CONTRACT DOCUMENTS

MTIGWAAKIIS HOUSING COMPLEX
WELL HOUSE AND WATER MAIN

LITTLE TRAVERSE BAY BANDS OF ODAWA INDIANS
7500 ODAWA CIRCLE
HARBOR SPRINGS, MICHIGAN 49740

JUNE 2023

PREPARED BY:
WADE TRIM
4241 Old US 27 South
Suite 1
Gaylord, MI 49735

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EXHIBITS

Section 00 1113
Advertisement for Bids

MTIGWAAKIIS HOUSING COMPLEX
WELL HOUSE AND WATER MAIN
LITTLE TRAVERSE BAY BANDS OF ODAWA INDIANS
HARBOR SPRINGS, MICHIGAN

Little Traverse Bay Bands of Odawa Indians solicits bids for Mtigwaakiis Housing Complex Well House and Water Main project. Bid shall be submitted to the Little Traverse Bay Bands of Odawa Indians at 7500 Odawa Circle, Harbor Springs, Michigan 49740, until **10:00 am**, Local Time, **July 7th, 2023** at which time and place said Bids will be opened and publicly read aloud for the following approximate quantities of work:

> Construction of new 20-ft x 22-ft well house including concrete foundation, building structure, interior piping, valves, meters, tanks, controls, mechanical, electrical, and plumbing, development of production well, water main, water services, demolition of existing well house, SESC measures, HMA and concrete removal and replacement, site restoration, and all other miscellaneous appurtenances.

Contract Documents are on file with:

> Little Traverse Bay Band of Odawa Indians, Planning Department, 1345 US-31 N, Petoskey, MICHIGAN, 49770, contact Shari at (231) 242-1581.
> Wade Trim, Inc., 4241 Old US-27 South, Gaylord, MI 49735 or
> http://www.wadetrim.com/resources/bid-tab/
> McGraw-Hill Dodge Reports & Builders Exchanges will have Contract Documents, Builders Exchanges are authorized to share the contract documents with other exchanges.

Each Bid package shall be accompanied by a certified check, cashier's check, money order, or bid bond, in the amount of at least five (5) percent of the amount bid, drawn payable to the OWNER as security for the proper execution of the Agreement.

The Little Traverse Bay Bands of Odawa Indians reserves the right to accept or reject any or all bids and to waive any informality in any bids should it consider same to be in its best interest.

Bids may not be withdrawn for the period of **sixty (60)** days after date of receiving bids.

All inquiries shall be directed to Paul Repasky, PE, at Phone: (989) 732-3584, Fax: (989) 732-6391, or Email: prepasky@wadetrim.com

Wade Trim, Inc.
4241 Old US 27 South
Suite 1
Gaylord, MI 49735

Little Traverse Bay Bands of Odawa Indians
7500 Odawa Circle
Harbor Springs, MI 49740

Section 00 2113
Instructions to Bidders

Part 1 General

1.01 Defined Terms

A. Terms used in these Instructions to Bidders have the meanings assigned to them in the General Conditions.

1. The term "Bidder" means one who submits a Bid directly to OWNER as distinct from a subbidder who submits a Bid to a Bidder.

2. The term "Successful Bidder" means the lowest, qualified, responsible Bidder to whom OWNER makes an award.

3. The term "OWNER" means Little Traverse Bay Band of Odawa Indians, being a party of the first part of this Contract.

4. The term “ENGINEER” means Wade Trim, Inc., 4241 Old US 27 South, Suite 1, Gaylord, Michigan 49735, or his duly authorized representative.

1.02 Scope of Work

A. The scope and location of Work are indicated in the Plans.

1.03 Bidders Qualifications

A. No Bid will be considered from any Bidder unless known to be skilled and regularly engaged in work of a character similar to that covered by the Contract Documents. In order to aid the OWNER in determining the responsibility of any Bidder, the Bidder, within 48 hours after being requested in writing by the OWNER to do so, shall furnish evidence, satisfactory to the OWNER, of the Bidder's experience and familiarity with Work of the character specified, and his financial ability to properly prosecute the proposed Work to completion within the specified time. The evidence requested may include, but shall not be limited to, the following:

1. The address and description of the Bidder's plant or permanent place of business.

2. The Bidder's performance records for all Work awarded to, or started by him within the past three years.

3. An itemized list of the Bidder's equipment available for use on the proposed Contract.

4. The Bidder's financial statement, including statement of ownership of equipment necessary to be used in executing Work under Contract.

5. Evidence that the Bidder is authorized to do business in the state in which the project is located, in case of a corporation organized under the laws of any other state; and,

6. Such additional information as will satisfy the OWNER that the Bidder is adequately prepared to fulfill the Contract.

7. Bidder shall not appear on the Federal debarment list.

1.04 Work Plan

CONTRACTOR shall submit a work plan describing in detail the tasks, timeline and deliverables as they relate to the Work. Include proposed equipment to be used and clearly indicate which tasks will be completed by subcontractors (if applicable).

1.05 Examination of Contract Documents and Site

A. It is the responsibility of each Bidder before submitting a Bid, to:

1. examine the Contract Documents thoroughly,

2. visit the site to familiarize himself with local conditions that may in any manner affect cost, progress or performance of the Work,

3. consider federal, state, and local Laws and Regulations that may affect cost, progress, performance, or furnishing of the Work; and

4. study and carefully correlate Bidder's knowledge and observations with the Contract Documents and such other related data; and

5. promptly notify ENGINEER in writing of all conflicts, errors, ambiguities or discrepancies which Bidder has discovered in or between Contract Documents and such related documents.

6. purchase official Procurement Documents from ENGINEER in order to be included on the project Plan Holder List and be considered eligible for bidding.

B. Reference is made to the Supplementary Conditions 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 ENGINEER in preparing the Contract Documents.

1. If such reports are not included as appendices to the Contract Documents, OWNER will make copies available to any Bidder requesting them. These reports are included for reference only and are not guaranteed as to accuracy or completeness, nor are they part of the Contract Documents.

2. The Bidder may rely upon the general accuracy of the "technical data" contained in such reports but not upon other data, interpretations, opinions or information contained in such reports or otherwise relating to the subsurface conditions at the site, nor upon the completeness thereof for bidding or construction purposes.

3. 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.

C. On request OWNER will provide each Bidder access to the site to conduct such investigations and tests as each Bidder deems necessary for submission of his Bid. Bidder shall fill all holes and clean up and restore the site to its former conditions upon completion of such investigations and tests.

D. The lands upon which the Work is to be performed, rights-of-way for access thereto and other lands designated for use by CONTRACTOR in performing the Work are identified in the Plans.

E. The locations of utilities as shown on the Plans are taken from sources believed to be reliable. Neither the OWNER nor the ENGINEER will be responsible for any omissions of, or variations from, the indicated location of existing utilities which may be encountered in the Work.

F. The submission of a Bid will constitute an incontrovertible representation by the Bidder that he has complied with every requirement of this Article 1.04, that without exception the Bid is based upon performing and furnishing the Work required by the Contract Documents and applying the specific means, methods, techniques, sequences or procedures of construction (if any) that may be shown, indicated or required by the Contract Documents, that Bidder has given ENGINEER written notice of all conflicts, errors, ambiguities and discrepancies that Bidder has discovered in Contract Documents and the resolution by ENGINEER is acceptable to Bidder, and that the Contract Documents are sufficient in scope and detail to indicate and convey understanding of all terms and conditions for performing and furnishing the Work, and that the time stated in the Proposal is sufficient to complete the project.

1.06 Interpretations and Addenda

A. Should any prospective bidder find discrepancies in, or omissions from the Plans, Specifications or other parts of the Contract Documents, he may submit a written request to the ENGINEER for an interpretation thereof. The person submitting the request will be held responsible for its prompt delivery at least seven (7) days prior to the date for opening of Bids. Questions received less than seven (7) days prior to the date for opening of bids will not be answered. Any interpretation of inquiry will be made by Addendum duly issued to all prospective bidders.

B. Any change in or addition to the Contract Documents deemed necessary by the OWNER shall be made in the form of an Addendum issued to all prospective bidders who have taken out Contract Documents and all such Addenda shall become a part of the Contract Documents as though same were incorporated into same originally. Oral explanations and information do not constitute official notification and are not binding.

1.07 Bid Security

A. Bid Security shall be made payable to OWNER, in an amount of five (5) percent of the Bidder's maximum Bid price and in a form as indicated in the Advertisement. Bid Bonds, if indicated as acceptable in the Advertisement, shall be issued on the form included in the Contract Documents by a Surety meeting the requirements of paragraph 5.01 of the General Conditions.

B. The Bid Security of the Successful Bidder will be retained until such Bidder has executed the Agreement and furnished the required Contract Security, whereupon it will be returned; if the successful Bidder fails to execute and deliver the Agreement and furnish the required Contract Security within 15 days of the Notice of Award, OWNER may annul the Notice of Award and the Bid Security of that Bidder will be forfeited. The Bid Security of any Bidder whom OWNER believes to have a reasonable chance of receiving the award may be retained by OWNER until the earliest of the seventh day after the "Effective Date of Agreement" (which term is defined in the General Conditions) or the expiration of the hold period on the Bids. Bid Security of other Bidders will be returned within 14 days of the Bid opening, unless indicated otherwise in the Advertisement.

1.08 Contract Time

A. The number of days within which, or the date by which, the Work is to be Substantially Completed, if applicable, and also completed and ready for final payment (the Contract Time) are set forth in the Proposal and will be included in the Agreement.

1.09 Substitute and "Or-Equal" Items

A. The Contract, if awarded, will be on the basis of materials and equipment described in the Plans or specified in the Specifications without consideration of possible substitute or "or-equal" items. Whenever it is indicated in the Plans or specified in the Specifications that a substitute or an "or-equal" item of material or equipment may be furnished or used by CONTRACTOR if acceptable to ENGINEER, application for such acceptance will not be considered by ENGINEER until after the Effective Date of Agreement. In addition, in no case shall ENGINEER's denial of CONTRACTOR's application give rise to any claim for additional cost, it being understood by CONTRACTOR that acceptance of substitute or an "or equal" item of material is at the sole discretion of ENGINEER.

1.10 Receipt and Form of Bid

A. Bids shall be submitted at the time and place indicated in the Advertisement for Bids and shall be included in an opaque sealed envelope, marked with the Project title and name and address of the Bidder and accompanied by the Bid Security and other required documents. If the Bid is sent through the mail or other delivery system, the sealed envelope shall be enclosed in a separate envelope with the notation "BID ENCLOSED" on the face thereof. Any Bid received after the scheduled time and place indicated in the Advertisement for Bids shall be returned unopened.

1. OWNER invites bids on the Proposal and other form(s) attached hereto. Bids will be received at the time and place indicated in the Advertisement and thereupon will be publicly opened and read. An abstract of the amounts of the base bids and any major alternates will be made available after the opening of Bids.

2. OWNER may consider as informal any Bid on which there is an alteration of, or departure from the Proposal Form attached hereto.

3. The complete set of Contract Documents must be used in preparing Bids: neither OWNER nor ENGINEER assumes any responsibility for errors or misinterpretations resulting from the use of incomplete sets of Contract Documents. In order to verify the completeness of the set of Contract Documents the Bidder used in preparing his Bid, the OWNER may require the Bidder to submit the set of Contract Documents he used in preparing his Bid. The Bidder shall submit his Bid on the separate Proposal form included in these Contract Documents.

4. The Proposal shall be legibly prepared, with ink or typewriter, on the form included in these Contract Documents. All blank spaces in the proposal forms must be correctly filled in where indicated for each and every item for which a quantity is given. Proposals will be compared on basis of lump sum items, if any, and on product of the quantities of items listed at the respective unit prices bid.

5. Erasures or other changes in the Bids must be explained or noted over the signature of the Bidder.

6. Names must be typed or printed below the signature.

7. The quantities as shown in the Proposal are approximate only and will be usedas a basis of comparison of Bids, and award of Contracts. Payment will be made on basis of actual quantities of Work performed in accordance with the Contract Documents. The Unit Prices bid, shall include such amounts as the Bidder deems proper for overhead, profit, taxes, General Conditions and such other incidentals as noted in the Contact Documents.

8. The Bid shall contain an acknowledgment of receipt of all Addenda, the numbers of which shall be filled in on the Proposal Form.

9. The Legal Status of Bidder Form contained in the Contract Documents must be submitted with each Proposal and must clearly state the legal position of a Bidder. In the case of a corporation, the home address, name and title of all officers must be given. In the case of a partnership, show names and home addresses of all partners. If an individual, so state. Any individual bid not signed by the individual must have attached, thereto, a power of attorney evidencing authority to sign.

10. Other documents to be attached to the Proposal and made a condition thereof are identified in the Proposal. The same individual signing the Proposal shall sign these other documents.

1.11 Modifications and Withdrawal of Bids

A. Bids may be modified or withdrawn by an appropriate document duly executed (in the manner that a Bid must be executed) and delivered to the place where Bids are to be submitted at any time prior to the opening of Bids. If, within 24 hours after Bids are opened, any Bidder files a duly signed written notice with OWNER and promptly thereafter demonstrates to the reasonable satisfaction of OWNER that there was a material and substantial mistake in the preparation of his Bid, that Bidder may withdraw his Bid and the Bid Security will be returned. Thereafter, at the sole option of OWNER, that Bidder will be disqualified from further Bidding on the Work to be provided under the Contract Documents.

1.12 Award of Contract

A. OWNER reserves the right to reject any and all Bids for any reason, to waive any and all informalities not involving price, time, or changes in the Work and to negotiate contract terms with the Successful Bidder, and the right to disregard all nonconforming, non-responsive, unbalanced, or conditional Bids. Discrepancies between words and figures will be resolved in favor of words. Discrepancies in the multiplication of units of work and unit prices, will be resolved in favor of unit price. Discrepancies between the indicated sum of any column of figures and the correct sum thereof will be resolved in favor of the correct sum.

B. In evaluating Bids, OWNER shall consider the qualifications of the Bidders, whether or not the Bids comply with the prescribed requirements, and such alternates, unit prices and other data if requested in the Bid forms. It is OWNER's intent to accept alternates (if any are accepted) in the order in which they are listed in the Bid form but OWNER may accept them in any order or combination.

