessories:	Two complete PC Configurator Kits, Part # C100/0700

2.06 INDICATION

A. Pilot Indicator Light ((JJ)):

Function:	Visual indication of process parameter, transformer type; push-to-test, 120 VAC
Type:	NEMA rating as required
Lamps:	120 VAC, 60 Hz, Incandescent, lens color as required GREEN (running or open) RED (stopped or close) AMBER (alarm) WHITE (status)
Mounting:	Front face of control panel with legend plate
Manufacturer:	Allen-Bradley, or equal

Model:	800H
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B. Indicator ((\*1)):

Function:	Visual display of process variable
Type:	Electronic Solid State
Input:	Analog
Value:	4-20 mADC
Impedance:	100 ohms
Accuracy:	Linear, $\pm 0.05\%$ of calibrated span, +/- 1 count
Output:	Visual 4-1/2 digit digital display
Value:	As required by process, for scaling unit
Noise Rejection:	
Normal Mode:	55 db (typical) at 60 Hz
Common Mode:	110 db (min)
Power:	117 VAC +/- 10%, 47-400 Hz, 3.5 watts normal
Display:	
Type:	High-Brightness, 0.56-inch LED
Polarity:	Positive assumed, negative sign displayed
Decimal Points:	Selected by internal "solder bridge"
Overrange:	An above range input will blank out all digits and display a "1"
Environmental:	
Operating:	+5 to 55 degrees C
Storage:	-20 to +85 degrees C
Dimensions:	4.5-inch W x 2.24-inch H x 2.92-inch D
Manufacturer:	Precision Digital Corporation, or equal
Model:	PD6000

**2.07 RESERVED**

**2.08 FLOW**

A. Flow Element and Transmitter ((FE))/(FIT)):

Function:	Measure, indicate and transmit the process flow in a full pipe. Meter must be a full bore meter with the magnetic field traversing the entire cross section of the flow tube. Insert magmeters or multiple single point probes inserted into a spool piece are not acceptable. Magnetic flow meter, operating based with high impedance electrodes. Flow tube with two coils mounted outside a 304 stainless steel tube, transmitter, interconnection cables and mounting hardware.
Type:	Pulsed DC magnetic induction with absolute zero stability
Size:	As specified on Drawings and in Schedule
Input Signal:	Analog Process Flow
Conductivity:	Minimum 5 Micromho/cm
Process Temperature:	-10 to +130 degrees F

Outputs:	Isolated 4-20 mA DC into 1,000 ohms. Scaled pulse outputs as standard.
	Flow direction, empty pipe detection, configurable status two contact outputs and one contact input for zero contact return.
Display:	Backlight LCD capable of simultaneously displaying flow rate and totalization
Calibration:	Provide with each flow meter a printout of two points of calibration starting at 1 FPS with measurement devices traceable to NIST standards. Three minute 1.5 x PN- All meters shall have internal meter verification diagnostic.
Accuracy:	+/- 0.25 percent rate or less (3 to 33 ft/sec) or +/- 0.005 percent FPS below 1 FPS
Repeatability:	+/- 0.1 percent of reading
Range ability:	100:1 turndown
Selectable Damping:	0.01 to 99.99 seconds, configurable
Low Flow cutoff:	0 to 10 percent, configurable
Electrodes:	Hastelloy C, bullet nosed electrodes on wastewater and flush electrodes on clean fluid. Titanium or others for chemical feed applications. It is the manufacturer's responsibility to provide materials comparable with the process medium.
Liner:	Polyurethane, hard rubber, neoprene for sewage meters. Ebonite, Teflon or Tefzel for all sludge meters (RAS, WAS, thickened). Meters 14 inches and larger shall have a poly-urethane or hard rubber liner. All meters specified in potable water lines shall have an NSF 61 or FDA approved liner.
Flow Tube:	
0-12 inches:	304 or 316 stainless steel, meters 0-12 inches shall be capable of accidental submergence with 30 feet of cable to remote converter. Meters located below grade or in a meter vault shall be NEMA 6P rated with 100 foot cable. Cable shall be factory installed and potted. Compound mixtures installed in the field are not acceptable. All meter housings shall be of a welded design.
12-72 inches:	304 or 316 stainless steel shall be capable of continuous submergence in 30 feet of water with cable to remote converter.
End Connections:	
0-4 inches	150 lb. ANSI carbon steel or wafer design
6-24 inches	150 lb. ANSI carbon steel flanges
30-78 inches	Class D AWWA flanges
Lay length	All meters should comply with ISO 13359 lay lengths
Grounding:	All meters must be supplied with orifice type 316 stainless steel grounding rings. Grounding electrodes are not acceptable. Meters shall have 316 grounding straps.
Converter:	Microprocessor based remote converter. Refer to drawings for cable length. Only one conduit between flow tube and converter. Three totalizers for forward, reverse and net.
Power Requirements:	110/120 VAC 50/60 Hz.

Transmitter Enclosure:	NEMA 4X die cast aluminum rectangular housing immune to RFI inference, with flow rate and totalization indication.
Electrical Rating	All meters installed in a wastewater treatment plant shall be FM approved Class 1 Division 2 Grounds A, B, C and D. Meter shown on drawings in Class 1 Div 1 area shall be rated for that area.
Ambient Temperature:	-40 to 150 degrees F
Manufacturer:	Endress & Hauser 53W Promag, Rosemount 8700 Series or Johnson Yokagawa ADmag, Siemens 3100, or equal.
Model:	Manufacturer shall be ISO 9001 compliant and meters shall have a two year standard warranty. All meters shall have a stainless steel tag. All meters shall have internal meter verification along with coating, ground loop and process noise diagnostics. All meters shall have empty pipe direction with contact inputs for zero return.

**2.09 RESERVED**

**2.10 PRESSURE ELEMENTS AND TRANSMITTERS**

A. Pressure Transmitter ((PE)/(PIT)):

Function:	Measure process pressure and transmit signal proportional to pressure
Type:	Capacitor sensing element and electronic solid state transmitter with integrated LCD display
Input Signal:	Analog Process Pressure
Output Signal:	4-20 mA DC
Accuracy:	+/- 0.25% of span, including combined effects of hysteresis and repeatability
Stability:	+/- 0.2% of upper range limit for six months
Temperature Effect:	+/- 0.5% of upper range limit per 100 degrees F
Span and Zero:	Adjustable up to 10% of calibrated span
Damping:	Time constant continuously adjustable between minimum and 1.6 seconds
Temperature Limits:	-40 to +220 degrees F sensing element operating -40 to +200 degrees F amplifier operating
Fill Fluid:	Silicone
Wetted Parts:	Hastelloy C diaphragm, drain and vent valve, Viton O-ring
Diaphragm Seals:	To be provided where required to achieve instrument functionality or process isolation. Fill fluid and stiffness to be selected to minimize temperature effect. Direct flange mount where transmitter accessibility is not impeded. Capillaries and process connection taps shall be sized and located to minimized head and temperature effects.
Process Connection:	316 SS, integral 3-valve manifold with test pressure connections to be included
Power Requirements:	24 VDC
Housing:	Low-copper aluminum, NEMA 4X

Accessories:	One handheld HART communicator required for every four units, factory calibration certificate
Manufacturer:	Rosemount, Siemens, or Foxboro
Model:	1151 Series, or equal

**2.11 RESERVED**

**2.12 RESERVED**

**2.13 ANALYTICAL**

A. Chlorine Residual Analyzer ((AE)/(AIT)):

Function:	Continuous free residual chlorine monitoring, transmit signal proportional to chlorine residual
Type:	Free and total residual analysis, microprocessor based control unit using DPD colorimetric method, integrated LCD display
Performance Criteria:	Standard Methods 408.E
Range:	0 to 5 mg/l free or total chlorine residual
Outputs:	4-20 mA programmable over span, 130V isolation from earth ground,
	Two SPDT, 5A @ 230 VAC, relay contacts configurable for sample concentration alarm, system warning, and system shutdown alarms
Display:	Integral LCD indicator and alarm status LED
Resolution:	0.035 mg/l
Accuracy:	+/- 5% or 0.035 mg/l, whichever is greater
Repeatability:	Within 0.05 mg/l
Cycle Time:	One sample analysis every 2-1/2 minutes
Sample Flowrate:	Minimum 200 ml/min
Sample Inlet Pressure:	1.5 to 75 psig
Ambient Temperature:	41 to 104 degrees F
Power Requirements:	120 VAC, 90 VA max
Enclosure:	NEMA 12
Installation:	Sample supply line shall be provided with hot tap in process piping. Tap location and drain line routing shall be approved by Owner/Engineer.
Accessories:	Sample supply line including ball valve and pressure regulators (adjustable and preset), drain line, maintenance kit, Y-strainer, and (3) reagent kits for each analyzer
Manufacturer:	Hach Company
Model:	CL17, or equal

**2.14 ACCESSORIES**

- A. All piping and tubing for connections to instruments shall be stainless steel. Threaded pipe shall be ASTM A312, Grade TP304, Schedule 40S, and fittings shall be AISI Type 304. Tubing shall be ASTM Grade TP304, 0.028-inch minimum wall thickness for flareless "bite" type with threaded nut and ferrule fittings.

- B. Valves shall be stainless steel eccentric plug valves with a bolted-on non-removable lever actuator. Valves shall be equal to DeZuric Figure 130 with synthetic rubber faced plugs. Valves shall have screwed or flanged ends as required. Valves for gas service shall be designed for gas service and shall provide leak-proof shutoff.
- C. Diaphragm seals shall provide continuous isolation between pressure gauges, switches, and transmitters from process fluid. Upon instrument removal or failure, there shall be no leakage. Seals shall be of the type to allow instrument and diaphragm top housing to be removed from the process piping with no leakage of process fluid. Seal fill fluid shall be incompressible, non-corrosive, and suitable for materials of construction and temperature encountered, and shall be selected to minimize temperature effect. Sludge piping process connections shall be 1-1/2-inch, 150 pound flanged. Gas and water piping process connections shall be 3/4-inch NPT. All instrument piping connections shall be 1/2-inch or 1/4-inch NPT, as required. All process connections shall have a 1/4-inch NPT flushing connection with a 316 SS plug.
- D. All mechanical fasteners such as bolts, nuts, screws, cinch anchors, clamps, etc., shall be stainless steel.
- E. All special mounting brackets shall be stainless steel, galvanized, or nonferrous non-corrosive metal.
- F. All equipment mounted outdoors that includes any type of visual indicator, LCD, etc., shall be furnished with a sun visor.
- G. All equipment located outdoors shall include a thermostatically controlled space heater.
- H. All field instruments and devices shall be equipped with a 1-inch by 3-inch stainless steel identification tag firmly affixed to the instrument or device with stainless steel fasteners. Each tag shall show the manufacturer's name, serial number, part number, tag number (to be approved by the Engineer), calibrated ranges, or calibration constants.
- I. For each type of device installed, the Contractor shall supply two complete sets of software, hardware, calibration devices, and cabling, used to configure, calibrate, or make adjustments.

## **PART 3 EXECUTION**

### **3.01 GENERAL**

- A. The features and installation of the instrumentation shall be coordinated for optimal performance with the characteristics of the process material to be metered.
- B. Care must be exercised to identify locations that meet the requirements of the manufacturer including upstream and downstream distances, pressures, temperatures, and accessibility for maintenance.
- C. Verify equipment requirements and dimensions with provisions specified under this Section. Check actual field conditions, report necessary changes, and submit equipment reflecting changes.

- D. Coordinate Work with other trades to avoid conflict and to provide correct rough-in and electrical connection requirements. Inform Contractors of other trades of the required access to and clearances around equipment to maintain serviceability and code compliance.
- E. Where the installation of any device is dependent on, or affected by, Work performed under other sections of these specifications, the Contractor shall coordinate the Work. Installation coordination includes the correct location and placement of devices, piping to the equipment, pipe taps, control power circuits, connections to the control system, etc.
- F. Installation of instrumentation in an existing system being modified, replaced, or abandoned, shall be coordinated with the Owner and shall be performed to minimize operational disruptions and minimize time that equipment may be out of service.

**3.02 INSTALLATION**

- A. Installation shall include the provision of materials, and the coordination of all details, necessary to properly install the instruments including location, arrangement in piping, power source, signal wiring and conduit, special brackets, and all mounting hardware.
- B. All instrumentation devices shall be installed in accordance with the manufacturer’s installation requirements.
- C. Wiring practices for intrinsically safe systems shall be in accordance with ISA RP12.06.01.
- D. Instruments shall be installed so that the various components are accessible for maintenance. Care shall be taken in the installation to ensure sufficient space is provided between instruments and other equipment, including piping, for ease of removal and servicing. All instruments shall be readily accessible from grade, permanent platforms, or fixed ladders.

**3.03 STARTUP AND TRAINING**

- A. The Contractor shall provide the services of component manufacturer’s factory trained personnel for the supervision of installation, initialization, and calibration of equipment.
  - 1. These services shall also include a minimum of one eight-hour day to instruct the Owner’s personnel in the operation and maintenance of the equipment. Specifically, these services shall be provided for but not limited to the following equipment items: All new equipment that is provided by Contractor.

Specification Subsection	Description



**PART 4 SPECIAL PROVISIONS**

**4.01 GENERAL**

- A. Schedules included herein are intended to supplement the Drawings and are not guaranteed to be complete. All instrumentation devices shown in the Contract Documents or otherwise required to complete the Work shall be furnished and installed.

**4.02 FLOW INSTRUMENT SCHEDULE**

- A. The following schedule is a listing of new flow devices to be installed.
- B. The following letter designations are used in the schedule:

Item Designation:

FT-1	First Letter	F	=	Indicates Flow Device
	Second Letter	T	=	Function, Transmitter
	Number	1	=	Item Number

Function:

S	Switch
I	Indicator
T	Transmitter

- C. Flow devices are numbered on the Drawings and scheduled as follows:

Item Designation	Function	Pipe Size	Range scfm/gpm	Process psig/in. H2O	Process Conditions	Power Supply	NEMA Rating	Dwg No.	Spec No.
FIT/FE-1	Pump Station Flow	12-inch	1500 -3500	80-94	City Water	120V	4X	E-4	2.08 A

**4.03 PRESSURE INSTRUMENT SCHEDULE**

- A. The following schedule is a listing of pressure assemblies including: gauges, diaphragm and in-line chemical seals, pressure transmitters, and pressure switches. Each line item requires a snubber (Ashcroft Type 1106S) and shut-off valve (Ashcroft Type 7004). Each line item so indicated shall include accessories shown.
- B. The following letter designations are used in the schedule:

Item Designation:

PT-1	First Letter	P	=	Indicates Pressure Device
	Second Letter	T	=	Function, Transmitter
	Number	1	=	Item Number

Function:

E	Element or Sensing Device
S	Switch Only
I	Indicator Only
T	Transmitter

Tap Size:

1-1/2-inch	Sludge
3/4-inch	Water and Gas
1/2-inch	Air

Service Pipe Size - As shown on the Drawings

Type:

P	Pressure
C	Compound

Note: Unless noted, all compound pressure gauges shall have 0-30-inch Hg vacuum range.

C. Pressure instruments are numbered on the Drawings and scheduled as follows:

Item No.	Function	Range/Setpoint	Seal	Tap Size	Power Supply	NEMA Rating	Dwg No.	Spec No.
PE/PT-5	Inlet pressure	30-50		1-inch	120v	4x	E-4	2.10
PE/PT-6	Outlet pressure	80 to95		1-inch	120v	4x	E-4	2.10

**4.04 ANALYTICAL INSTRUMENT SCHEDULE**

A. The following schedule is a listing of analytical devices including: gas detection, chlorine residual monitors, turbidity, etc.