C. Subject to the approval of OWNER, the Contract will be awarded to the lowest responsive and responsible Bidder. Responsibility of Bidder will be determined on basis of past performance and Work of similar character, equipment and labor available to do the Work and financial status.

1. The Contract shall be considered to have been awarded after the approval of the OWNER has been duly obtained and a formal Notice of Award duly served on the successful Bidder by OWNER.

2. The Contract shall not be binding upon the OWNER until the Agreement has been duly executed by the Bidder and the duly authorized officials of the OWNER.

D. If the Contract is to be awarded, OWNER will give the successful Bidder a Notice of Award within 60 days after the day of the Bid opening, unless such other time is specified in the Advertisement for Bids.

1.13 Signing of Agreement

A. Within fifteen (15) days after OWNER gives a Notice of Award to the successful Bidder, the CONTRACTOR shall sign and deliver the specified number of counterparts of the Agreement to OWNER with all other Contract Documents attached. Within ten (10) days thereafter, OWNER will deliver two (2) fully signed counterparts to CONTRACTOR. ENGINEER will identify, date or correct those portions of the Contract Documents not fully signed, dated or executed by OWNER and CONTRACTOR and such identification, dating or correction shall be binding on all parties.

1.14 Sales and Use Taxes

A. Per the tax agreement in effect between the Owner and State of Michigan, this project is exempt from state sales taxes and use taxes on materials and equipment to be incorporated in the Work. Said taxes shall not be included in the Bid. Bidders shall fully cooperate with Owner to effectuate any administrative requirements of the agreement.

1.15 Preferences for Contractor

A. Native American preference shall apply.
   1) Citizen of the Little Traverse Bay Bands of Odawa Indians
   2) Citizens of Other Federally Recognized Tribes, as certified by the Bureau of Indian Affairs

B. Special consideration shall also be given to firms proven to be minority owned and/or classified as small business, see Section 1.15.

1.16 Documentation Required for Preferences

A. All things being equal, the following types of firms would receive special consideration, in the award of this contract:

- Indian Owned— Indian owned is defined as, at least 51% Indian owned & controlled by person(s) of certified (federally recognized) Native American heritage; SBA or Tribal certification required.
- Minority Owned— Minority owned is a firm that is at least 51% owned and controlled by a minority and so documented; SBA 8-a certification required.
- Small Business— Small business for this purpose is firm doing less than $2 million annually as verified by gross receipts, SBA certification required.

1.17 Contracts to be Assigned (Indian Preference)

A. The Contractor agrees to give preference to Indians who can perform the work required, and to the extent feasible consistent with training opportunities, regardless of age (subject to existing laws and regulation), sex, religion, or tribal affiliation, for training and employment opportunities under this contract. The Contractor also agrees to give preference to Indian organizations and Indian-owned economic enterprises in the awarding of any subcontracts consistent with the effective performance of this contract. The Contractor shall maintain and provide to the Bureau's Contracting Officer, such records as are necessary to indicate compliance with this paragraph.

1.18 Wage Rate Requirements

A. The Contractor and Subcontractors are required to pay prevailing wage rates.

Part 2 Products (Not Used)

Part 3 Execution (Not Used)

End of Section

Section 00 2213
Supplementary Instructions to Bidders

Part 1 General

1.01 Modifications

A. These Supplementary Instructions to Bidders amend or supplement, Section 00 2113, Instructions to Bidders, as indicated below. All provisions which are not amended or supplemented remain in full force and effect.

B. The terms used in these Supplementary Instructions to Bidders have the meanings assigned to them in the Instructions to Bidders, General Conditions, and as follows:

1. OWNER – Little Traverse Bay Bands of Odawa Indians, being a party of the first part of this Contract.

2. ENGINEER - Wade Trim, Inc., or his duly authorized representative.

Part 2 Products (Not Used)

Part 3 Execution (Not Used)

End of Section

Section 00 4243
Proposal

LITTLE TRAVERSE BAY BAND OF ODAWA INDIANS
7500 ODAWA CIRCLE
HARBOR SPRINGS, MI 49740

Re: MTIGWAAKIIS HOUSING COMPLEX
WELL HOUSE AND WATER MAIN

The undersigned Bidder proposes and agrees, if this Proposal is accepted, to enter into an Agreement with the Little Traverse Bay Bands of Odawa Indians in the form included in the Contract Documents to complete all Work as specified or indicated in the Contract Documents for the Contract Price and within the Contract Time indicated in this Bid and in accordance with the Contract Documents.

In submitting this Proposal, Bidder represents, as more fully set forth in the Agreement, that;

a) Bidder has examined copies of all Contract Documents which he understands and accepts as sufficient for the purpose, including any and all Addenda officially issued, the receipt of which is hereby acknowledged.

Addendum No.	Date of Release	Signature
_____	_____	_____
_____	_____	_____
_____	_____	_____

b) Bidder has examined the surface and subsurface conditions where the Work is to be performed, the legal requirements and local conditions affecting cost, progress, furnishing or performance of the Work and has made such independent investigations as Bidder deems necessary.

c) This Bid is genuine and not made in the interest of or on behalf of any undisclosed person, firm or corporation and is not submitted in conformity with any Agreement or rules of any group, association, organization or corporation; Bidder has not directly or indirectly induced or solicited any other Bidder to submit a false or sham Bid; Bidder has not solicited or induced any person, firm or a corporation to refrain from bidding; and Bidder has not sought by collusion to obtain for himself any advantage over any other Bidder or over OWNER.

The Bidder agrees to complete the Work, in accordance with the Contract Documents, for the following Contract Price:

Item	Description	Quantity	Unit	Unit Price	Amount
PART A – WELL AND WELL HOUSE					
1.	Mobilization, 5% Max	1	LSUM	$ _____	$ _____
2.	Pitless Adapter and Submersible Well Pump	1	LSUM	$ _____	$ _____
3.	Galvanized Drop Pipe	130	LFT	$ _____	$ _____
4.	VFD Control System	1	LSUM	$ _____	$ _____
5.	3-inch, HDPE Water Main	210	LFT	$ _____	$ _____
6.	Silt Fence	420	LFT	$ _____	$ _____
7.	Demolish and Remove Ex Well House	1	LSUM	$ _____	$ _____
8.	Remove Water Main	1	LSUM	$ _____	$ _____
9.	Well House, Structure and Foundation	1	LSUM	$ _____	$ _____
10.	Well House, Electrical	1	LSUM	$ _____	$ _____

11.	Well House, Mechanical, HVAC & Plumbing System	1	LSUM	$ _____	$ _____
12.	Well House, Valves, Tanks, and Interior Piping	1	LSUM	$ _____	$ _____
13.	Connection to Ex 2-inch dia Water Main	2	EA	$ _____	$ _____
14.	Connection to Ex 8-inch dia Water Main	1	EA	$ _____	$ _____
15.	2-inch Gate Valve and Valve Box	2	EA	$ _____	$ _____
16.	6-inch Gate Valve and Valve Box	1	EA	$ _____	$ _____
17.	2-inch, Water Main C-900 PVC	45	LFT	$ _____	$ _____
18.	8-inch, Water Main C-900 PVC	128	LFT	$ _____	$ _____
19.	6-inch Sanitary Cleanout	1	EA	$ _____	$ _____
20.	6-inch, Sanitary Sewer, Sched 40 PVC	85	LFT		
21.	Aggregate Surface Course, Afton Stone, 6-inch	650	SYD	$ _____	$ _____
22.	Ditching	75	LFT	$ _____	$ _____
23.	Riprap, Plain	20	SYD	$ _____	$ _____
24.	Restoration	1	LSUM	$ _____	$ _____

PART B – WATER MAIN

1.	Mobilization, 5% Max	1	LSUM	$ _____	$ _____
2.	Silt Fence	800	LFT	$ _____	$ _____
3.	Clearing and Grubbing	0.01	AC	$ _____	$ _____
4.	Sidewalk, Rem	350	SFT	$ _____	$ _____
5.	Pvmt, Rem	38	SYD	$ _____	$ _____
6.	Connection to Ex 6-inch dia Water Main	2	EA	$ _____	$ _____
7.	Connection to Ex 8-inch dia Water Main	1	EA	$ _____	$ _____
8.	2-inch Corp, Curb Stop and Box	4	EA	$ _____	$ _____
9.	6-inch Gate Valve and Valve Box	3	EA	$ _____	$ _____
10.	8-inch Gate Valve and Valve Box	2	EA	$ _____	$ _____
11.	2-inch, Water Service Type K Copper	298	LFT	$ _____	$ _____
12.	6-inch, Water Main C-900 PVC	658	LFT	$ _____	$ _____
13.	Yard Hydrant	3	EA		
14.	Blow-Off Hydrant	2	EA	$ _____	$ _____
15.	Concrete Sidewalk, 4-inch	350	SFT	$ _____	$ _____
16.	Aggregate Base, 22A	17	TON	$ _____	$ _____
17.	HMA, Hand Patching	5	TON	$ _____	$ _____
18.	Restoration	1	LSUM	$ _____	$ _____

TOTAL BASE CONTRACT PRICE
(PARTS A and B) $ _____
(numeric)

_____
(In Words)

The undersigned, as Bidder, hereby certifies that he or a qualified designated person in his employ has examined the Contract Documents provided by OWNER for bidding purposes. Further, the undersigned certifies that he or his qualified employee has reviewed the Bidder's proposed construction methods and finds them compatible with the conditions and from the information provided for Bidding.

Parts A and B are divided for clarity, schedule timeline and organization only. Parts A and B will be awarded to one successful Bidder.

The undersigned, as Bidder, shall complete the Work under any job circumstances or field conditions present and/or ascertainable prior to bidding. In addition, he shall also complete the Work under whatever conditions he may create by his own sequence of construction, construction methods, or other conditions he may create, at no additional cost to OWNER.

The undersigned, as Bidder, declares that he has familiarized himself with the location of the proposed Work and the conditions under which it must be constructed. Also, that he has carefully examined the Plans, the Specifications, and the Contract Documents, which he understands and accepts as sufficient for the purpose and agrees that he will Contract with OWNER to furnish all labor, material, tools, and equipment necessary to do all Work specified and prescribed for the completion of the Project.

The undersigned agrees, if awarded Contract, to sign the Agreement and submit satisfactory bonds and certificates of insurance coverage and other evidence of insurance required by the Contract Documents within 15 days after the date of OWNER'S Notice of Award.

The undersigned agrees that time is of the essence and, if awarded Contract, that the Work included in **Part A – Well and Well House** will be Substantially Completed on or before **June 21, 2024** and completed by **June 28, 2024**. The Work included in **Part B – Water Main** shall be Substantially Completed on or before **December 8, 2023** and completed by **December 15, 2023**

Liquidated damages, as specified in the General Conditions, Supplementary Conditions and Agreement, shall also apply to the above Substantial Completion date.

Engineering and inspection costs incurred after the above final completion date shall be paid by CONTRACTOR to OWNER as specified in the Conditions of the Contract and Agreement.

Proposals may not be withdrawn for a period of sixty (60) days after bid opening.

The following documents are attached to and made a condition of this Proposal:

a) Required Bid security in the form checked below:

☐ Certified Check ☐ Cashier's Check ☐ Money Order ☐ Bid Bond

b) Legal Status of Bidder.

c) Bidder's Name: _____

By: _____
(Signature) *(Printed Name)*

Address: _____

_____

Phone No.: _____ Fax No.: _____

Email: _____

Section 00 4313
Bid Bond Form

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

as Principal, hereinafter called the Principal, and _____

a corporation duly organized under the laws of the State of _____, and duly authorized to transact business in the state of Michigan, as Surety, hereinafter called the Surety, are held and firmly bound unto OWNER, hereinafter called the OWNER, in the sum of _____

_____ Dollars ($ _____)

for the payment of which sum well and truly to be made, the said Principal and the said Surety, bind ourselves, our heirs, executors, administrators, successors and assigns, jointly and severally, firmly by these presents.

WHEREAS, the Principal has submitted a Bid for _____

_____

_____

_____

_____

NOW, THEREFORE, if the OWNER shall accept the Bid of the Principal and the Principal shall enter into a Contract with the OWNER in accordance with the terms of such Bid, and give such Bond or Bonds as may be specified in the Contract Documents with good and sufficient surety for the faithful performance of such Contract and for the prompt payment of labor and material furnished in the prosecution thereof, or in the event of the failure of the Principal to enter such Contract and give such Bond or Bonds, if the Principal shall pay to the OWNER the difference not-to-exceed the penalty hereof between the amount specified in said Bid and such larger amount for which the OWNER may in good faith contract with another party to perform the Work covered by said Bid, then this obligation shall be null and void, otherwise to remain in full force and effect.

Signed and Sealed this _____ day of _____, 20____.

_____ (Witness)

_____ (Principal)

_____ (Title)

_____ (Witness)

_____ (Surety)

_____ (Title)

Section 00 5100
Notice of Award

To: _____ Date: _____, 20_____

_____

_____

Attention: _____

Project: MTIGWAAKIIS HOUSING COMPLEX WELL HOUSE AND WATER MAIN

Pursuant to the provisions of Article 1.11 of the Instructions to Bidders, you are hereby notified that the Little Traverse Bay Bands of Odawa Indians (OWNER) during a _____ Meeting held on _____, _____, 20_____, has directed the acceptance of your Bid for the above-referenced Project in the amount of $_____ ( ). This project shall consist of _____

_____

as delineated in your Bid submitted to the _____

on _____.

Please comply with the following conditions within 15 days of the date of this Notice of Award; that is by _____, _____, 20_____.

1. Deliver to the ENGINEER **( )** fully executed counterparts of the Agreement including all the Contract Documents.

2. Deliver with the executed Agreement the Contract Security (Bonds), on the form included in the Contract Documents, as specified in the General Conditions (Article 5).

3. Deliver with the executed Agreement the Insurance Certificates (and other evidence of insurance) as specified in the General Conditions (Article 5).