B. The following letter designations are used in the schedule:

Item Designation:

AIT-1	First Letter	A	=	Indicates Analytical Device
	Second Letter	I	=	Function, Indicator
	Third Letter	T	=	Function, Transmitter
	Number	1	=	Item Number

Function:

C	Controller
S	Switch
I	Indicator
T	Transmitter

C. Analytical instruments are numbered on the Drawings and scheduled as follows:

Item No.	Function	Range	Power Supply	NEMA Rating	Dwg No	Spec No.
AE/AIT-1	Inlet Cl residual	0-10 mg/L	120v	4x	E-4	2.13

END OF SECTION

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**SECTION 16903  
CONTROL PANELS**

**PART 1 GENERAL**

**1.01 SCOPE**

- A. Work under this Section includes the fabrication and installation of all control panels and other enclosures required to provide a complete instrumentation and control package. Panel wiring is also included herein.
- B. All control panels furnished or installed under this contract shall meet the requirements of this Section. Panels include, but are not limited to, those designated control panels, interim panels, enclosures, remote I/O panels, or other required enclosures necessary to complete the Work.

**1.02 SUBMITTALS**

- A. Submittals shall be in accordance with the requirements of Section 01300 and shall include:
  - 1. Shop Drawings for Review:
    - a. Submittals shall show door arrangement and device layout, wireways, subpanel layout, padlock and vault type locking handle, dimensions, legends, terminal blocks, and terminations, etc.
    - b. Panel schematic wiring diagrams shall be provided to show all panel wiring systematically numbered. All devices shall be identified by device symbol designation; all lines and points shall be numbered. Each line shall be identified by function.
    - c. Furnish manufacturer's name, catalog numbers, and product specifications for each component and panel to be furnished.
  - 2. Information for the Record:
    - a. Operation and maintenance manuals.
    - b. Upon completion of the installation and acceptance by the Owner and Engineer, all electrical (schematic) diagrams, interconnection diagrams, panel layouts, and related support materials shall be corrected and amended to reflect the installed system.

**1.03 QUALITY ASSURANCE**

- A. All control panel enclosures shall be UL listed and designed in accordance with applicable NEMA, ANSI, and UL 508 Standards.
- B. All wiring and terminations shall be designed, manufactured, and tested in accordance with the latest applicable standards of the NEC as well as state and local codes.

- C. Control panels shall conform to third party safety certification. The assembled control panel shall bear a serialized UL label listed for "Industrial Control Panels" UL 508A. The enclosure, and all components mounted thereto shall conform to UL descriptions and procedures.

## PART 2 PRODUCTS

### 2.01 ENCLOSURES

- A. All enclosures shall be Hoffman Enclosures, Inc., Bulletin A4, A12, A19, or A30 as specified, or equal.
- B. All equipment and controls shall be mounted in metal enclosures designed and manufactured in accordance with the applicable standards of NEMA, ANSI, and UL 508A Standards. Panels shall be floor-mounted, free standing or wall mounted (as determined by manufacturer's mounting provisions for the size and type of panel).
- C. Enclosures in a Control Room shall be NEMA 12 rated. Enclosures not located in a Control Room shall be NEMA 4X rated, nonventilated stainless steel unless noted otherwise.
- D. Enclosures shall have a rolled lip around all sides of the opening so that a drip hood is not required.
- E. Single door enclosures shall be hinged left with removable hinge pins. All NEMA 12 rated panel doors shall incorporate a vault type handle with 3-point latching mechanism for securing the door in closed position and door locks shall be keyed alike. NEMA 4X rated panel doors shall be furnished with padlock hasp and padlocks, all keyed alike. NEMA 4X rated panel doors shall be held closed with hardware certified compatible with the epoxy resin coating or stainless steel. Only smooth rubber gasket material shall be used for providing the door seal.
- F. Double door enclosures shall have a removable center mullion and overlapping doors with three-point latching mechanisms with oil tight keyed locking handles, all keyed alike.
- G. Removable "eye" bolts shall be provided to facilitate slinging and handling of enclosures. "Eye" bolts shall be mounted directly to and be part of the enclosure structural members so as to distribute the stresses and weight while slinging.
- H. Panels shall have print pockets attached inside the door, as space permits.
- I. Cover boxes, enclosures; etc. regardless of size with front mounted devices shall have a hinged door unless noted otherwise.
- J. Panel layout and equipment spacing shall be sufficient to allow for device removal and maintenance without disassembly of adjacent devices. Additionally, ample panel gutter space (sides, top, and bottom) shall be provided for training wires and cables.
- K. The Contractor shall properly size each enclosure, allowing 20% back panel spare space. Each enclosure shall be sized as specified herein or shown on the Drawings, or to suit

the physical dimensions required for components and heat requirements of the components mounted within, whichever is the largest.

- L. Control panel doors shall not exceed 36 inches in width.
- M. Control panel depth shall not be less than 8 inches.
- N. Floor mounted type enclosures shall be provided with floor stands. The legs of floor-mounted enclosures shall be at least 12 inches high.

**2.02 PLC AND REMOTE I/O ENCLOSURES**

- A. Programmable controller system enclosures shall include, in addition to those general requirements previously listed:
  - 1. Power supply and distribution equipment.
  - 2. All I/O wiring from the modules, including spares, wired to terminal strips.
  - 3. The main processor chassis, I/O chassis as required, power supplies and power strips.
  - 4. A constant-voltage, filtered power supply shall be provided for all AC loads or an uninterruptible power supply.
  - 5. Circuitry and devices for a POWER ON indicating light.
  - 6. A 15 amp, specification grade, duplex receptacle, and interior fluorescent lighting switched by a door operated switch, both powered from a circuit separate from the control voltage circuit.
- B. All panel enclosures housing a PLC shall be of sufficient size to house any required analog output power supplies, properly sized wiring channel and wiring terminals sufficient in number to terminate all incoming and outgoing wiring of the enclosures, plus enough spares to wire all spare points in the I/O chassis assuming worst case conditions (all 120VAC inputs).

**2.03 POWER, INSTRUMENTATION, AND CONTROL WIRING**

- A. Panel interior control wiring shall be a minimum of No. 16 AWG-MTW, 2/64 PVC insulation, and 90 degrees C rated for AC connections. Nylon jacketed and/or TFFN wire will not be accepted. Thermoplastic wire cover shall be colored:

RED	for AC wires
DARK BLUE	for DC wires
CANARY YELLOW	all foreign wiring inside the panel not being de-energized by the panel feed circuit breaker
GREEN	all ground wire connections
BLACK	for power source
WHITE	for power neutral
LIGHT BLUE	intrinsically safe system

- B. Signal conductors shall be as specified in Section 16121.

- C. Power wiring shall be 600 volts and as specified in Section 16120. Conductors shall be stranded copper. No wire smaller than No. 12 AWG shall be used for power wiring.
- D. All wire in control enclosures shall be identified at each terminal with wire identification tags as specified in Section 16030.

#### **2.04 ENCLOSURE ACCESSORIES**

- A. Terminal blocks shall be Allen Bradley 1492 - W4 or equal. The Contractor shall allow 20% extra terminal connections in addition to those terminals required for the termination of spare control conductors and instrument cables.
- B. Outdoor NEMA 4X rated enclosures shall have condensation protection and temperature control to maintain equipment manufacturer's specified operating temperatures. Condensation protection and temperature control shall be typical for all such enclosures and shall be sized accordingly and thermostatically controlled. Condensation protection and temperature control shall be Hoffman Enclosures Inc. - Bulletin D85, or equal.
- C. Plastic wireway shall be used to train wires in all control panels and enclosures. Wireway fill shall not exceed 20% and shall be run in continuous lengths with snap-on type covers.
- D. Each panel shall have a panel grounding bus bonded to the panel enclosure and a braided grounding strap connecting the panel door(s) to the panel enclosure frame.
- E. Nameplates and legends shall be per Section 16030.

#### **2.05 FABRICATION**

- A. Equipment, controls, and devices specified elsewhere and shown on the Drawings shall be mounted in enclosures manufactured in accordance with applicable NEMA, ANSI, and UL 508A Standards. All devices shall be mounted in accordance with the component manufacturer's recommendation. Devices shall be adequately supported and organized so that operation and maintenance access is unrestricted.
- B. All necessary inner panels and supporting members shall be provided by the Contractor.
- C. To minimize future maintenance problems, all panel enclosures shall be provided by one manufacturer to the extent that it is possible.
- D. All panel wiring shall terminate at terminal blocks unless noted otherwise. Wire numbers shall be marked on an integral marker strip in numerical sequence for each individual block.
- E. Instrumentation designs shall be such that analog signals that do not leave the enclosure shall be wired direct, without splices or terminals, from instrument to instrument unless accomplished in accordance with other provisions of these specifications.
- F. Signal wiring shall be segregated and shielded from control and power wiring, grouped functionally, and arranged neatly to facilitate tracing of circuits.

- G. No combination of analog, digital input, or control output wiring should be intermixed within the same bundle or duct. All analog wires shall be justified right while discrete 120 VAC wires shall be justified left.
- H. Plastic wiring wraps shall be used to bundle wires, except within wiring ducts. The bundles shall be securely fastened to the steel structure at suitable intervals, not exceeding 12 inches.
- I. Required device holes shall be provided by the panel manufacturer and punched prior to coating. No extra holes or field cut holes shall be permitted unless approved by Owner or Engineer.
- J. Door or cover mounted panel devices shall not be located less than 30 inches above the finished floor. Door and cover mounted devices (i.e., pushbuttons, pilot lights, selector switches, meters, etc.) mounted in NEMA 12 and 4X enclosures shall, in addition to standard gaskets, be sealed with silicone grease compound as manufactured by Dow-Corning (No. 732), or equal.
- K. Panels containing 480 volt power wiring contained within shall have a defeatable (disconnect switch) mounted on the panel front exterior to prevent opening the panel while the switch is in the ON position.
- L. Panels containing 120-volt power (except canary yellow foreign wiring powered elsewhere) shall have provided inside the enclosure a properly sized fused isolation switch or circuit breaker.
- M. Floor mounted and free-standing enclosures shall be equipped with an interior, 15 amp, specification grade duplex receptacle and interior fluorescent lighting. A switch shall be provided to control the lighting unless noted otherwise in these specifications. The receptacle and light shall be powered from a circuit separate from the control voltage circuit.
- N. Panel shall have sufficient structural reinforcement to ensure a flat plane surface, to limit vibration, and to provide rigidity during shipment, installation, and operation, without distortion or damage to the panel or damage to any instrument mounted thereon. Minimum thickness of panels shall be:
  - 1. Single door wall mounted up to 48-inch high by 36-inch wide by 16-inch deep shall be a minimum of 14-gauge steel.
  - 2. Floor-mounted, wall-mounted, and free-standing panels larger than the above shall be a minimum of 12-gauge steel with angle reinforcement.
- O. Joined edges, corners, and seams shall be of a continuous bead weld (filler or dubbing shall not be permitted), and ground to a finish so as not to be detectable after painting. Spot welds shall be used only to connect flat metal surfaces to structural support bracing to provide rigidity. Panels with any warping due to welding procedures or any other cause shall be rejected.



- P. Panels shall be bonderized or cold phosphated before painting. NEMA 12 rated panel shall be primed and factory finished with two coats of ANSI color baked enamel. The color is to be selected by the Owner. NEMA 4X rated panels shall be primed and coated with a powdered resin, heat-cured, 100% solid thermosetting epoxy, unless the enclosure is stainless steel. Interior surfaces shall be high-gloss white, and the exterior surfaces shall be a high-gloss color to be selected by the Owner.
- Q. The inner-mounting panel shall be a minimum of 12 gauge for single door enclosures and 10 gauge for double door enclosures. The panel shall be mounted with stainless steel fasteners and coated the same as panel interior.
- R. Equipment mounted within free standing and floor-mounted control enclosures shall not be located such that it will be less than 18 inches above the mounting surface (floor, housekeeping pad, platform, etc.) after installation in the field.
- S. Outdoor enclosures shall have their operator controls, (such as, but not limited to: pushbuttons and selector switches), mounted on a steel inner swing-out panel unless noted otherwise on the drawings. The swing-out panel mounted controls shall be accessible only after opening the lockable outer door.
- T. Indicators and control operators mounted through the exterior of control enclosures shall be at least 30 inches above the walking surface (floor, housekeeping pad, platform, etc.) after installation in the field. The only exception to this rule will be alarm horns, speakers, and similar audible devices.

### **PART 3 EXECUTION**

#### **3.01 COORDINATION**

- A. Panel location and clearances shall be in compliance with the NEC.

#### **3.02 INSTALLATION**

- A. Each conduit penetration of the panel shall be made in accordance with the manufacturer's recommendations. Each panel penetration shall comply with requirements to maintain NEMA ratings specified. No remaining holes or knockouts will be permitted except for power wiring entrances, signal wiring entrances, and mounting hole for any future panel mounted device(s). Holes shall be covered with a plastic plate. Conduit entrances shall be from the bottom of the enclosure first; then if bottom is not practical, the sides of the enclosure will be used. All panel mounted equipment will be protected from metal shavings, moisture, and debris while working in enclosures.
- B. Install wiring between panel mounted devices and field devices as specified in Section 16120.
- C. Check connectors, terminals, bus joints, and mountings for tightness. Tighten field-connected connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL Standards 486A and UL 486B.

- D. Provide equipment grounding connections for individually mounted units as indicated and as required by the NEC. Tighten connectors to comply with tightening torques specified in UL Standard 486A to assure permanent and effective grounding.
- E. Upon completion of installation, inspect devices, and remove paint splatters, other spots, dirt, and debris. Touch up scratches and mars of finish to match original finish.
- F. The bottom of wall-mounted control enclosures shall be at least 18 inches above the floor or platform. Use galvanized or aluminum unistrut when attaching control enclosures to vertical surfaces. Consideration shall be given to compatibility of unistrut and control panel metal surfaces in contact with one another.
- G. The mounting of each panel shall allow for a minimum of 30-inch wide by 42-inch deep work area and door opening clearance of 90 degrees in front of panel to accommodate suitable room to open panel door and to provide the necessary work area.
- H. Each floor mounted or freestanding panel shall be installed on a 4-inch thick housekeeping pad, continuous under the panel and extending 1-inch out from all sides. Pads shall have a 1/2-inch chamfer on all sides, except against walls.

### **3.03 IDENTIFICATION**

- A. Identify panel and components in accordance with Section 16030.
- B. Individual nameplates shall be labeled to match the single line and schematic drawings.

## **PART 4 SPECIAL PROVISIONS**

### **4.01 TELEMETRY PANEL**

- A. The new telemetry panel is being assembled and provided by PAC Engineering, 734-708-4722.
- B. The Contractor shall schedule delivery of the panel from PAC.
- C. The Contractor shall install panel and land all wiring.
- D. PAC shall complete panel check out and programming. Contractor shall coordinate scheduling PAC for these services and provide a technician to assist with the checkout.

END OF SECTION

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"General Decision Number: MI20230092 02/24/2023

Superseded General Decision Number: MI20220092

State: Michigan

Construction Type: Building

County: Monroe County in Michigan.

BUILDING CONSTRUCTION PROJECTS (does not include single family homes or apartments up to and including 4 stories).

Note: Contracts subject to the Davis-Bacon Act are generally required to pay at least the applicable minimum wage rate required under Executive Order 14026 or Executive Order 13658. Please note that these Executive Orders apply to covered contracts entered into by the federal government that are subject to the Davis-Bacon Act itself, but do not apply to contracts subject only to the Davis-Bacon Related Acts, including those set forth at 29 CFR 5.1(a)(2)-(60).