4. Please do not date Agreement and Contract Security (Bonds), as these will be dated by the OWNER when executed by him.

It is important to comply with these conditions and time limits as 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 (10) days after you comply with those conditions, OWNER will return to you two (2) fully signed counterparts of the Agreement with the Contract Documents attached.

In accordance with paragraph 2.05 of the General Conditions, please submit to the ENGINEER the required schedules prior to the scheduling of a Pre-Construction Meeting.

Copy to ENGINEER:
Wade Trim, Inc.
4241 Old US 27 South, Suite 1
Gaylord, MI 49735

_____
(OWNER)

By: _____
(Authorized Signature)

Section 00 5200
Agreement

This Agreement, made and entered into this _____ day of _____ in the year 20_____ by and between the Little Traverse Bay Bands of Odawa Indians hereinafter called OWNER, and _____ _____ hereinafter called CONTRACTOR, in consideration of the mutual covenants hereinafter sent forth, agree as follows:

ARTICLE 1. WORK

CONTRACTOR shall complete all Work as specified or indicated in the Contract Documents. The Work is generally described as follows:

> Construction of new 20-ft x 22-ft well house including concrete foundation, building structure, interior piping, valves, meters, tanks, controls, mechanical, electrical, and plumbing, development of production well, water main, water services, demolition of existing well house, SESC measures, HMA and concrete removal and replacement, site restoration, and all other miscellaneous appurtenances.

ARTICLE 2. CONTRACT TIME

2.1 The Work included in **Part A – Well and Well House** shall be substantially completed on or before **June 21, 2024**, and completed and ready for final payment in accordance with paragraph 14.11 of the General Conditions on or before **June 28, 2024**. The Work included in **Part B – Water Main** shall be substantially completed on or before **December 8, 2023** and completed and ready for final payment in accordance with paragraph 14.11 of the General Conditions on or before **December 15, 2023**

2.2 Engineering and inspection costs incurred after the specified final completion date shall be paid by the CONTRACTOR to the OWNER prior to final payment authorization. Charges shall be made at such times and in such amounts as the ENGINEER shall invoice the OWNER, provided however said charges shall be in accordance with the ENGINEER's current rate schedule at the time the costs are incurred. The costs of ENGINEER incurred after the specified final completion date shall be deducted from the CONTRACTOR's progress payments.

2.3 Liquidated Damages. OWNER and CONTRACTOR recognize that time is of the essence of this Agreement and that OWNER will suffer financial loss if the Work is not Substantially Complete within the time specified in Article 2.1 above, plus any extensions thereof allowed in accordance with Article 12 of the General Conditions. They also recognize the delays, expense and difficulties involved in proving in a legal or arbitration proceeding the actual loss suffered by OWNER if the Work is not Substantially Complete on time. Accordingly, instead of requiring any such proof, OWNER and CONTRACTOR agree that as liquidated damages for delay (but not as penalty) CONTRACTOR shall pay OWNER **EIGHT HUNDRED** Dollars (**$800**) for each day that expires after the time specified in Article 2.1 for Substantial Completion until the Work is Substantially Complete. Liquidated damages charged shall be deducted from the CONTRACTOR's progress payment.

ARTICLE 3. CONTRACT PRICE

3.1 OWNER shall pay CONTRACTOR as provided in the attached Proposal for performance of the Work in accordance with the Contract Documents.

ARTICLE 4. PAYMENT PROCEDURES

Progress payments and retainage under this Contract are governed by the provisions of PA 1980, No. 524 (MCLA 125.1561 et seq.). That Act is incorporated herein by reference and made a part of this Contract.

Without excluding any provisions of the Act from this Contract, but in order to comply therewith and summarize certain provisions, the following shall apply:

4.1 The person representing CONTRACTOR who will submit written requests for progress payments shall be: _____

4.2 The person representing OWNER to whom requests for progress payments are to be submitted shall be: _____

4.3 CONTRACTOR's representative, listed above, shall submit Applications for Payment on the form provided in the Contract Documents in accordance with Article 14 of the General Conditions. Applications for Payment will be processed as provided in the General Conditions.

ARTICLE 5. CONTRACTOR'S REPRESENTATIONS

In order to induce OWNER to enter into this Agreement, CONTRACTOR makes the following representations:

5.1 CONTRACTOR has considered the nature and extent of the Contract Documents, Work, locality, and all local conditions and federal, state and local laws, and regulations that may affect cost, progress, performance, or furnishing of the Work.

5.2 CONTRACTOR has studied carefully all 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 were relied upon in the preparation of the Plans and Specifications and which have been identified in the Supplementary Conditions.

5.3 CONTRACTOR has made or caused to be made examinations, investigations and tests and studies of such reports and related data in addition to those referred to in Article 5.2 as he deems necessary for the performance of the Work at the Contract Price, within the Contract Time and in accordance with the other terms and conditions of the Contract Documents; and no additional examinations, investigations, tests, reports or similar data are or will be required by CONTRACTOR for such purposes.

5.4 CONTRACTOR has correlated the results of all such observations, examinations, investigations, tests, reports and data with the terms and conditions of the Contract Documents.

5.5 CONTRACTOR has given ENGINEER written notice of all conflicts, errors or discrepancies that he has discovered in the Contract documents and the written resolution thereof by ENGINEER is acceptable to CONTRACTOR.

ARTICLE 6. CONTRACT DOCUMENTS

The Contract Documents which comprise the entire Contract between OWNER and CONTRACTOR are attached to this Agreement, made a part hereof and consists of the following:

6.1 Procurement Requirements (including Advertisement for Bids, Instructions to Bidders, Supplementary Instructions to Bidders, Proposal, Legal Status of Bidder, and other documents listed in the Table of Contents thereof).

6.2 This Agreement

6.3 Performance and other Bonds

6.4 Notice of Award

6.5 Notice to Proceed (if issued)

6.6 Conditions of the Contract (including General Conditions and Supplementary Conditions, if any)

6.7 Specifications contained within Division 01 through 49 of the Contract Documents dated June 2023

6.8 Plans consisting of sheets dated 06.02.2023 and numbered T1.0 through M1 inclusive with each sheet bearing the following general title: MTIGWAAKIIS HOUSING COMPLEX WELL HOUSE AND WATER MAIN

6.9 Addenda numbers _____ to _____, inclusive

6.10 Documentation submitted by CONTRACTOR prior to Notice of Award

6.11 Any Modification, including Change Orders, duly delivered after execution of Agreement.

ARTICLE 7. MISCELLANEOUS

7.1 Terms used in this Agreement which are defined in Article 1 of the General Conditions shall have the meanings indicated in the General Conditions.

7.2 No assignment by a party hereto of any rights under or interests in the Contract Documents will be binding on any other party without the written consent of the party sought to be bound; and specifically but without limitation, monies that may become due and monies that are due may not be assigned without such consent (except to the extent that the effect of this restriction may be limited by law), and unless specifically stated to the contrary in any written consent to an assignment no assignment will release or discharge the assignor from any duty or responsibility under the Contract Documents.

7.3 OWNER and CONTRACTOR each binds himself, his partners, successors, assigns and legal representatives to the other party hereto, his partners, successors, assigns and legal representatives in respect to all covenants, agreements and obligations contained in the Contract Documents.

7.4 Any provision or part of the Contract Documents held to be void or unenforceable under any Law or Regulation shall be deemed stricken, and all remaining provisions shall continue to be valid and binding upon OWNER and CONTRACTOR, who agree that the Contract Documents shall be reformed to replace such stricken provision or part thereof with a valid and enforceable provision that comes as close as possible to expressing the intention of the stricken provision.

IN WITNESS WHEREOF, the parties hereto have signed this Agreement in _____ counterparts. _____ counterparts each have been delivered to OWNER and CONTRACTOR, one counterpart has been delivered to the ENGINEER. All portions of the Contract Documents have been signed or identified by OWNER and CONTRACTOR.

This Agreement will be effective on _____, _____, 20_____.

OWNER _____

By _____

Attest _____

Address for giving notices

_____

_____

_____

CONTRACTOR _____

By _____

Attest _____

Address for giving notices

_____

_____

_____

License No. _____

Agent for service of process: _____

_____

Section 00 5500
Notice to Proceed

To: _____ Date: _____, 20_____

_____

_____

Attention: _____

Project: MTIGWAAKIIS HOUSING COMPLEX WELL HOUSE AND WATER MAIN

Please note that the Contract Time under the above Contract will commence to run on _____, _____, 20_____. Within ten (10) days of this date you are to start performing the Work. The dates of Substantial Completion and Final Completion are set forth in the Agreement: they are _____, and _____, respectively.

In accordance with paragraph 2.05 of the General Conditions, please submit to the ENGINEER the required schedules prior to the scheduling of a Pre-Construction Meeting.

Also, in accordance with paragraph 2.05 of the General Conditions, please request a Pre-Construction Meeting from the ENGINEER prior to delivery of any materials or start of any construction. A minimum of three (3) full working days notice is required to set up the Pre-Construction Meeting. Also, please notify the ENGINEER three (3) full working days in advance of any staking requirements or other activity on the Project.

Work at the site must be started by _____, _____, 20_____.

Copy to ENGINEER:
Wade Trim, Inc.
4241 Old US 27 South
Suite 1
Gaylord, MI 49735

_____
(OWNER)

By: _____
(Authorized Signature)

Section 00 6112
Performance Bond

Bond No. _____

KNOW ALL BY THESE PRESENT, That we, _____, a corporation organized and existing under the laws of the State of _____, and duly authorized to transact business in the State of Michigan, hereinafter called the "Principal," and _____ _____, a corporation organized and existing under the laws of the State of _____ _____, and duly authorized to transact business in the State of Michigan, as Surety, hereinafter called "Surety", are held and firmly bound unto _____, as Obligee, and hereinafter called "Obligee," in the just and full sum of _____ Dollars ($_____) lawful money of the United States of America, to be paid to the said Obligee, to which payment well and truly to be made, we bind ourselves, our heirs, administrators, executors, successors and assigns, jointly and severally, firmly by these presents.

THE CONDITIONS OF THIS OBLIGATION is such that, WHEREAS, the above Principal has entered into a contract with the said Obligee, dated the _____ day of _____, _____, for

_____

_____

_____

_____.

Herein referred to and made a part hereof as fully and to the same extent as if the same were entirely written herein, and

WHEREAS, it was one of the conditions of the award of the said Obligee, pursuant to which said contract was entered into, that these presents should be executed.

AND THE SAID SURETY, for value received, hereby stipulates and agrees that no change, extension of time, or any other forbearance, alteration or addition to the terms of the contract or to the work to be performed thereunder or the Contract Documents accompanying the same shall in anywise affect its obligations on this bond, and it does hereby waive notice of any such change, extension of time, or any other forbearance, alteration or addition to the terms of the contract or to the Work or to the Contract Documents.

NOW, THEREFORE, if the above Principal shall in all respects comply with the terms and conditions of said contract, and his (their or its) obligations thereunder, including the Contract Documents therein referred to and made a part thereof, and such alteration as may be made in such contract or Contract Documents, as herein or therein provided for, then this obligation shall be void; otherwise, this bond and obligation shall be and remain in full force and effect.

Signed and sealed this _____ day of _____.

Signed, sealed and delivered in the presence of:

_____	_____
Witness for CONTRACTOR	(Principal)
	_____
	(Title)
	By _____
_____	_____
Witness for Surety	(Surety)
	_____
	(Title)
_____	By _____
Attorney-In-Fact (Seal)	
_____	_____
Address	Address of Surety
_____	_____
City Zip Code	City Zip Code
_____	_____
Telephone	Telephone

Section 00 6113
Labor and Material Payment Bond

Bond No. _____

KNOW ALL BY THESE PRESENT, that we, _____, a corporation organized and existing under the laws of the State of _____, and duly authorized to transact business in the State of Michigan, hereinafter called the "Principal," and _____ _____, a corporation organized and existing under the laws of the State of _____ _____, and duly authorized to transact business in the State of Michigan, as Surety, hereinafter called "Surety", are held and firmly bound unto _____, as Obligee, and hereinafter called "Obligee," in the just and full sum of _____Dollars ($_____), lawful money of the United States of America, to be paid to the said Obligee, to which payment well and truly to be made, we bind ourselves, our heirs, administrators, executors, successors and assigns, jointly and severally, firmly by these presents.

THE CONDITIONS OF THIS OBLIGATION is such that, WHEREAS, the above Principal has entered into a contract with the said Obligee, dated the _____ day of _____, _____, for

_____

_____

_____,

which contract is herein referred to and made a part hereof as fully and to the same extent as if the same were entirely written herein, and

WHEREAS, it was one of the conditions of the award of the said Obligee, pursuant to which said contract was entered into, that these presents should be executed.

AND WHEREAS, this Bond is given in compliance with and subject to the provisions of Act No. 213 of the Public Acts of Michigan for the year 1963, as amended, including all notices, time limitation provisions and other requirements set forth therein, which are incorporated herein by reference.

AND THE SAID SURETY, for value received, hereby stipulates and agrees that no change, extension of time, or any other forbearance, alteration or addition to the terms of the contract or to the Work to be performed thereunder or the Contract Documents accompanying the same shall in anywise affect its obligations on this bond, and it does hereby waive notice of any such change, extension of time, or any other forbearance, alteration or addition to the terms of the contract or to the Work or to the Contract Documents.

NOW, THEREFORE, the condition of this obligation is such that if all claimants as defined in Act No. 213 of the Public Acts of Michigan for the year 1963, as amended, are timely paid for all labor and material used or reasonably required for use in the performance of the contract, then this obligation shall be void; otherwise, it shall remain in full force and effect.

Signed and sealed this _____ day of _____.