If the contract is entered into on or after January 30, 2022, or the contract is renewed or extended (e.g., an option is exercised) on or after January 30, 2022:	. Executive Order 14026 generally applies to the contract. . The contractor must pay all covered workers at least \$16.20 per hour (or the applicable wage rate listed on this wage determination, if it is higher) for all hours spent performing on the contract in 2023.
If the contract was awarded on or between January 1, 2015 and January 29, 2022, and the contract is not renewed or extended on or after January 30, 2022:	. Executive Order 13658 generally applies to the contract. . The contractor must pay all covered workers at least \$12.15 per hour (or the applicable wage rate listed on this wage determination, if it is higher) for all hours spent performing on that contract in 2023.

The applicable Executive Order minimum wage rate will be adjusted annually. If this contract is covered by one of the Executive Orders and a classification considered necessary for performance of work on the contract does not appear on this wage determination, the contractor must still submit a conformance request.

Additional information on contractor requirements and worker protections under the Executive Orders is available at <http://www.dol.gov/whd/govcontracts>.

Modification Number	Publication Date
0	01/06/2023
1	02/03/2023

ASBE0045-005 07/01/2022

	Rates	Fringes
ASBESTOS WORKER/HEAT & FROST INSULATOR.....	\$ 35.01	30.61

BOIL0085-003 01/06/2014

	Rates	Fringes
BOILERMAKER.....	\$ 31.82	24.48

\* BRMI0001-001 06/01/2022

	Rates	Fringes
BRICKLAYER.....	\$ 38.87	25.18
TILE FINISHER.....	\$ 30.75	22.67
TILE SETTER.....	\$ 37.88	22.67

CARP0687-004 06/01/2021

	Rates	Fringes
CARPENTER (Including Acoustical Ceiling Installation; Drywall Hanging, Finishing/Taping; Form Work; Metal Stud Installation; & Scaffold Building).....	\$ 35.16	29.22

CARP1102-002 06/01/2020

	Rates	Fringes
MILLWRIGHT.....	\$ 35.30	34.10

ELEC0008-006 05/25/2022

	Rates	Fringes
ELECTRICIAN, Excludes Low Voltage Wiring.....	\$ 44.79	1.5%+15.61

ENGI0324-017 06/01/2022

	Rates	Fringes
OPERATOR: Power Equipment		
GROUP 1.....	\$ 46.44	24.95
GROUP 2.....	\$ 44.94	24.95
GROUP 3.....	\$ 43.44	24.95
GROUP 4.....	\$ 43.14	24.95
GROUP 5.....	\$ 42.32	24.95
GROUP 6.....	\$ 41.46	24.95
GROUP 7.....	\$ 40.49	24.95
GROUP 8.....	\$ 38.78	24.95
GROUP 9.....	\$ 30.44	24.95

FOOTNOTES:

Tower cranes: to be paid the crane operator rate determined

by the combined length of the mast and the boom. If the worker must climb 50 ft. or more to the work station, \$.25 per hour additional.

Derrick and cranes where the operator must climb 50 ft. or more to the work station, \$.25 per hour additional to the applicable crane operator rate.

POWER EQUIPMENT OPERATOR CLASSIFICATIONS

GROUP 1: Crane with boom and jib or leads 400' or longer

GROUP 2: Crane with boom and jib or leads 300' or longer

GROUP 3: Crane with boom and jib or leads 220' or longer

GROUP 4: Crane with boom and jib or leads 140' or longer

GROUP 5: Crane with boom and jib or leads 120' or longer

GROUP 6: Regular crane operator, and concrete pump with boom operator

GROUP 7: Backhoe/Excavator/Trackhoe, bobcat/skid Loader, broom/sweeper, bulldozer, grader/blade, highlift, hoist, loader, roller, scraper, tractor & trencher

GROUP 8: Forklift & extend-a-boom forklift

GROUP 9: Oiler

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IRON0055-014 07/01/2022

	Rates	Fringes
IRONWORKER		
Metal Building Erection.....	\$ 23.59	19.35
Reinforcing & Structural....	\$ 33.00	27.20

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LAB00334-005 06/01/2022

	Rates	Fringes
LABORER: Landscape & Irrigation		
GROUP 1.....	\$ 23.82	7.60
GROUP 2.....	\$ 21.60	7.60

CLASSIFICATIONS

GROUP 1: Landscape specialist, including air, gas and diesel equipment operator, lawn sprinkler installer, skidsteer (or equivalent)

GROUP 2: Landscape laborer: small power tool operator, material mover, truck driver and lawn sprinkler installer tender

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LAB00499-003 06/01/2022

	Rates	Fringes
LABORER		

Common or General; Grade Checker; Sandblaster.....	\$ 31.16	14.95
Mason Tender - Brick; Mason Tender - Cement/Concrete.....	\$ 31.63	14.95
Pipelayer.....	\$ 31.71	14.95

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PAIN0022-006 06/01/2022

	Rates	Fringes
PAINTER: Brush and Roller.....	\$ 32.85	20.41
PAINTER: Spray.....	\$ 26.86	17.66

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PAIN0357-002 06/01/2022

	Rates	Fringes
GLAZIER.....	\$ 37.15	20.98

PAID HOLIDAYS: New Year's Day, Decoration Day, Fourth of July, Labor Day, Thanksgiving Day and Christmas Day; provided that the employee has worked the last full regular scheduled work day prior to the holiday, and the first full regular scheduled work day following the holiday, provided the employee is physically able to work.

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PLAS0067-001 04/01/2014

	Rates	Fringes
CEMENT MASON/CONCRETE FINISHER...	\$ 30.63	14.07

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PLUM0671-001 07/01/2022

	Rates	Fringes
PIPEFITTER (Including HVAC Pipe Installation; Excluding HVAC System Installation).....	\$ 43.76	23.94
PLUMBER, Excludes HVAC Pipe and Unit Installation.....	\$ 43.76	23.94

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ROOF0134-002 07/01/2021

	Rates	Fringes
ROOFER.....	\$ 29.07	22.51

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SHEE0033-014 07/01/2011

	Rates	Fringes
SHEET METAL WORKER, Includes HVAC Duct and Unit Installation.....	\$ 30.80	21.51

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TEAM0247-002 06/01/2018

	Rates	Fringes
TRUCK DRIVER GROUP 1 Dump; Flatbed; Pickup.....	\$ 26.71	0.70+a

GROUP 2		
Semi.....	\$ 26.86	0.70+a
GROUP 3		
Lowboy.....	\$ 26.96	0.70+a

PAID HOLIDAYS: New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day and Christmas Day. If any of the above holidays fall on a Sunday, the following Monday shall be considered the holiday and, if work is performed, the rate shall be double time.

FOOTNOTE:

a. \$456.70 per week, plus \$67.10 per day.

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 \* SUMI2011-017 02/01/2011

	Rates	Fringes
IRONWORKER, ORNAMENTAL.....	\$ 18.48	7.93
TRUCK DRIVER: Tractor Haul Truck.....	\$ 13.57 **	1.18

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WELDERS - Receive rate prescribed for craft performing operation to which welding is incidental.

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\*\* Workers in this classification may be entitled to a higher minimum wage under Executive Order 14026 (\$16.20) or 13658 (\$12.15). Please see the Note at the top of the wage determination for more information.

Note: Executive Order (EO) 13706, Establishing Paid Sick Leave for Federal Contractors applies to all contracts subject to the Davis-Bacon Act for which the contract is awarded (and any solicitation was issued) on or after January 1, 2017. If this contract is covered by the EO, the contractor must provide employees with 1 hour of paid sick leave for every 30 hours they work, up to 56 hours of paid sick leave each year. Employees must be permitted to use paid sick leave for their own illness, injury or other health-related needs, including preventive care; to assist a family member (or person who is like family to the employee) who is ill, injured, or has other health-related needs, including preventive care; or for reasons resulting from, or to assist a family member (or person who is like family to the employee) who is a victim of, domestic violence, sexual assault, or stalking. Additional information on contractor requirements and worker protections under the EO is available at <https://www.dol.gov/agencies/whd/government-contracts>.

Unlisted classifications needed for work not included within the scope of the classifications listed may be added after award only as provided in the labor standards contract clauses (29CFR 5.5 (a) (1) (ii)).

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The body of each wage determination lists the classification and wage rates that have been found to be prevailing for the



cited type(s) of construction in the area covered by the wage determination. The classifications are listed in alphabetical order of ""identifiers"" that indicate whether the particular rate is a union rate (current union negotiated rate for local), a survey rate (weighted average rate) or a union average rate (weighted union average rate).

#### Union Rate Identifiers

A four letter classification abbreviation identifier enclosed in dotted lines beginning with characters other than ""SU"" or ""UAVG"" denotes that the union classification and rate were prevailing for that classification in the survey. Example: PLUM0198-005 07/01/2014. PLUM is an abbreviation identifier of the union which prevailed in the survey for this classification, which in this example would be Plumbers. 0198 indicates the local union number or district council number where applicable, i.e., Plumbers Local 0198. The next number, 005 in the example, is an internal number used in processing the wage determination. 07/01/2014 is the effective date of the most current negotiated rate, which in this example is July 1, 2014.

Union prevailing wage rates are updated to reflect all rate changes in the collective bargaining agreement (CBA) governing this classification and rate.

#### Survey Rate Identifiers

Classifications listed under the ""SU"" identifier indicate that no one rate prevailed for this classification in the survey and the published rate is derived by computing a weighted average rate based on all the rates reported in the survey for that classification. As this weighted average rate includes all rates reported in the survey, it may include both union and non-union rates. Example: SULA2012-007 5/13/2014. SU indicates the rates are survey rates based on a weighted average calculation of rates and are not majority rates. LA indicates the State of Louisiana. 2012 is the year of survey on which these classifications and rates are based. The next number, 007 in the example, is an internal number used in producing the wage determination. 5/13/2014 indicates the survey completion date for the classifications and rates under that identifier.

Survey wage rates are not updated and remain in effect until a new survey is conducted.

#### Union Average Rate Identifiers

Classification(s) listed under the UAVG identifier indicate that no single majority rate prevailed for those classifications; however, 100% of the data reported for the classifications was union data. EXAMPLE: UAVG-OH-0010 08/29/2014. UAVG indicates that the rate is a weighted union average rate. OH indicates the state. The next number, 0010 in the example, is an internal number used in producing the wage determination. 08/29/2014 indicates the survey completion date for the classifications and rates under that identifier.

A UAVG rate will be updated once a year, usually in January of each year, to reflect a weighted average of the current negotiated/CBA rate of the union locals from which the rate is based.

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WAGE DETERMINATION APPEALS PROCESS

1.) Has there been an initial decision in the matter? This can be:

- \* an existing published wage determination
- \* a survey underlying a wage determination
- \* a Wage and Hour Division letter setting forth a position on a wage determination matter
- \* a conformance (additional classification and rate) ruling

On survey related matters, initial contact, including requests for summaries of surveys, should be with the Wage and Hour National Office because National Office has responsibility for the Davis-Bacon survey program. If the response from this initial contact is not satisfactory, then the process described in 2.) and 3.) should be followed.

With regard to any other matter not yet ripe for the formal process described here, initial contact should be with the Branch of Construction Wage Determinations. Write to:

Branch of Construction Wage Determinations  
Wage and Hour Division  
U.S. Department of Labor  
200 Constitution Avenue, N.W.  
Washington, DC 20210

2.) If the answer to the question in 1.) is yes, then an interested party (those affected by the action) can request review and reconsideration from the Wage and Hour Administrator (See 29 CFR Part 1.8 and 29 CFR Part 7). Write to:

Wage and Hour Administrator  
U.S. Department of Labor  
200 Constitution Avenue, N.W.  
Washington, DC 20210

The request should be accompanied by a full statement of the interested party's position and by any information (wage payment data, project description, area practice material, etc.) that the requestor considers relevant to the issue.

3.) If the decision of the Administrator is not favorable, an interested party may appeal directly to the Administrative Review Board (formerly the Wage Appeals Board). Write to:

Administrative Review Board  
U.S. Department of Labor  
200 Constitution Avenue, N.W.  
Washington, DC 20210

4.) All decisions by the Administrative Review Board are final.

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END OF GENERAL DECISIO"



## **RESPONSIBLE BIDDER PRE-QUALIFICATION PACKAGE DEPARTMENT OF ENGINEERING AND PUBLIC SERVICES**

**Revised: May 9, 2022**

### **BACKGROUND**

On December 6, 2021, the City Council approved amendments to Section 114-13 of the Code of the City of Monroe, known commonly as the "Responsible Bidders Ordinance". The full text of this ordinance is available on the City of Monroe website at [monroemi.gov](http://monroemi.gov), and applicable sections are included in Division D of the City's contract documents. These provisions require a two-part process for review of bids in excess of \$175,000, and for any subcontractors whose contract value exceeds \$50,000.

### **PART ONE**

The first of these is a required pre-qualification scoring process, and a contractor deemed to be prequalified will remain so for a period of one (1) year from approval. To fulfill these requirements, each prospective bidder is required to submit documentation of each of the following items to the Engineering Department no later than ten (10) days prior to bid opening, and submitted information will be retained on file and may be amended by the bidder at any time. **Please note that bidders are either deemed "responsible bidders" or "not responsible bidders" strictly based on reaching the 80-point threshold in this PART ONE. Bidders deemed not responsible will be ineligible for contract awards until such time as they are able to receive the qualifying score. If bidder has already been deemed "responsible" within the last twelve (12) months, Part One does not need to be resubmitted.**

### **PART TWO**

The second of these is completion of a Bidder Information Questionnaire, which must be submitted with each bid and is intended to describe, in more detail, the bidder's characteristics at the actual time of bidding. To fulfill these requirements, each prospective bidder is required to submit this form, along with any additional supporting documentation they wish. Additional pages may be submitted where space does not allow for complete answers to any question. **Part Two will not be scored, however, any documentation will be reviewed and relevant information taken into consideration by the Engineering Department and / or City Council if needed to determine award of a contract in the City's sole best interest. Part Two must be submitted with each project as a part of the bid submission.**

## **SCORING OF PRE-QUALIFICATION PACKAGE – PART ONE**

Pre-qualification of each prospective bidder shall be in accordance with the requirements contained in the tables below. Points shall be awarded in discrete increments of five (5), ten (10), or fifteen (15) as shown below, with no intermediate increments awarded. Contractor shall sign and date this form, which will be provided as a cover to the required documentation. The Engineering Department will circle the applicable point value for each category on its own scoring form, provide point total at the bottom, and certify pre-qualification status.

Documentation can be submitted on any form of the bidder's choosing, but it must be dated and clearly identified by the bidder as pre-qualification information, by means of a cover letter or equivalent. This information will remain on file in the Engineering Department for a period of not less than two (2) years.

Corporate Accountability		
Provided	Not Provided	
5	0	References from individuals or entities the bidder has worked for within the last five (5) years including information regarding records of performance and job site cooperation.
5	0	Evidence of any quality assurance program used by the bidder and the results of any such program on the bidder's previous projects.

Workplace Safety		
Provided	Not Provided	
5	0	Documentation of an on-going Michigan OSHA-approved, safety-training program for employees to be used on the proposed job site.
EMR 1.0 or Less	EMR greater than 1.0	
10	5	Evidence of the bidder's worker's compensation Experience Modification Rating ("EMR"). Preference will be given to contractors and subcontractors who exhibit an EMR of 1.0 or less based on a three-year average.

Completed	Not Completed	
10	5	All craft labor that will be employed by the firm for the project has completed at least the OSHA 30-hour training course for safety established by the U.S. Department of Labor, Occupational Safety & Health Administration.
1:3 or Less	More than 1:3	
10	5	Number of apprentices under the supervision of a journeyperson.