Signed, sealed and delivered in the presence of:

_____	_____
Witness for CONTRACTOR	(Principal)
	_____
	(Title)
	By _____
_____	_____
Witness for Surety	(Surety)
	_____
	(Title)
_____	By _____
Attorney-In-Fact (Seal)	
_____	_____
Address	Address of Surety
_____	_____
City Zip Code	City Zip Code
_____	_____
Telephone	Telephone

Section 00 6276
Contractor's Application for Payment

Job No. _____ Application No. _____ Date _____

OWNER: Little Traverse Bay Bands of Odawa Indians

CONTRACTOR: _____

Project: Mtigwaakiis Housing Complex Well House and Water Main

Period of this Application for Payment and Declaration _____ to _____

Contract Dated _____

CONTRACTOR'S CERTIFICATION

Total Earned to Date ..... $ _____

Less Total Earned to Date ..... $ _____
Previous Certificate No. _____

Total Earned This Application ..... $ _____

The undersigned CONTRACTOR certifies that to the best of his knowledge, information, and belief the Work covered by this Application for Payment has been completed in accordance with the Contract Documents, that all amounts have been paid by him for Work for which previous Certificates for Payment were issued and payments received from the OWNER, and that current payment shows herein is now due.

_____
(CONTRACTOR)

By: _____

Title: _____

CONTRACTOR'S DECLARATION

I hereby declare that I have not, during the period covered by this Application, performed any work, furnished any material, sustained any loss, damage, or delay for any reason, including soil conditions encountered or created, or otherwise done anything for which I shall ask, demand, sue for, or claim compensation from the OWNER, or its agents, and the ENGINEER, or its agents, in addition to the regular items set forth in the Contract as dated above executed between myself and the OWNER, and in the Change Orders for Work issued by the OWNER in writing as provided thereunder, except as I hereby make claim for additional compensation and/or extension of time, as set forth on the itemized statement attached hereto.

_____
(CONTRACTOR)

By: _____

Title: _____

Section 00 7200
General Conditions

Article 1 Definitions

1.01 Defined Terms

A. Wherever used in these General Conditions or in the other Contract Documents, the following terms have the meanings indicated which are applicable to both the singular and plural thereof:

1. Addenda -- Written or graphic instruments issued prior to the opening of Bids which clarify, correct or change the Contract Documents.

2. Agreement -- The written Agreement between OWNER and CONTRACTOR covering the Work to be performed; other Contract Documents are attached to the Agreement and made a part thereof as provided therein.

3. Application and Certificate for Payment -- The form included in the Contract Documents which is to be used by CONTRACTOR in requesting progress or final payment and which is to be accompanied by such supporting documentation as is required by the Contract Documents.

4. Bid -- The offer or proposal of the bidder submitted on the prescribed form setting forth the price(s) for the Work to be performed.

5. Bidding Requirements -- The Advertisement for Bids, Instructions to Bidders, Supplementary Instructions to Bidders, Proposal, Legal Status of Bidder, Bid Bond, and any other documents identified in the Proposal, to be submitted with the Bid.

6. Bonds -- Bid, Performance and Payment bonds and other instruments of security.

7. Change Order -- A written order to CONTRACTOR, reviewed by the ENGINEER and signed by OWNER, issued after execution of the Contract, authorizing a change in the Work or an adjustment in the Contract Price or the Contract Time. The Contract Price and Contract Time may be changed only by Change Order. A Change Order signed by CONTRACTOR indicates his agreement therewith, including that the Change Order constitutes a final adjustment in the Contract Price or Contract Time for all issues addressed or described in the Change Order.

8. Change Proposal -- A written request by CONTRACTOR, duly submitted in compliance with the procedural requirements set forth herein, seeking an adjustment in Contract Price or Contract Times; contesting an initial decision by ENGINEER concerning the requirements of the Contract Documents or the acceptability of Work under the Contract Documents; challenging a set-off against payments due; or seeking other relief with respect to the terms of the Contract.

9. Claims --

   a. A demand or assertion by OWNER directly to CONTRACTOR, duly submitted in compliance with the procedural requirements set forth herein, seeking an adjustment of Contract Price or Contract Times; contesting an initial decision by ENGINEER concerning the requirements of the Contract Documents or the acceptability of Work under the Contract Documents; contesting ENGINEER's decision regarding a Change Proposal; seeking resolution of a contractual issue that ENGINEER has declined to address; or seeking other relief with respect to the terms of the Contract.

b. A demand or assertion by CONTRACTOR directly to OWNER, duly submitted in compliance with the procedural requirements set forth herein, contesting ENGINEER's decision regarding a Change Proposal, or seeking resolution of a contractual issue that ENGINEER has declined to address.

c. A demand or assertion by OWNER or CONTRACTOR, duly submitted in compliance with the procedural requirements set forth herein, arising after ENGINEER has issued a recommendation of final payment.

d. A demand for money or services by a third party is not a Claim.

10. Constituents of Concern -- Asbestos, petroleum, radioactive materials, polychlorinated biphenyls (PCBs), lead-based paint (as defined by the HUD/EPA standard), hazardous waste, and any substance, product, waste, or other material of any nature whatsoever that is or becomes listed, regulated, or addressed pursuant to Laws and Regulations regulating, relating to, or imposing liability or standards of conduct concerning, any hazardous, toxic, or dangerous waste, substance, or material.

11. Contract -- The entire and integrated written contract between OWNER and CONTRACTOR concerning the Work

12. Contract Documents -- Those items so designated in the Agreement, and which together comprise the Contract.

13. Contract Price -- The monies or other considerations payable by OWNER to CONTRACTOR for completion of acceptable Work in accordance with the Contract Documents as stated in the Agreement.

14. Contract Time -- The number of days or the date stated in the Agreement:

a. to achieve Substantial Completion of all or any specified portions of the Work, and;

b. to complete the Work so that it is ready for final payment as evidenced by ENGINEER's written recommendation of final payment in accordance with paragraph 14.11.

15. CONTRACTOR -- The person, firm or corporation with whom OWNER has entered into the Agreement.

16. Cost of the Work -- The term Cost of the Work means the sum of all costs necessary for the proper performance of the Work at issue, as further defined in paragraph 12.01.

17. Day -- A calendar day of 24 hours measured from midnight to the next midnight.

18. Defective -- An adjective which when modifying the word Work refers to Work that is unsatisfactory, faulty or deficient, in that it does not conform to the Contract Documents or does not meet the requirements of any inspection, reference standard, test or approval referred to in the Contract Documents, or has been damaged prior to ENGINEER's recommendation of final payment.

19. Drawings -- See Plans.

20. Effective Date of Agreement -- The date indicated in the Agreement on which it becomes effective, but if no such date is indicated it means the date on which the Agreement is signed and delivered by the last of the two parties to sign and deliver.

21. Electronic Document -- Any Project-related correspondence, attachments to correspondence, data, documents, drawings, information, or graphics, including but not limited to Shop Drawings and other Submittals, that are in an electronic or digital format.

22. Electronic Means -- Electronic mail (email), upload/download from a secure Project website, or other communications methods that allow:

    a. the transmission or communication of Electronic Documents;

    b. the documentation of transmissions, including sending and receipt;

    c. printing of the transmitted Electronic Document by the recipient;

    d. the storage and archiving of the Electronic Document by sender and recipient; and

    e. the use by recipient of the Electronic Document for purposes permitted by this Contract. Electronic Means does not include the use of text messaging, or of Facebook, Twitter, Instagram, or similar social media services for transmission of Electronic Documents.

23. ENGINEER -- The person, firm, or corporation identified in the Supplementary Instructions to Bidders hired by OWNER to prepare Plans and Specifications for the Project and to assist OWNER in interpreting Plans and Specifications during the performance of the Work. ENGINEER's authority and responsibility are set forth in the Contract between OWNER and ENGINEER. CONTRACTOR acknowledges and agrees that ENGINEER's obligations and duties under ENGINEER's contract with OWNER are obligations and duties to OWNER only, and ENGINEER has no independent obligation to CONTRACTOR of any kind, including but not limited to providing services, or to take any action or to refrain from taking action on behalf of CONTRACTOR or any Subcontractor, Sub-Subcontractor or Supplier.

24. Field Order -- A written order issued by ENGINEER which clarifies or interprets the Contract Documents or orders minor changes in the Work in accordance with paragraphs 9.04 and 9.05 but which does not involve a change in the Contract Price or the Contract Time.

25. Hazardous Environmental Conditions -- The presence at the Site of Constituents of Concern in such quantities or circumstances that may present a danger to persons or property exposed thereto.

    a. The presence at the Site of materials that are necessary for the execution of the Work, or that are to be incorporated into the Work, and that are controlled and contained pursuant to industry practices, Laws and Regulations, and the requirements of the Contract, is not a Hazardous Environmental Condition.

    b. The presence of Constituents of Concern that are to be removed or remediated as part of the Work is not a Hazardous Environmental Condition.

c. The presence of Constituents of Concern as part of the routine, anticipated, and obvious working conditions at the Site, is not a Hazardous Environmental Condition.

26. Laws and Regulations; Laws or Regulations Any and all applicable laws, rules, regulations, ordinances, codes and orders of any and all governmental bodies, agencies, authorities and courts having jurisdiction.

27. Lump Sum -- Construction Work where the OWNER pays a single stipulate price (Lump Sum) for the entire scope of Work; plus or minus alternates and/or allowances. However, unit prices may be required for individual items of Work for the purposes of changes, additions, or deletions.

28. Milestone -- A principal event specified in the Contract Documents relating to an intermediate completion date or time prior to Substantial Completion of the Work.

29. Notice of Award -- The written notice by OWNER to the apparent successful Bidder stating that, upon compliance by the apparent successful Bidder with the conditions precedent enumerated therein, within the time specified, OWNER will sign and deliver the Agreement.

30. Notice to Proceed -- A written notice given by OWNER to CONTRACTOR (with a copy to ENGINEER) fixing the date on which the Contract Time will commence to run and on which CONTRACTOR shall start to perform his obligation under the Contract Documents.

31. OWNER -- The public body or authority, corporation, limited liability company, association, partnership, or individual with whom CONTRACTOR has entered into the Agreement and for whom the Work is to be provided and as identified in the Supplementary Instructions to Bidders.

32. Partial Utilization -- Use by OWNER of a substantially completed part of the Work for the purpose for which it is intended (or a related purpose) prior to Substantial Completion of all the Work.

33. Plans -- The part of the Contract Documents which graphically show the extent, character and Scope of the Work to be furnished and performed by CONTRACTOR and which have been prepared or approved by the ENGINEER or OWNER; sometimes also referred to as Drawings.

34. Progress Schedule -- A schedule, prepared and maintained by CONTRACTOR, describing the sequence and duration of the activities comprising CONTRACTOR's plan to accomplish the Work within the Contract Times.

35. Project -- The total construction of which the Work to be provided under the Contract Documents may be the whole or a part as indicated elsewhere in the Contract Documents.

36. Project Manual -- The volume assembled for the Project which may include, among other parts, Procurement Requirements, Contracting Requirements and Specifications.

37. Proposal -- The offer or bid of the Bidder submitted on the prescribed form setting forth the prices for the Work to be performed.

38. Radioactive Material -- Source, special nuclear, or byproduct material as defined by the Atomic Energy Act of 1954 as amended.

39. Resident Project Representative -- The authorized representative of ENGINEER who may be assigned to the Site or any part thereof.

40. Samples -- Physical examples of materials, equipment, or workmanship that are representative of some portion of the Work and which establish the standards by which such portion of the Work will be judged.

41. Schedule of Submittals -- A schedule, prepared and maintained by CONTRACTOR, of required Submittals and the time requirements for ENGINEER's review of the Submittals.

42. Schedule of Values -- A schedule, prepared and maintained by CONTRACTOR, allocating portions of the Contract Price to various portions of the Work and used as the basis for reviewing CONTRACTOR's Applications for Payment.

43. Shop Drawings -- All drawings, diagrams, illustrations, schedules and other data or information required by the Contract Documents which are specifically prepared or assembled by or for CONTRACTOR and submitted by CONTRACTOR to illustrate material or equipment for some portion of the Work.

44. Site -- Lands or areas indicated in the Contract Documents as being furnished by OWNER upon which the Work is to be performed, including rights-of-way and easements, and such other lands or areas furnished by OWNER which are designated for the use of CONTRACTOR.

45. Specifications -- That part of the Contract Documents which consist of written technical descriptions of materials, equipment, construction systems, standards and workmanship as applied to the Work and certain administrative details applicable thereto.

    a. Project Specifications are those portions of the Contract Documents which have been prepared specifically for this Project and which are identified by the job number in the lower right-hand corner of each page.

    b. Standard Specifications are Specification sections that are the same from Project to Project as of the revision date shown in the lower left-hand corner of the page.

    c. Standard Specification Section Revisions -- Section 00 9120 of the Specifications which amends or supplements the Standard Specification Sections.

46. Subcontractor -- An individual, firm or corporation having a direct contract with CONTRACTOR or with any other Subcontractor for the performance of a part of the Work at the Site.

47. Submittal -- A written or graphic document, prepared by or for CONTRACTOR, which the Contract Documents require CONTRACTOR to submit to ENGINEER, or that is indicated as a Submittal in the Schedule of Submittals accepted by ENGINEER. Submittals may include Shop Drawings and Samples; schedules; product data; OWNER-delegated designs; sustainable design information; information on special procedures; testing plans; results of tests and evaluations, source quality-control testing and inspections, and field or Site quality-control testing and inspections; warranties and certifications; Suppliers' instructions and reports; records of delivery of spare parts and tools; operations and maintenance data; Project photographic documentation; record

documents; and other such documents required by the Contract Documents. Submittals, whether or not approved or accepted by ENGINEER, are not Contract Documents. Change Proposals, Change Orders, Claims, notices, Applications for Payment, and requests for interpretation or clarification are not Submittals.

48. Substantial Completion -- The Work (or a specified part thereof) has progressed to the point where, in the opinion of ENGINEER as evidenced by the Certificate of Substantial Completion, it is sufficiently complete, in accordance with the Contract Documents, so that the Work (or specified part) can be utilized for the purposes for which it was intended; or if no such certificate is issued, when the Work is complete and ready for final payment as evidenced by ENGINEER's written recommendation of final payment in accordance with paragraph 14.11. The terms "substantially complete" and "substantially completed" as applied to all or part of the Work refer to Substantial Completion thereof.