Workforce Development		
Yes	No	
15	0	Will bidder pay prevailing wages or greater together with benefits (i.e. healthcare, pension and/or retirement program) on all City Construction Project work.
10	0	Documentation that the bidder has participated in a U.S. Department of Labor approved Industry-Registered Apprenticeship Program (IRAP) for the past three years, at a minimum, for each separate trade or classification in which it employs craft employees and shall continue to participate in such programs for the duration of the project.
Provided	Not Provided	
10	0	Documentation of how the bidder assesses the skills and qualifications of any employees who do not have master or journeyman certification or status, or are not participants in a Industry-Registered Apprenticeship Program (IRAP).

Social Equity		
Provided	Not Provided	
5	0	A statement from the bidder as to what percentage of its workforce can be drawn significantly from Monroe County residents because a goal of the City is to utilize, in its construction activities, local residents as much as is economically feasible while retaining the high quality of construction required for its construction activities, consistent with applicable law.
5	0	Evidence of Equal Employment Opportunity Programs for minorities, women, veterans, returning citizens, and small businesses.
10	0	Assurance that the bidder is an equal opportunity employer and does not discriminate on the basis of race, sex, pregnancy, age, religion, national origin, marital status, sexual orientation, gender identity or expression, height, weight, or disability.

Total Column A	Total Column B	Total Points A+B	Maximum Points 100 (Percentage)	
				Pre-Qualification is 80% or better.

## **SUBMISSION INSTRUCTIONS FOR PART ONE**

For ease in submitting documentation, the following are examples of acceptable documentation that will be used by the Engineering Department to determine the score of each bidder. This is NOT an exhaustive list, and other equivalent documentation may be accepted. Instructions to the bidders are listed in *bold italics* following each section. Documentation should be provided in whatever form the bidder desires to the City Engineering Department at least ten (10) days prior to bid opening.

1. Corporate Accountability

- a. Performance references – bidder shall provide references from individuals or entities the bidder has worked for within the last five (5) years including information regarding records of performance and job site cooperation. *Submittal requirement: This documentation may take any form desired, but should include a listing of projects with project / contract names, locations, work types, overall cost, time of project, and contact individuals.*
- b. Quality assurance program – *Submittal requirement: provide a statement in letter form describing the processes in place to ensure quality control of typical construction projects. If the firm has adopted a formal quality assurance program, it can be attached as well.*

2. Workplace Safety

- a. Evidence of OSHA-approved safety training program – *Submittal requirement: As OSHA does not formally approve safety programs, bidders should submit their company's safety program, which will be evaluated by the Engineering Department to ensure that it meets relevant OSHA standards for the expected work activities found in most common construction projects.*
- b. Worker's Compensation EMR rating – *Submittal requirement: attach a statement from bidder's Worker's Compensation carrier as to the present rating.*
- c. OSHA 30-hour training program – *Submittal requirement: provide a list of all employees and any OSHA training completed (30-hour course preferred, also list any that have completed 10-hour course).*
- d. Journeyman / apprentice ratio – *Submittal requirement: attach a statement / breakdown of which trades are present within the company, number of master / journeyman / apprentice, and a statement of the ratio to be used on contracts (particularly maximum number of apprentices supervised by a journeyman at any one time).*

3. Workforce Development

- a. Prevailing wage conformance – *Submittal requirement: Signed statement from contractor as to compliance / non-compliance.*
- b. Department of Labor Apprenticeship Program – *Submittal requirement: Bidder shall provide a description as to their current apprenticeship program used for each trade. If the bidder has participated in a U.S. Department of Labor approved Industry-Registered Apprenticeship Program (IRAP), documentation to this effect should be submitted. If an*

*alternative program is used, or if the bidder works directly through one or more trade unions for employees of that trade to utilize the program under that trade, a statement to this effect and description of the program and affected employees should be provided.*

- c. Skills assessment for other employees - *Submittal requirement: Provide listing of employees (or general classification of employees) that do not fall under item b above, and describe the skills assessment / interview / evaluation process used to determine fitness for duty and qualifications for their position.*

4. Social Equity

- a. Local Labor declaration - Submittal requirement: *Statement of approximate percentage, if known, of employees that reside in Monroe County. As it is understood that employees may change throughout a 12-month period and may not be known, estimates and ranges are acceptable.*
- b. Evidence of Equal Opportunity Program - *Submittal requirement: Any documentation of an Equal Employment Opportunity Program for minorities, women, veterans, returning citizens, and small businesses. If the company ownership structure includes any of the above categories or similar, this should be stated as well, as it may be considered to satisfy this requirement.*
- c. Equal Opportunity Employment Assurance - *Submittal requirement: Provide written assurance that bidder is an equal opportunity employer and does not discriminate on the basis of race, sex, pregnancy, age, religion, national origin, marital status, sexual orientation, gender identity or expression, height, weight, or disability.*

**CONTRACTOR SUBMISSION**

Contractor shall certify that the information contained within this pre-qualification submission and its attachments (if any) thereto is truthful and accurate to the best of their knowledge by signing below and completing the Affidavit of Responsible Bidder found on Page B-9 of the contract documents. Any information submitted may be provided to the City Council by the Engineering Department for informational purposes prior to awarding of a contract.

\_\_\_\_\_  
Agent / Officer Name / Signature

\_\_\_\_\_  
Date

\_\_\_\_\_  
Contractor Name

**END OF PART ONE REQUIREMENTS**

**(Submit Part One to Engineering minimum 10 days prior to bid opening unless bidder has qualified as Responsible Bidder in past 12 months)**

**SUBMISSION INSTRUCTIONS FOR PART TWO - BIDDER INFORMATION**

Provide answers to each of the following items, in as complete detail as possible:

(i) General information about the bidder’s company, its principals, and its history, including all former business names, and an explanation of any business name changes.

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(ii) If the submitting bidder has ever operated under another name or is controlled by another company or business entity or in the past five years controlled or was controlled by another company or business entity, whether as a parent company, subsidiary or in any other business relation, it must attach a separate statement to its bid packet that explains in detail the nature of any such relationship. Additional information may be required from such an entity if the relationship in question could potentially impact contract performance.

(List if applicable - yes / no)\_\_\_\_\_

(iii) Information regarding the state and local licenses and license numbers held by the bidder.

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(iv) A confirmation that all subcontractors, employees and other individuals working on the construction project will maintain current applicable licenses required by law for all licensed occupations and professions. *(Please list applicable licenses if known.)*

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(v) Documentation of master or journeyperson certification or status for masters and journeypersons to be used on the project, and the source of such certification or status.

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(vi) Verification that the bidder is in compliance with all applicable state and federal laws and visa requirements regarding the hiring of non-US citizens, and disclosure of any work visas sought or obtained by the bidder, any of the bidder's subcontractors, or any of the bidder's employees or independent contractors, in order to perform any portion of the project.

(Verify compliance - yes / no)\_\_\_\_\_

(vii) A list of projects completed within the past five (5) years of comparable size/complexity, including dates, clients, approximate dollar value, and size. Documentation from these previous projects including but not limited to all extra costs relating to the bidder's timeliness, performance, quality of work, extension requests, contractual fines and penalties imposed, liens filed, history of claims for extra work and any contract defaults with an explanation of the reason for the default and how the default was resolved. *(This information is designed to supplement Statement of Experience on Page B-6 of the contract documents.)*

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(viii) Evidence of experience with construction techniques, trade standards, quality workmanship, project scheduling, cost control, management of projects of comparable size/complexity, and building codes by documenting the bidder's ability and capacity to perform the project. The bidder must identify those portions of the project it reasonably believes will be subcontracted and the names of the subcontractors, if known at the time of submission. *(Subcontractor listing should also be provided on Page B-10 of the contract documents).*

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(ix) written verification of bonding capacity equal to or exceeding the amount of the bidder's scope of work on the project. The written verification must be submitted by a licensed surety company rated "B+" (or better) in the current A.M. Best Guide and qualified to do business within the State of Michigan.