49. Supplementary Conditions -- The part of the Contract Documents which amends or supplements these General Conditions.

50. Supplementary Instructions to Bidders -- The part of the Contract Documents which amends or supplements the Instructions to Bidders.

51. Supplier -- A manufacturer, fabricator, supplier, distributor, material man, or vendor having a direct contract with CONTRACTOR, or with any Subcontractor, or with OWNER, to furnish materials or equipment to be incorporated in the Work by CONTRACTOR or any Subcontractor.

52. Unit Price -- Construction Work where the OWNER pays a fixed sum (Unit Price) per each completed unit of Work. Units are listed on the Proposal Form.

53. Utilities – Underground or above ground pipelines, conduits, ducts, cables, wires, manholes, vaults, tanks, tunnels or other such facilities or attachments, and any structures or encasements containing such facilities, which have been installed to furnish any of the following services or materials: electricity, gases, steam, liquid petroleum products, telephone or other communications, cable television, sewage and drainage removal, traffic or other control systems, water or other liquids or chemicals.

54. Work -- The entire completed construction or the various separately identifiable parts thereof required to be furnished under the Contract Documents. Work includes and is the result of performing or furnishing labor and furnishing and incorporating materials and equipment into the construction, and performing or furnishing services and furnishing documents, all as required by the Contract Documents.

55. Work Change Directive -- A written directive to CONTRACTOR, issued on or after the Effective Date of the Agreement and signed by OWNER and reviewed by ENGINEER, ordering an addition, deletion or revision in the Work, or responding to differing or unforeseen physical conditions under which the Work is to be performed as provided in paragraph 4.03 or to emergencies under paragraph 6.18. A Work Change Directive will not change the Contract Price or Contract Time but is evidence that the parties expect that the change directed or documented by a Work Change Directive will be incorporated in a subsequently issued Change Order following negotiations by the parties as to its effect, if any, on the Contract Price or Contract Time as provided in paragraph 10.01.

1.02 Terminology

A. The following words, terms, or phrases are not defined but, when used in the Contract Documents, have the following meaning:

1. Whenever in the Contract Documents the terms "as ordered," "as directed," "as required," "as allowed," "as approved" or terms of like effect or import are used; or the adjectives "reasonable," "suitable," "acceptable," "proper" or "satisfactory" or adjectives of like effect or import are used to describe a requirement, direction, review or judgment of ENGINEER as to the Work, it is intended that such requirement, direction, review or judgment will be solely to evaluate, in general, the completed Work for compliance with the technical requirements of and information in the Contract Documents and conformance with the design concept of the completed Project as a functioning whole as shown or indicated in the Contract Documents (unless there is a specific statement indicating otherwise). The use of any such term or adjective shall not be effective to assign to ENGINEER any duty or authority to supervise or direct the furnishing or performance of the Work or any duty or authority to undertake responsibility contrary to the provisions of paragraph 9.10 or any other provision of the Contract Documents.

2. The word "furnish," when used in connection with services, materials, or equipment, shall mean to supply and deliver said services, materials, or equipment to the Site (or some other specified location) ready for use or installation and in usable or operable condition.

3. The word "install," when used in connection with services, materials, or equipment, shall mean to put into use or place in final position said services, materials, or equipment complete and ready for intended use.

4. The words "perform" or "provide," when used in connection with services, materials, or equipment, shall mean to furnish and install said services, materials, or equipment complete and ready for intended use.

5. When "furnish," "install," "perform," or "provide" is not used in connection with services, materials, or equipment in a context clearly requiring an obligation of CONTRACTOR, "provide" is implied.

B. Unless stated otherwise in the Contract Documents, words or phrases which have a well-known technical or construction industry or trade meaning are used in the Contract Documents in accordance with such recognized meaning.

Article 2 Preliminary Matters

2.01 Delivery of Bonds and Insurance

A. When CONTRACTOR delivers the executed Agreements to OWNER, CONTRACTOR shall also deliver to OWNER such Bonds and Insurance Certificates and other evidence of Insurance requested as CONTRACTOR may be required to furnish in accordance with Article 5. No Work at the site may begin or progress payments made to CONTRACTOR until all Bonds and Insurance Certificates in the form and substance required in Article 5 have been submitted and approved by OWNER.

2.02 Copies of Documents

A. OWNER shall furnish to CONTRACTOR up to 5copies of the Contract Documents (including at least one fully signed counterpart of the Agreement) as are reasonably necessary for the execution of the Work. Additional copies will be furnished, upon request, at the cost of reproduction.

2.03 Commencement of Contract Time; Notice to Proceed

A. Time is of the essence in the performance of the Work. The Contract Time will commence to run on the 30th day after the effective date of the Agreement, or, if a Notice to Proceed is given, on the day indicated in the Notice to Proceed. A Notice to Proceed may be given at any time within 30 days after the effective date of the Agreement. In no event will the Contract Time commence to run later than the 30th day after the effective date of the Agreement. Time limits stated in the Contract Documents are of the essence of the Agreement.

2.04 Starting the Project

A. CONTRACTOR shall start to perform the Work within 10 days of when the Contract Time commences to run, but no Work shall be done at the Site prior to the date on which the Contract Time commences to run. CONTRACTOR shall notify the ENGINEER at least 3 working days in advance of the time he intends to start Work.

2.05 Preconstruction Meeting

A. Within 10 days of the Effective Date of the Agreement and prior to the delivery of materials or the start of any construction, the CONTRACTOR shall request a Preconstruction Meeting from ENGINEER. A minimum of 3 full working days' notice shall be required.

B. Prior to the scheduling of the Preconstruction Meeting, CONTRACTOR shall submit to ENGINEER for review:

1. A preliminary Progress Schedule indicating the starting and completion dates of the various stages of the Work, including any Milestones specified in the Contract Documents;

2. A preliminary Schedule of Submittals which will list each required Submittal and the times for submitting, reviewing and processing such Submittal;

3. An estimated monthly payment schedule, and a preliminary Schedule of Values for all of the Work.

C. The Preconstruction Meeting will be held for review and acceptance of the schedules, to establish procedures for handling Shop Drawings and other Submittals, for processing Applications for Payment, and to establish a working understanding among the parties as to the Work.

2.06 Electronic Transmittals

A. Except as otherwise stated elsewhere in the Contract, the OWNER, ENGINEER, and CONTRACTOR may send, and shall accept, Electronic Documents transmitted by Electronic Means.

B. If the Contract does not establish protocols for Electronic Means, then OWNER, ENGINEER, and CONTRACTOR shall jointly develop such protocols.

C. Subject to any governing protocols for Electronic Means, when transmitting Electronic Documents by Electronic Means, the transmitting party makes no representations as to long-term compatibility, usability, or readability of the Electronic Documents resulting from the recipient's use of software application packages, operating systems, or computer hardware differing from those used in the drafting or transmittal of the Electronic Documents.

Article 3 Contract Documents Intent and Reuse

3.01 Intent

A. The Contract Documents are complementary; what is required by one Contract Document is as binding as if required by all.

B. It is the intent of the Contract Documents to describe a functionally complete Project (or part thereof) to be constructed in accordance with the Contract Documents.

C. Unless otherwise stated in the Contract Documents, if there is a discrepancy between the electronic versions of the Contract Documents (including any printed copies derived from such electronic versions) and the printed record version, the printed record version will govern.

D. The Contract supersedes prior negotiations, representations, and agreements, whether written or oral.

E. ENGINEER will issue clarifications and interpretations of the Contract Documents as provided herein.

F. Any provision or part of the Contract Documents held to be void or unenforceable under any Law or Regulation will be deemed stricken, and all remaining provisions will continue to be valid and binding upon OWNER and CONTRACTOR, which agree that the Contract Documents will be reformed to replace such stricken provision or part thereof with a valid and enforceable provision that comes as close as possible to expressing the intention of the stricken provision.

G. Nothing in the Contract Documents creates:

1. any contractual relationship between OWNER or ENGINEER and any Subcontractor, Supplier, or other individual or entity performing or furnishing any of the Work, for the benefit of such Subcontractor, Supplier, or other individual or entity; or

2. any obligation on the part of OWNER or ENGINEER to pay or to see to the payment of any money due any such Subcontractor, Supplier, or other individual or entity, except as may otherwise be required by Laws and Regulations; or

3. any obligation on the part of ENGINEER to CONTRACTOR.

3.02 Reference to Standards and Specifications of Technical Societies

A. Reference to standards, specifications, manuals or codes of any technical society, organization or association, or to the Laws or Regulations of any governmental authority, whether such reference be specific or by implication, shall mean the latest standard, specification, manual, or Laws or Regulations in effect at the time of opening of Bids or, on the effective date of the Agreement if there were no Bids, except as may be otherwise specifically stated in the Contract Documents.

B. It is the intent of the Contract Documents to describe a functionally complete project (or part thereof) to be constructed in accordance with the Contract Documents. Any Work, materials, or equipment that may reasonably be inferred from the Contract Documents or from prevailing custom or trade usage as being required to produce the intended result shall be furnished and performed whether or not it is specifically called for.

C. No provision of any standard, specification, manual, code or instruction shall be effective to change the duties and responsibilities of OWNER, CONTRACTOR or ENGINEER, or any of their Subcontractors, consultants, agents, or employees from those set forth in the Contract Documents, nor shall it be effective to assign to OWNER, ENGINEER or any of ENGINEER's consultants, agents or employees, any duty or authority to supervise or direct the furnishing or performance of the Work or any duty or authority to undertake responsibility inconsistent with the provisions of paragraph 9.10 or any other provision of the Contract Documents.

3.03 Reporting and Resolving Discrepancies

A. Before undertaking each part of the Work, CONTRACTOR shall carefully study and compare the Contract Documents and check and verify pertinent figures therein and all applicable field measurements. CONTRACTOR has a duty to and shall promptly report in writing to ENGINEER any conflict, error, ambiguity, or discrepancy which CONTRACTOR should reasonably have discovered and shall obtain a written interpretation or clarification from ENGINEER before proceeding with any Work affected thereby.

B. If, during the performance of the Work, CONTRACTOR discovers any conflict, error, ambiguity or discrepancy within the Contract Documents or between the Contract Documents and any provision of any Law or Regulation applicable to the performance of the Work or of any standard, specification, manual or code, or of any instruction of any Supplier, CONTRACTOR shall report it to ENGINEER in writing at once, and, CONTRACTOR shall not proceed with the Work affected thereby (except in an emergency as authorized by paragraph 6.18) until receiving written instruction or clarification from ENGINEER or OWNER. However, CONTRACTOR shall not be liable to OWNER or ENGINEER for failure to report any such conflict, error, ambiguity or discrepancy unless CONTRACTOR knew or reasonably should have known thereof.

C. Except as otherwise specifically stated in the Contract Documents or as may be provided by amendment or supplement issued by one of the methods indicated in paragraph 3.05, the provisions of the Contract Documents shall take precedence in resolving any conflict, error, ambiguity or discrepancy between the provisions of the Contract Documents and;

1. the provisions of any standard, specification, manual, code or instruction (whether or not specifically incorporated by reference in the Contract Documents); or

2. the provisions of any Laws or Regulations applicable to the performance of the Work (unless such an interpretation of the provisions of the Contract Documents would result in violation of such Law or Regulation).

3.04 Requirements of Contract Documents

A. During the performance of the Work and until final payment, CONTRACTOR and OWNER shall submit to the ENGINEER in writing all matters in question concerning the requirements of the Contract Documents (sometimes referred to as requests for information or interpretation—RFIs), or relating to the acceptability of the Work under the Contract Documents, as soon as possible after such matters arise. ENGINEER will be the initial interpreter of the requirements of the Contract Documents, and judge of the acceptability of the Work.

B. ENGINEER will, with reasonable promptness, render a written clarification, interpretation, or decision on the issue submitted, or initiate an amendment or supplement to the Contract Documents. ENGINEER's written clarification, interpretation, or decision will be final and binding on CONTRACTOR, unless it appeals by submitting a Change Proposal, and on OWNER, unless it appeals by filing a Claim.

C. If a submitted matter in question concerns terms and conditions of the Contract Documents that do not involve

1. the performance or acceptability of the Work under the Contract Documents,

2. the design (as set forth in the Drawings, Specifications, or otherwise), or

3. other engineering or technical matters, then ENGINEER will promptly notify OWNER and CONTRACTOR in writing that ENGINEER is unable to provide a decision or interpretation. If OWNER and CONTRACTOR are unable to agree on resolution of such a matter in question, either party may pursue resolution as provided in paragraph 11.01.

3.05 Order of Precedence

A. In resolving conflicts, errors or discrepancies between Plans and Specifications,

1. figured dimensions shall govern over scaled dimensions;

2. Plans shall govern over Standard Specifications;

3. and Project Specifications shall govern over Standard Specifications and Plans.

3.06 Amending and Supplementing Contract Documents

A. The Contract Documents may be amended to provide for additions, deletions and revisions in the Work or to modify the terms and conditions thereof in one or more of the following ways:

1. a Field Order (pursuant to paragraph 9.05), or,

2. a Change Order (pursuant to paragraph 10.01.A.1), or

3. a Work Change Directive Order (pursuant to paragraph 10.01.A.2)

B. In addition, the requirements of the Contract Documents may be supplemented, and minor variations and deviations in the Work may be authorized, in one or more of the following ways:

1. a Field Order (pursuant to paragraph 9.05),

2. ENGINEER's review of a Shop Drawing or Sample (pursuant to paragraph 6.21), or

3. ENGINEER's written interpretation or clarification (pursuant to paragraph 9.04).

3.07 Reuse of Documents

A. Neither CONTRACTOR nor any Subcontractor, manufacturer, fabricator, Supplier, distributor, or other person or organization performing or furnishing any of the Work under a direct or indirect contract with OWNER:

1. shall have or acquire any title to or ownership rights in any of the Plans, Specifications, or other documents (or copies of any thereof) prepared by or bearing the seal of ENGINEER or ENGINEER's Consultant, and

2. they shall not reuse any of such Plans, Specification, other documents or copies on extensions of the Project or any other project without written consent of OWNER and ENGINEER and specific written verification or adaptation by ENGINEER.

3.08 Electronic Data

A. Except as otherwise stated elsewhere in the Contract Documents, OWNER, ENGINEER and CONTRACTOR may transmit, and shall accept, Project-related correspondence, text, data, documents, drawings, information and graphics, including but not limited to Shop Drawings and other Submittals, in electronic media or digital format, either directly or through access to a secure Project website.

B. When transferring documents in electronic media format, the transferring party makes no representations as to long term compatibility, usability, or readability of documents resulting from the use of software application packages, operating systems, or computer hardware differing from those used by the data's creator.

Article 4 Availability of Lands; Subsurface and Physical Conditions; Reference Points

4.01 Availability of Lands

A. OWNER shall furnish, as indicated in the Contract Documents and not later than the established date for beginning Work on the Contract, the lands upon which the Work is to be performed, rights of way and easements for access thereto, and such other lands which are designated for the use of CONTRACTOR. OWNER shall identify any encumbrances or restrictions not of general application but specifically related to use of lands so furnished with which CONTRACTOR will have to comply in performing the Work. Easements for permanent structures or permanent changes in existing facilities will be obtained and paid for by OWNER, unless otherwise provided in the Contract Documents. CONTRACTOR shall provide for all additional lands and access thereto that may be required for temporary construction facilities or storage of materials and equipment unless otherwise provided in the Contract Documents.

4.02 Subsurface and Physical Conditions; Investigations and Reports

A. Reference is made to the Supplementary Conditions for identification of those reports of investigations and tests of subsurface and physical conditions at the Site or otherwise affecting cost, progress or performance of the Work which have been reviewed in preparation of the Contract Documents. Such reports are not guaranteed as to accuracy or completeness and are not part of the Contract Documents.

B. The locations of utilities or other physical conditions relating to existing surface or subsurface structures at or contiguous to the Site as shown on the Plans are taken from drawings from sources believed to be reliable. Neither the OWNER nor ENGINEER will be responsible for any omissions of, or variations from, the indicated location of existing utilities which may be encountered in the Work.

C. CONTRACTOR shall draw its own conclusions as to the general accuracy of the "technical data" contained in such reports and drawings, and confirms such reports and drawings are not Contract Documents. CONTRACTOR may not rely upon or make any Claim against OWNER, ENGINEER or any of ENGINEER's Consultants with respect to:

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

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

c. any CONTRACTOR interpretation of or conclusion drawn from any "technical data" or any such data, interpretations, opinions or information.

2. The cost of all the following will be included in the Contract Price and CONTRACTOR shall have full responsibility for:

a. reviewing and checking all such information and data,

b. locating all Utilities during construction,

c. coordination of the Work with the owners of such Utilities, and

d. the safety and protection of all such Utilities as provided in paragraph 6.15 and repairing any damage thereto resulting from the Work.

4.03 Unforeseen Physical Conditions

A. A. If CONTRACTOR discovers one or both of the following physical conditions of surface or subsurface at the Project or improvement Site, before disturbing the physical condition, the CONTRACTOR shall immediately notify OWNER and ENGINEER of the physical condition; and follow up within 48 hours in writing:

1. A subsurface or a physical condition at the Site differing materially from those indicated in the Contract Documents, or

2. An unknown physical condition at the Site of a nature differing materially from those ordinarily encountered and generally recognized as inherent in work of the character provided for the improvement project.

B. ENGINEER's Review. After receipt of written notice as required by the preceding paragraph, ENGINEER will promptly review the subsurface or physical condition in question; determine the necessity of OWNER's obtaining additional exploration or tests with respect to the condition; conclude whether the condition falls within any one or more of the differing site condition categories in paragraph 4.03.A above; obtain any pertinent cost or schedule information from CONTRACTOR; prepare recommendations to OWNER regarding the CONTRACTOR's resumption of Work in connection with the subsurface or physical condition in question and the need for any change in the Drawings or Specifications; and advise OWNER in writing of ENGINEER's findings, conclusions, and recommendations.

C. OWNER's Statement to CONTRACTOR Regarding Site Condition. After receipt of ENGINEER's written findings, conclusions, and recommendations, OWNER shall issue a written statement to CONTRACTOR (with a copy to ENGINEER) regarding the subsurface or physical condition in question, addressing the resumption of Work in connection with such condition, indicating whether any change in the Drawings or Specifications will be made, and adopting or rejecting ENGINEER's written findings, conclusions, and recommendations, in whole or in part.

D. Possible Price and Times Adjustments.

1. CONTRACTOR shall be entitled to an equitable adjustment in Contract Price or Contract Times, or both, to the extent that the existence of a differing subsurface or physical condition, or any related delay, disruption, or interference, causes an increase or decrease in CONTRACTOR's cost of, or time required for, performance of the Work; subject, however, to the following:

   a. such condition must fall within any one or more of the categories described in paragraph 4.03.A;

   b. with respect to Work that is paid for on a Unit Price basis, any adjustment in Contract Price will be subject to the provisions of paragraph 12.03; and

   c. CONTRACTOR's entitlement to an adjustment of the Contract Times is conditioned on such adjustment being essential to CONTRACTOR's ability to complete the Work within the Contract Times pursuant to paragraph 10.05.

2. CONTRACTOR shall not be entitled to any adjustment in the Contract Price or Contract Times with respect to a subsurface or physical condition if:

   a. CONTRACTOR knew of the existence of such condition at the time CONTRACTOR made a commitment to OWNER with respect to Contract Price and Contract times by the submission of a Bid or becoming bound under a negotiated contract, or otherwise; or

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

   c. CONTRACTOR failed to give the written notice as required by paragraph 4.03.A.

3. If OWNER and CONTRACTOR agree regarding CONTRACTOR's entitlement to and the amount or extent of any adjustment in the Contract Price or Contract Times, or both, then any such adjustment shall be set forth in a Change Order or Work Change Directive.

4. CONTRACTOR may submit a Change Proposal regarding its entitlement to or the amount or extent of any adjustment in the Contract Price or Contract Times, or both, no later than 30 days after OWNER's issuance of the OWNER's written statement to CONTRACTOR regarding the subsurface or physical condition in question.

4.04 Utilities

A. CONTRACTOR's Responsibilities. The information and data shown or indicated in the Contract Documents with respect to existing Utilities at or adjacent to the Site, if any, is based on information and data furnished to OWNER or ENGINEER by the owners of such Utilities, including OWNER, or by others.

1. OWNER and ENGINEER do not warrant or guarantee the accuracy or completeness of any such information or data provided by others; and

2. the cost of all of the following will be included in the Contract Price, and CONTRACTOR shall have full responsibility for:

   a. reviewing and checking all information and data regarding existing Utilities at the Site;

   b. locating all Utilities shown or indicated in the Contract Documents as being at the Site;

   c. coordination of the Work with the owners (including OWNER) of such Utilities, during construction; and

   d. the safety and protection of all existing Utilities at the Site, and repairing any damage thereto resulting from the Work.

B. Notice by CONTRACTOR. If CONTRACTOR believes that an Utilities that is uncovered or revealed at the Site was not shown or indicated in the Contract Documents, or was not shown or indicated with reasonable accuracy, then CONTRACTOR shall, promptly after becoming aware thereof and before further disturbing conditions affected thereby or performing any Work in connection therewith (except in an emergency as required by paragraph 6.18), identify the owner of such Underground Facility and give written notice to that owner and to OWNER and ENGINEER.

C. ENGINEER's Review. ENGINEER will:

1. promptly review the Utilities and conclude whether such Utilities was not shown or indicated in the Contract Documents,

2. or was not shown or indicated with reasonable accuracy;

3. obtain any pertinent cost or schedule information from CONTRACTOR;

4. prepare recommendations to OWNER regarding the CONTRACTOR's resumption of Work in connection with the Utilities in question;

5. determine the extent, if any, to which a change is required in the Drawings or Specifications to reflect and document the consequences of the existence or location of the Utilities;

6. and advise OWNER in writing of ENGINEER's findings, conclusions, and recommendations.

During such time, CONTRACTOR shall be responsible for the safety and protection of such Underground Facility.

D. OWNER's Statement to CONTRACTOR Regarding Utilities. After receipt of ENGINEER's written findings, conclusions, and recommendations, OWNER shall issue a written statement to CONTRACTOR (with a copy to ENGINEER) regarding the Utilities in question, addressing the resumption of Work in connection with such Underground Facility, indicating whether any change in the Drawings or Specifications will be made, and adopting or rejecting ENGINEER's written findings, conclusions, and recommendations in whole or in part.

E. Possible Price and Times Adjustments:

1. CONTRACTOR shall be entitled to an equitable adjustment in the Contract Price or Contract Times, or both, to the extent that any existing Utilities at the Site that was not shown or indicated in the Contract Documents, or was not shown or indicated with reasonable accuracy, or any related delay, disruption, or interference, causes an increase or decrease in CONTRACTOR's cost of, or time required for, performance of the Work; subject, however, to the following:

a. CONTRACTOR did not know of and could not reasonably have been expected to be aware of or to have anticipated the existence or actual location of the Utilities in question;

b. With respect to Work that is paid for on a Unit Price basis, any adjustment in Contract Price will be subject to the provisions of paragraph 12.03;

c. CONTRACTOR's entitlement to an adjustment of the Contract Times is conditioned on such adjustment being essential to CONTRACTOR's ability to complete the Work within the Contract Times; and

d. CONTRACTOR gave the notice required in paragraph 4.04.B.

2. If OWNER and CONTRACTOR agree regarding CONTRACTOR's entitlement to and the amount or extent of any adjustment in the Contract Price or Contract Times, or both, then any such adjustment shall be set forth in a Change Order.

3. CONTRACTOR may submit a Change Proposal regarding its entitlement to or the amount or extent of any adjustment in the Contract Price or Contract Times, or both, no later than 30 days after OWNER's issuance of the OWNER's written statement to CONTRACTOR regarding the Underground Facility in question.

4.05 Reference Points

A. OWNER shall provide engineering surveys for construction to establish property corners, monuments, bench marks and similar reference points which in his judgment are necessary to enable CONTRACTOR to proceed with the Work. CONTRACTOR shall be responsible for the preservation of established reference points and shall make no changes or relocations without the prior written approval of OWNER. CONTRACTOR shall report to ENGINEER whenever any reference point is lost or destroyed or requires relocation because of necessary changes in grades or locations. Reference points destroyed by negligence of CONTRACTOR will be replaced by OWNER at the expense of CONTRACTOR. Construction Staking will be furnished by OWNER as provided in Division 01 of the Specifications.

4.06 Constituents of Concern

A. OWNER shall be responsible for any Constituents of Concern uncovered or revealed at the Site which was not shown or indicated in Plans or Specifications or identified in the Contract Documents to be within the scope of the Work and which may present a substantial danger to persons or property exposed thereto in connection with the Work at the Site. OWNER shall not be responsible for any such materials brought to the Site by CONTRACTOR, Subcontractor, Suppliers or anyone else for whom CONTRACTOR is responsible.

B. Upon discovering any such material, CONTRACTOR shall immediately:

1. stop all Work in connection with such Hazardous Environmental Condition and in any area affected thereby (except in emergency as required by paragraph 6.18), and

2. notify OWNER and ENGINEER (and thereafter confirm such notice in writing). OWNER shall promptly consult with ENGINEER concerning the necessity for OWNER to retain a qualified expert to evaluate such Hazardous Environmental Condition or take corrective action, if any.

C. CONTRACTOR shall not be required to resume Work in connection with such Hazardous Environmental Condition or in any such affected areas until after OWNER has obtained any required permits related thereto and delivered to CONTRACTOR special written notice:

1. specifying that such condition and any affected area is or has been rendered safe for the resumption of Work, or

2. specifying any special conditions under which such Work may be resumed safely.

D. If OWNER and CONTRACTOR cannot agree as to entitlement to, or the amount, or extent of an adjustment, if any, in Contract Price or Contract Terms as a result of such Work stoppage or such special conditions under which Work is agreed by CONTRACTOR to be resumed, either party may make a Claim therefor as provided in paragraph 11.01.

E. If after receipt of such special written notice CONTRACTOR does not agree to resume such Work based on a reasonable belief it is unsafe, or does not agree to resume such Work under such special conditions, then OWNER may order such portion of the Work that is in connection with such condition, or in such affected area, to be deleted from the Work. If OWNER and CONTRACTOR cannot agree as to entitlement to, or the amount, or extent of an adjustment, if any, in Contract Price or Contract Time as a result of deleting such portion of the Work, then either party may make a Claim therefor as provided in paragraph 11.01. OWNER may have such deleted portion of the Work performed by OWNER's own forces or others in accordance with paragraph 7.01.

F. To the fullest extent permitted by Laws and Regulations, OWNER shall indemnify and hold harmless CONTRACTOR, Subcontractors, ENGINEER, ENGINEER's Consultants and the officers, directors, employees, agents, other consultants and subcontractors of each and any of them from and against all claims, costs, losses, damages and expenses arising out of or resulting from such condition per this paragraph 4.06, provided that:

1. any such claim, cost, loss or damage is attributable to bodily injury, sickness, disease or death, or to injury to or destruction of tangible property (other than the Work itself), including the loss of use resulting therefrom, and

2. nothing in this paragraph 4.06 shall obligate OWNER to indemnify any person or entity from and against the consequences of that person's or entity's own negligence.

G. The provisions of paragraph 4.03 are not intended to apply to the presence of Constituents of Concern or Hazardous Environmental Conditions uncovered or revealed at the Site.

Article 5 Bonds and Insurance

5.01 Performance and Other Bonds

A. CONTRACTOR shall furnish performance and payment Bonds, on the form included in the Contract Documents, each in an amount at least equal to the Contract Price, as security for the faithful performance and payment of all of CONTRACTOR's obligations under the Contract Documents. These Bonds shall remain in effect at least until 1 year after the date when final payment becomes due, except as otherwise provided by Laws and Regulations or as specified in the Contract Documents or Bond. CONTRACTOR shall also furnish such other Bonds as are required by the Supplementary Conditions.