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(x) A list of all litigation and arbitrations currently pending and concluded whether by settlement or decision within the past five (5) years, including an explanation of each (parties, court/forum, legal claims, damages sought, and resolution). A list of all claims made against the bidder that were resolved through the payment of \$25,000.00 or more by the bidder or the bidder's insurance and/or bonding/surety companies.

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(xi) Disclosure of any violations of state, federal or local laws or regulations, including OSHA or MIOSHA violations, state or federal prevailing wage laws, wage and hour laws, worker's compensation or unemployment compensation laws, rules or regulations, issued to or against the bidder within the past five years.

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(xii) Disclosure of any debarment by any federal, state or local governmental unit and/or findings of non-responsibility or non-compliance with respect to any public or private construction project performed by the bidder.

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(xiii) Proof of insurance, including certificates of insurance, confirming existence and amount of coverage for liability, property damage, workers compensation, and any other insurances required by the proposed contract documents. *(Attach sample certificate, does not need to insure City until contract is executed.)*

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(xiv) A statement regarding the bidder's staffing capabilities and labor sources including subcontractors and a verification from the bidder that construction workers will not be misclassified as independent contractors in violation of state or federal law.

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(xv) Verification of an existing drug and alcohol testing and/or screening program for bidder, including, but not limited to a Fitness for Duty Program, or a comparable recognized program or provider.

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(xvi) A statement affirming that the City will require and the bidder will provide a one-year maintenance bond valued at 5% of the total contract amount at the time of contract close-out with such bond effective at the time of final payment by the City.

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(xvii) A statement affirming that the bidder will pay all craft employees that it employs on the project the current wage rates and fringe benefits as required under applicable federal, state, or local wage laws.

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(xviii) A statement identifying what possible change orders could be necessary and what their approximate subsequent total costs would be.

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(xix) A statement from the contractor or subcontractor acknowledging their obligation to comply with this Ordinance in each contract and subcontract.

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(xx) Assurances that the project timeline the contractor submits will be followed and that the project will finish in a timely fashion.

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(xxi) Any change in the Experience Modification Rating (EMR) since the submittal and scoring of the Responsible Contractor Pre-Qualification.

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(xxii) The anticipated percentage of Monroe County residents that comprise the bidder's labor pool that will be used on the Construction Project. *(Approximate percentage estimated at time of bidding is sufficient.)*

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**CONTRACTOR SUBMISSION**

Contractor shall certify that the information contained within this questionnaire and its attachments (if any) thereto is truthful and accurate to the best of their knowledge by signing below and completing the Affidavit of Responsible Bidder found on Page B-9 of the contract documents. This questionnaire may be provided to the City Council by the Engineering Department for informational purposes prior to awarding of a contract.

-----  
Agent / Officer Name / Signature

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Date

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Contractor Name

**END OF PART TWO REQUIREMENTS**  
**(Submit Part Two with Bid Submission on EACH project)**



## **RESPONSIBLE CONTRACTOR PRE-QUALIFICATION SCORING SHEET**

### **Revised: February 1, 2022**

#### **BACKGROUND**

On December 6, 2021, the City Council approved amendments to Section 114-13 of the Code of the City of Monroe, known commonly as the "Responsible Bidders Ordinance". The full text of this ordinance is available on the City of Monroe website at [monroemi.gov](http://monroemi.gov), and applicable sections are included in Division D of the City's contract documents. These provisions require a two-part process for review of bids in excess of \$175,000. The first of these is a required pre-qualification scoring process, and a contractor deemed to be prequalified will remain so for a period of one (1) year from approval. To fulfill these requirements, each prospective bidder is required to submit documentation of each of the following items to the Engineering Department no later than ten (10) days prior to bid opening, and this sheet will be retained on file and may be amended by the bidder at any time.

#### **OVERALL SCORING CATEGORIES**

The following is a breakdown of the scoring matrix, and prospective bidders must receive a minimum score of 80 points out of 100 possible in order to be determined to be a responsible bidder.

1. Corporate Accountability (10 points total possible)
  - a. Performance references (5 points)
  - b. Quality assurance program (5 points)
2. Workplace Safety (35 points total possible)
  - a. Evidence of OSHA-approved safety training program (10 points)
  - b. Worker's Compensation EMR rating (10 points)
  - c. OSHA 30-hour training program (10 points)
  - d. Journeyman / apprentice ratio (5 points)
3. Workforce Development (35 points total possible)
  - a. Prevailing wage conformance (15 points)
  - b. Department of Labor Apprenticeship Program (10 points)
  - c. Skills assessment for other employees (10 points)
4. Social Equity (20 points total possible)
  - a. Local Labor declaration (5 points)
  - b. Evidence of Equal Opportunity Program (5 points)
  - c. Equal Opportunity Employment Assurance (10 points)

## SCORING OF PRE-QUALIFICATION PACKAGE

Pre-qualification of each prospective bidder shall be in accordance with the requirements contained in the tables below. Points shall be awarded in discrete increments of five (5), ten (10), or fifteen (15) as shown below, with no intermediate increments awarded. Contractor shall sign and date this form, which will be provided as a cover to the required documentation. The Engineering Department will circle the applicable point value for each category, provide point total at the bottom, and certify pre-qualification status.

Documentation can be submitted on any form of the bidder's choosing, but it must be dated and clearly identified by the bidder as pre-qualification information, by means of a cover letter or equivalent. This information will remain on file in the Engineering Department for a period of not less than two (2) years.

Corporate Accountability		
Provided	Not Provided	
5	0	References from individuals or entities the bidder has worked for within the last five (5) years including information regarding records of performance and job site cooperation.
5	0	Evidence of any quality assurance program used by the bidder and the results of any such program on the bidder's previous projects.

Workplace Safety		
Provided	Not Provided	
5	0	Documentation of an on-going Michigan OSHA-approved, safety-training program for employees to be used on the proposed job site.
EMR 1.0 or Less	EMR greater than 1.0	
10	5	Evidence of the bidder's worker's compensation Experience Modification Rating ("EMR"). Preference will be given to contractors and subcontractors who exhibit an EMR of 1.0 or less based on a three-year average.

Completed	Not Completed	
10	5	All craft labor that will be employed by the firm for the project has completed at least the OSHA 30-hour training course for safety established by the U.S. Department of Labor, Occupational Safety & Health Administration.
1:3 or Less	More than 1:3	
10	5	Number of apprentices under the supervision of a journeyman.



Workforce Development		
Yes	No	
15	0	Will bidder pay prevailing wages or greater together with benefits (i.e. healthcare, pension and/or retirement program) on all City Construction Project work.
10	0	Documentation that the bidder has participated in a U.S. Department of Labor approved Industry-Registered Apprenticeship Program (IRAP) for the past three years, at a minimum, for each separate trade or classification in which it employs craft employees and shall continue to participate in such programs for the duration of the project.
Provided	Not Provided	
10	0	Documentation of how the bidder assesses the skills and qualifications of any employees who do not have master or journeyman certification or status, or are not participants in a Industry-Registered Apprenticeship Program (IRAP).

Social Equity		
Provided	Not Provided	
5	0	A statement from the bidder as to what percentage of its workforce can be drawn significantly from Monroe County residents because a goal of the City is to utilize, in its construction activities, local residents as much as is economically feasible while retaining the high quality of construction required for its construction activities, consistent with applicable law.
5	0	Evidence of Equal Employment Opportunity Programs for minorities, women, veterans, returning citizens, and small businesses.
10	0	Assurance that the bidder is an equal opportunity employer and does not discriminate on the basis of race, sex, pregnancy, age, religion, national origin, marital status, sexual orientation, gender identity or expression, height, weight, or disability.

Total Column A	Total Column B	Total Points A+B	Maximum Points 100 (Percentage)	
				Pre-Qualification is 80% or better.

Scoring Reviewed by:

Prequalification Approved:

\_\_\_\_\_  
Patrick M. Lewis, P.E.  
Director of Engineering and Public Services  
Or Designee

\_\_\_\_\_  
Date

\_\_\_\_\_  
Yes

\_\_\_\_\_  
No