B. All Bonds shall be in the forms prescribed by the Contract Documents and be executed by such Sureties as

1. are licensed to conduct business in the state where the Project is located, and

2. are named in the current list of "Companies Holding Certificates of Authority as Acceptable Sureties on Federal Bonds and as Acceptable Reinsuring Companies" as published in Circular 570 (amended) by the U.S. Department of Treasury, Financial Management Service, Surety Bond Branch.

C. All Bonds signed by an agent must be accompanied by a certified copy of such agent's authority to act.

D. If Surety on any Bond furnished by CONTRACTOR is declared as bankrupt or becomes insolvent, or its right to do business is terminated in any state where any part of the Project is located, or it ceases to meet the requirements of clauses (1) and (2) of paragraph 5.01, CONTRACTOR shall within 5 days thereafter substitute another Bond and Surety, both of which shall be acceptable to OWNER.

5.02 Licensed Insurers and Sureties

A. Bonds and insurance required by the Contract Documents to be purchased and maintained by OWNER or CONTRACTOR shall be obtained from surety or insurance companies that are duly licensed or authorized in the jurisdiction in which the Project is located to issue Bonds or insurance policies for the limits and coverages so required.

5.03 Insurance

A. CONTRACTOR shall purchase and maintain during the term of the Project such insurance as will protect him, OWNER(s) and ENGINEER(s) from Claims arising out of the Work described in this Contract and performed by CONTRACTOR, Subcontractor(s) or Sub subcontractor(s) consisting of:

1. Workers' Compensation Insurance including Employer's Liability to cover employee injuries or disease compensable under the Workers' Compensation Statutes of the states in which Work is conducted under this Contract; disability benefit laws, if any; or Federal compensation acts such as U.S. Longshoremen or Harbor Workers', Maritime Employment, or Railroad Compensation Act(s), if applicable. Self-insurance plans approved by the regulatory authorities in the state in which Work on this Project is performed are acceptable.

2. An occurrence form Commercial General Liability policy to cover bodily injury to persons other than employees and for damage to tangible property, including loss of use thereof, plus appropriate endorsements to protect OWNER and ENGINEER against Claims, demands, and lawsuits from employees of CONTRACTOR and Subcontractors, including the following exposures:

a. All premises and operations.

b. Explosion, collapse and underground damage.

c. CONTRACTOR's Protective coverage for independent contractors or Subcontractors employed by him.

d. Broad form blanket, contractual liability for the obligation assumed in the Indemnification or Hold Harmless agreement found in the General Conditions or Supplementary Conditions of this Contract.

e. Personal Injury Liability endorsement with no exclusions pertaining to employment.

f. Products and Completed Operations coverage. Coverage shall extend through the Contract guarantee period.

g. Broad form property damage.

h. Cross liability endorsement.

i. For design professional additional insureds, ISO Endorsement CG 20 32 04 13, "Additional Insured-Engineers, Architects or Surveyors Not Engaged by the Named Insured" or its equivalent.

3. Comprehensive Automobile Liability policy to cover bodily injury and property damage arising out of the ownership, maintenance or use of any motor vehicle, including owned, non-owned and hired vehicles. Comprehensive General Liability and the Comprehensive Auto Liability shall be written by the same insurance carrier, though not necessarily in one policy.

4. CONTRACTOR shall purchase for OWNER an Owner's Protective Liability policy to protect OWNER, ENGINEER, their consultants, agents, employees and such public corporations in whose jurisdiction the Work is located for their liability for Work performed by the CONTRACTOR, the Subcontractor(s) or the Sub subcontractor(s) under this Contract.

5. When a limit of liability is identified in the Supplementary Conditions, CONTRACTOR shall purchase a Builder's Risk Installation Floater in a form acceptable to OWNER covering property of the Project for the full cost of replacement as of the time of any loss which shall include, as named insureds,

   a. CONTRACTOR,

   b. all Subcontractors,

   c. all Sub subcontractors,

   d. OWNER, and ENGINEER(s) or Architect(s), as their respective interests may prove to be at the time of loss, covering insurable property which is the subject of this Contract, whether in place, stored at the Site, stored elsewhere, or in transit at the risk of the insured(s).

   Coverage shall be effected on an "All Risk" form including, but not limited to, the perils of fire, wind, vandalism, collapse, theft, flood and earthquake, with removal of passive design error exclusion. Except as may otherwise be required by OWNER, CONTRACTOR may arrange for such deductibles as CONTRACTOR deems to be within CONTRACTOR's ability to self-assume, but CONTRACTOR will be held solely responsible for the amount of such deductible and for any co-insurance penalties. Any insured loss shall be adjusted with OWNER and CONTRACTOR and paid to OWNER and CONTRACTOR as Trustee for the other insureds.

6. Umbrella or Excess Liability

a. The CONTRACTOR is granted the option of arranging coverage under a single policy for the full limit required or by a combination of underlying policies with the balance provided by an Excess or Umbrella Liability policy equal to the total limit(s) requested. Umbrella or Excess policy wording shall be at least as broad as the primary or underlying policy(ies) and shall apply both to CONTRACTOR's General Liability and Automobile Liability Insurance and shall be written on an occurrence basis.

7. Railroad Protective Liability

a. Where any of the Work is within a railroad right-of-way or where a limit of liability is identified in the Supplementary Conditions, CONTRACTOR will provide coverage in the name of each railroad company having jurisdiction over rights of way across which Work under the Contract is to be performed. The form of policy and the limits of liability shall be determined by the railroad company(ies) involved. See the Supplementary Conditions for limits and coverage requested.

8. CONTRACTOR's Professional Liability Insurance

a. If CONTRACTOR will provide or furnish professional services under this Contract through a delegation of professional design services or otherwise, then CONTRACTOR shall be responsible for purchasing and maintaining applicable professional liability insurance. This insurance shall provide protection against Claims arising out of performance of professional design or related services caused by a negligent error, omission, or act for which the insured party is legally liable. It shall be maintained throughout the duration of the Contract and for a minimum of two years after Substantial Completion. If such professional design services are performed by a Subcontractor, and not by CONTRACTOR itself, then the requirements of this paragraph may be satisfied through the purchasing and maintenance of such insurance by such Subcontractor.

B. OWNER's responsibilities in respect of purchasing and maintaining insurance are set forth below:

1. OWNER shall assume responsibility for such boiler and machinery insurance as may be required or considered to be necessary by OWNER in the course of construction, testing or after completion.

a. OWNER shall assume responsibility for such insurance as will protect the OWNER against any loss of use of OWNER's property due to those perils insured pursuant to paragraph 1 above.

5.04 Limits of Liability

A. The required limits of liability for insurance coverages required in paragraphs 5.03 shall be not less than those specified in the Supplementary Conditions.

5.05 Notice of Cancellation or Intent Not to Renew

A. Policies will be endorsed to provide that at least 30 days written notice shall be given to OWNER and to ENGINEER of cancellation, intent not to renew, or material modification of the coverage.

5.06 Evidence of Coverage

A. Prior to commencement of the Work, CONTRACTOR shall furnish to OWNER and ENGINEER, Certificates of Insurance in force on current Accord® Certificate of Insurance form. Other forms of Certificate are acceptable only if;

1. they include all of the items prescribed in the current Accord® Certificate of Insurance form, including agreement to cancellation provisions outlined in paragraph 5.05 above; and

2. they have approval of OWNER and ENGINEER.

B. Prior to the commencement of the Work, CONTRACTOR shall furnish to OWNER complete "originally signed" copies of the Owner's Protective Liability Policy. The number of copies shall be the same as the number of counterparts of the Agreement. OWNER reserves the right to request complete copies of other policies if deemed necessary to ascertain details of coverage not provided by the certificates. Such policy copies shall be "Originally Signed Copies," and so designated.

5.07 Qualification of Insurers

A. In order to determine financial strength and reputation of insurance carriers, all companies providing the coverages required shall be licensed or approved by the Insurance Bureau of the state in which the Project is located and shall have a financial rating not lower than XI and a policyholder's service rating no lower than B+ as listed in A.M. Best's Key Rating Guide, current edition. Companies with ratings lower than B+:XI will be acceptable only upon written consent of OWNER.

5.08 Damage Claims - Acknowledgment and Reports

A. CONTRACTOR shall furnish to OWNER an acknowledgment receipt from the insurance carrier for each damage claim against the Project. The receipt shall include the insurance carrier’s assigned claim number.

B. Upon request, CONTRACTOR or his insurance carrier shall also furnish to OWNER a status report on all damage claims. This report shall include inspections made, the disposition of claims, and what action has been taken towards settlement of each claim.

C. Failure of CONTRACTOR to comply with this paragraph 5.08 may result in the amount of such damage claims being withheld from CONTRACTOR’s monthly pay estimate. Such withholding shall be reimbursed in the monthly pay estimate following compliance with this paragraph.

5.09 Cost of Insurance

A. The unit cost of the insurance herein specified will not be a specific bid item, but the cost of such insurance will be included by the CONTRACTOR in the various prices bid.

5.10 Waiver of Rights

A. OWNER and CONTRACTOR intend that all policies purchased in accordance with paragraph 5.03 will protect OWNER, CONTRACTOR, Subcontractors, ENGINEER, ENGINEER’s Consultants (and all other persons or entities identified in the Supplementary General Conditions to be listed as insureds or additional insureds in such policies) and will provide primary coverage for all losses and damages caused by the perils covered thereby. Such policies shall contain provisions to

the effect that in the event of payment of any loss or damage the insurers will have no rights of recovery against any of the insureds or additional insureds thereunder.

B. OWNER and CONTRACTOR waive all rights against each other and their respective officers, directors, employees and agents for all losses and damages caused by, arising out of or resulting from any of the perils covered by such policies and any other property insurance applicable to the Work; and in addition, waive all such rights against Subcontractors, ENGINEER, ENGINEER's Consultants and any other persons or entities identified in the Supplementary General Conditions to be listed as insureds or additional insureds under such policies for loss and damages so caused. None of the above waivers shall extend to the rights that any party making such waiver may have to the proceeds of insurance held by OWNER as trustee or otherwise payable under any policy so issued.

5.11 Receipt and Application of Insurance Proceeds

A. Any insured loss under the policies of insurance required by paragraph 5.03.A.5 will be adjusted with OWNER and made payable to OWNER as fiduciary for the insureds, as their interests may appear, subject to the requirements of any applicable mortgage clause. If no other special agreement is reached the damaged Work shall be repaired or replaced, the monies so received applied on account thereof, and the Work and the cost thereof covered by an appropriate Change Order, Field Oder or Work Change Directive.

B. OWNER as fiduciary shall have power to adjust and settle any loss under the policies required by paragraph 5.03.A.5 with the insurers unless one of the parties in interest shall object in writing within fifteen days after the occurrence of loss to OWNER's exercise of this power. If such objection be made, OWNER as fiduciary shall make settlement with the insurers in accordance with such agreement as the parties in interest may reach. If no such agreement among the parties in interest is reached, OWNER as fiduciary shall adjust and settle the loss with the insurers.

Article 6 Contractor's Responsibilities

6.01 Supervision and Superintendence

A. CONTRACTOR shall supervise and direct the Work competently and efficiently, devoting such attention thereto and applying such skills and expertise as may be necessary to perform the Work in accordance with the Contract Documents. CONTRACTOR shall be solely responsible for the means, methods, techniques, sequences and procedures of construction. CONTRACTOR shall be responsible to see that the finished Work complies with the Contract Documents. However, if specific means, methods, techniques, sequences and procedures of construction are prescribed in the Plans or Specifications, CONTRACTOR shall be responsible to comply therewith, but may implement such prescribed Work in a manner of CONTRACTOR's choosing so long as the Work complies with the requirements of the Plans and Specifications.

B. At all times during the progress of the Work, CONTRACTOR shall assign and maintain a competent superintendent who shall not be replaced without written notice to OWNER and ENGINEER except under extraordinary circumstances. Any superintendent or foreman who neglects to have Work done in accordance with the Plans and Specifications shall be removed from the Project. The superintendent will be CONTRACTOR's representative at the Site and shall have authority to act on behalf of CONTRACTOR. All communications given to the superintendent shall be as binding as if given to CONTRACTOR.

6.02 Labor and Working Hours

A. CONTRACTOR shall provide competent, suitably qualified personnel in their various duties. CONTRACTOR shall at all times maintain good discipline and order at the Site. Except as otherwise required for the safety or protection of persons, the Work, property at the Site or adjacent thereto, and except as otherwise indicated in the Contract Documents, all Work at the Site shall be performed during regular working hours (7:00 a.m. to 7:00 p.m.), and CONTRACTOR will not permit the performance of Work on Sunday or any legal holiday without OWNER's written consent given after prior written notice to ENGINEER.

6.03 Services, Materials and Equipment

A. Unless otherwise specified in the Contract Documents, CONTRACTOR shall furnish and assume full responsibility for all services, materials, equipment, labor, transportation, construction equipment and machinery, tools, appliances, fuel, power, light, heat, telephone, water, sanitary facilities, temporary facilities and all other facilities and incidentals necessary for the furnishing, performance, testing, start up and completion of the Work.

B. All materials and equipment shall be of good quality and new, except as otherwise provided in the Contract Documents. All warranties and guarantees specifically called for by the Contract Documents shall expressly run to the benefit of OWNER. If required by ENGINEER, CONTRACTOR shall furnish satisfactory evidence, (including reports of required tests) as to the kind and quality of materials and equipment to be incorporated in the Work. The CONTRACTOR shall not use material in the Work until Shop Drawing or Submittals have been reviewed by the ENGINEER. All materials which do not meet the requirements of the Specifications at the time they are to be used will be rejected, and unless otherwise permitted by ENGINEER, shall be plainly marked and removed immediately from the Work.

C. All materials and equipment shall be applied, installed, connected, erected, used, cleaned and conditioned in accordance with the instructions of the applicable manufacturer, fabricator, Supplier or distributor, except as otherwise provided in the Contract Documents.

6.04 Substitutes and “Or-Equals”

Whenever an item of materials or equipment is specified or described in the Contract Documents for installation in the Work by using the name of a proprietary item or the name of a particular manufacturer, fabricator, supplier or distributor; or means, methods, techniques, sequences and procedures of construction are prescribed in the Plans or Specifications; the specification or description is intended to establish the type, function and quality required or the means, methods, techniques, sequences and procedures of construction required. Unless the specification or description contains or is followed by words indicating that no like, equivalent or “or-equal” item or no substitution is permitted, other items of material or equipment or materials or equipment of other manufacturers, fabricators, suppliers or distributors; or other means, methods, techniques, sequences and procedures of construction may be accepted by ENGINEER under the following circumstances:

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

2. Substitute Items: If in ENGINEER's sole discretion an item of material or equipment proposed by CONTRACTOR does not qualify as an "or-equal" item under paragraph 6.04.A; or a proposed means, methods, techniques, sequences and procedures of construction are different from what is prescribed in the Plans or Specifications, it will be considered a proposed substitute item.

B. CONTRACTOR shall submit sufficient information as provided below to allow ENGINEER to determine that the item of material or equipment or means, methods, techniques, sequences and/or procedures proposed is essentially equivalent to that named and an acceptable substitute therefor. The procedure for review by the ENGINEER will include the following, as supplemented in the Specifications, and as ENGINEER may decide is appropriate under the circumstances. Requests for review of substitute items of material and equipment will not be accepted by ENGINEER from anyone other than CONTRACTOR.

C. If CONTRACTOR wishes to furnish or use a substitute, CONTRACTOR shall make written application to ENGINEER on the Substitution Request Form provided for acceptance thereof, certifying that the proposed substitute will:

1. perform adequately the functions and achieve the results called for by the general design,

2. be similar in substance to that specified,

3. and be suited to the same use and capable of performing the same function as that specified.

The application will state the extent, if any, to which the evaluation and acceptance of the proposed substitute will prejudice CONTRACTOR's achievement of Substantial Completion on time, whether or not acceptance of the proposed substitute for use in the Work will require a change in the Contract Documents (or in the provisions of any other direct contract with OWNER for work on the Project) to adapt the design to the proposed substitute, and whether or not incorporation or use of the substitute in connection with the Work is subject to payment of any license fee or royalty.

D. All variations of the proposed substitute from that specified shall be identified in the application and available maintenance, repair and replacement service shall be indicated. The application shall also contain an itemized estimate of all costs or credits that will result directly or indirectly from acceptance of such substitute, including costs of redesign and claims of other contractors affected by the resulting change, all of which shall be considered by ENGINEER in evaluating the proposed substitute. ENGINEER may require CONTRACTOR to furnish additional data about the proposed substitute.

E. All data to be provided by CONTRACTOR in support of any proposed "or-equal" or substitute item will be at CONTRACTOR's expense. ENGINEER will be the sole judge of acceptability, and ENGINEER's determination shall be final and binding, may not be reversed through an appeal under any provisions of the Contract Documents, and no "or-equal" or substitute shall be ordered, installed or utilized without ENGINEER's prior written acceptance. OWNER may require CONTRACTOR to furnish at CONTRACTOR's expense a special performance guarantee or other surety with respect to any "or-equal" or substitute which has been approved by ENGINEER.

F. ENGINEER will record time required by ENGINEER and ENGINEER's consultants in evaluating substitutions proposed by CONTRACTOR and in making changes in the Contract Documents occasioned thereby. Whether or not ENGINEER accepts a proposed substitute, CONTRACTOR shall reimburse OWNER for the charges of ENGINEER and ENGINEER's consultants for evaluating any proposed substitute and in making any changes in the Contract Documents resulting therefrom.

6.05 Concerning Subcontractors

A. CONTRACTOR shall not employ any Subcontractor, Supplier or other person or organizations, including those who are to furnish the principal items of materials or equipment, whether initially or as a substitute, against whom OWNER or ENGINEER may have reasonable objection. CONTRACTOR shall furnish ENGINEER a complete list of any Subcontractor, Supplier or other person or organization furnishing principal items of material or equipment within 4 days of request. Failure to object to any Subcontractor, Supplier, other person or organization by OWNER or ENGINEER shall not constitute a waiver of any right of OWNER or ENGINEER to reject defective Work.

B. If OWNER or ENGINEER, after due investigation, has reasonable objection to any Subcontractor, Supplier, other person or organization proposed by CONTRACTOR after the Notice of Award, CONTRACTOR shall submit an acceptable substitute and the Contract Price shall be increased or decreased by the difference in cost occasioned by such substitution, and an appropriate Change Order shall be issued. CONTRACTOR shall not be required to employ any Subcontractor, Supplier, other person or organization against whom CONTRACTOR has reasonable objection.

C. The CONTRACTOR shall not award Work to Subcontractor(s), in excess of 50% of the Contract Price, without prior written approval of the OWNER.

CONTRACTOR shall be fully responsible for all acts and omissions of his Subcontractors, Suppliers and of persons and organizations performing or furnishing any of the Work under a direct or indirect contract with CONTRACTOR just as CONTRACTOR is responsible for CONTRACTOR's own acts and omissions. Nothing in the Contract Documents shall create for the benefit of any such Subcontractor, Supplier of other person or organization any contractual relationship between OWNER or ENGINEER and any such Subcontractor, Supplier or other person or organization, nor shall it create any obligation on the part of OWNER or ENGINEER to pay or to see to the payment of any moneys due any Subcontractor, Supplier or other person or organization. OWNER or ENGINEER may furnish to any Subcontractor, Supplier or other person or organization, to the extent practicable, evidence of amounts paid to CONTRACTOR on account of specific Work done.

D. CONTRACTOR shall be solely responsible for scheduling and coordinating the Work of Subcontractors, Suppliers and other persons and organizations performing or furnishing any of the Work under a direct or indirect contract with CONTRACTOR. CONTRACTOR shall require all Subcontractors, Suppliers and such other persons and organizations performing or furnishing any of the Work to communicate with ENGINEER through CONTRACTOR.

E. If the amount of the subcontract or the nature of the Work to be performed thereunder warrants, OWNER may require Subcontractor to furnish, for the benefit of OWNER and CONTRACTOR jointly, Bonds in an amount proportioned to the amount of his subcontract, and for the same purpose and under the same specifications as those of the general Contract. The Surety on the general Contract shall not be eligible to furnish such Subcontract Bonds.

F. All Work performed for CONTRACTOR by a Subcontractor or Supplier will be pursuant to an appropriate agreement between CONTRACTOR and the Subcontractor or Supplier which specifically binds the Subcontractor or Supplier to the applicable terms and conditions of the Contract Documents for the benefit of OWNER and ENGINEER. Whenever any such agreement is with a Subcontractor or Supplier who is listed as and additional insured on the property insurance provided in paragraph 5.03.A.5, the agreement between the CONTRACTOR and the Subcontractor or Supplier will contain provisions whereby the Subcontractor or Supplier waives all rights against OWNER, CONTRACTOR, ENGINEER, ENGINEER's Consultants and all other additional insureds for all losses and damages caused by, arising out of or resulting from any of the perils covered by such policies and any other property insurance applicable to the Work. If the insurers on any such policies require separate waiver forms to be signed by any Subcontractor or Supplier, CONTRACTOR will obtain the same. CONTRACTOR shall file a true copy of such agreement with OWNER.

6.06 Patent Fees and Royalties

A. CONTRACTOR shall pay all license fees and royalties and assume all costs incident to the use in the performance of the Work or the incorporation in the Work of any invention, design, process, product or device which is the subject of patent rights or copyrights held by others. If a particular invention, design, process, product or device is specified in the Contract Documents for use in the performance of the Work and if to the actual knowledge of OWNER or ENGINEER its use is subject to patent rights or copyrights calling for the payment of any license fee or royalty to others, the existence of such rights shall be disclosed by OWNER in Contract Documents.

B. To the fullest extent permitted by Laws and Regulations, CONTRACTOR shall defend, indemnify and hold harmless OWNER and ENGINEER and anyone directly or indirectly employed by either of them from and against all claims, costs, losses, damages and expenses arising out of or resulting from any infringement of patent rights or copyrights incident to the use in the performance of the Work or resulting from the incorporation in the Work of any invention, design, process, product or device not specified in the Contract Documents, and shall defend all such claims in connection with any alleged infringement of such rights.

6.07 Permits and Licenses

A. CONTRACTOR shall obtain and pay for all construction permits and licenses. OWNER shall assist CONTRACTOR, when necessary, in obtaining such permits and licenses. CONTRACTOR shall pay all governmental charges, permit, review, and inspection fees necessary for the prosecution of the Work, which are applicable at the time of opening of Bids, or, if there are no Bids, on the Effective Date of the Agreement. CONTRACTOR shall pay all charges of utility owners for connections to the Work.

6.08 Laws and Regulations

A. CONTRACTOR shall give all notices and comply with all laws, ordinances, rules, and regulations applicable to furnishing and performance of the Work. Neither OWNER nor ENGINEER shall be responsible for monitoring CONTRACTOR's compliance with any Laws, ordinances, rules, and Regulations.

B. If CONTRACTOR performs any Work that is contrary to such laws, ordinances, rules and regulations, CONTRACTOR shall bear all claims, costs, losses, damages and expenses caused by, arising out of, or resulting therefrom. However, it shall not be CONTRACTOR's primary responsibility to make certain that the Specifications and Plans are in accordance with such laws, ordinances, rules, and regulations, but this shall not relieve CONTRACTOR of CONTRACTOR's obligations under paragraph 3.03.

C. OWNER or CONTRACTOR may give notice to the other party of any changes after the submission of CONTRACTOR's Bid (or after the date when CONTRACTOR became bound under a negotiated Contract) in Laws or Regulations having an effect on the cost or time of performance of the Work, including but not limited to changes in Laws or Regulations having an effect on procuring permits and on sales, use, value-added, consumption, and other similar taxes. If OWNER and CONTRACTOR are unable to agree on entitlement to, or on the amount, or extent, if any, of any adjustment in Contract Price or Contract Times resulting from such changes, then within 30 days of such notice CONTRACTOR may submit a Change Proposal, or OWNER may initiate a Claim.

6.09 Taxes

A. CONTRACTOR shall pay all sales, consumer, use and other similar taxes required to be paid by CONTRACTOR in accordance with Laws and Regulations of the place of the Project which are applicable during the performance of the Work.

6.10 Use of Premises

A. CONTRACTOR shall confine construction equipment, the storage of materials and equipment and the operations of workers to the Project Site and land and areas identified in and permitted by the Contract Documents and other land and areas permitted by Laws and Regulations, rights of way, permits and easements, and shall not unreasonably encumber the premises with construction equipment or other materials or equipment. CONTRACTOR shall assume full responsibility for any damage to any such land or area or to the owner or occupant thereof or of any adjacent land or areas resulting from the performance of the Work. Should any claim be made by any such owner or occupant because of the performance of the Work, CONTRACTOR shall promptly settle with any such other party by negotiation or otherwise resolve the claim by arbitration or other dispute resolution proceeding or at law. CONTRACTOR's continuing obligations under paragraph 6.24 shall be applicable to any claim hereunder.

6.11 Removal of Debris and Cleaning

A. During the progress of the Work, CONTRACTOR shall keep the premises free from accumulations of waste materials, rubbish and other debris resulting from the Work. At the completion of the Work CONTRACTOR shall remove all waste materials, rubbish and debris from and about the premises as well as all tools, appliances, construction equipment and machinery, and surplus materials, and shall leave the Site clean and ready for occupancy by OWNER at Substantial Completion of the Work. CONTRACTOR shall restore to their original condition all property not designated for alteration by the Contract Documents. If CONTRACTOR shall fail to keep the above noted areas cleaned of dust or debris resulting from CONTRACTOR's operations, CONTRACTOR shall be so notified in writing by ENGINEER. If within 24 hours after receipt of such notice CONTRACTOR shall fail to clean such areas satisfactorily, OWNER may have such other agency as he shall designate, perform the work and all costs of such cleaning shall be paid for by CONTRACTOR.

6.12 Loading Structures

A. CONTRACTOR shall not load nor permit any part of any structure to be loaded in any manner that will endanger the structure, nor shall CONTRACTOR subject any part of the Work or adjacent property to stresses or pressures that will endanger it.

6.13 Protection of Utilities

A. When it is possible for construction operations to endanger any public or private utility, conduit, or structure, CONTRACTOR shall notify the utility owner of this possibility, and safeguard and support such utilities, conduits, or structures. Where it is the policy of any utility owner to make its own repairs to damaged conduit or other structures, CONTRACTOR shall cooperate to the fullest extent with the utility, and he shall see that his operations interfere as little as possible with these operations, and CONTRACTOR shall assume the cost of any charge against OWNER therefor. In cases where existing Utilities or Utility service connections are encountered, CONTRACTOR shall perform his operations in such a manner that service will be uninterrupted, and the cost thereof shall be at CONTRACTOR's expense, unless otherwise provided.

6.14 Record Documents

A. CONTRACTOR shall maintain in a safe place at the Site 1 record copy of all Specifications, Plans, Addenda, Change Orders, Work Change Directives, and Field Orders, in good order and annotated to show all changes made during construction. These record documents together with all Samples and all Shop Drawings shall be available to ENGINEER for examination and shall be delivered to ENGINEER for OWNER upon completion of the Work.

6.15 Safety and Protection

A. CONTRACTOR shall be solely responsible for initiating, maintaining and supervising all safety precautions and programs in connection with the Work. CONTRACTOR shall take all necessary precautions for the safety of, and shall provide the necessary protection to prevent damage, injury or loss to:

1. all persons on the Work Site or who may be affected by the Work,

2. all the Work and materials or equipment to be incorporated therein, whether in storage on or off the Site, and

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

B. CONTRACTOR shall comply with all applicable Laws and Regulations and orders of any public body having jurisdiction for the safety of persons or property or to protect them from damage, injury or loss; and shall erect and maintain all necessary safeguards for such safety and protection. CONTRACTOR shall notify owners of adjacent property, Utilities, and utility owners when prosecution of the Work may affect them.

C. CONTRACTOR shall restore, at his own expense, any public or private property damaged or injured in consequence of any act or omission on his part, or on the part of his employees or agents, to a condition equal or better than that existing before such injury or damage was done. If CONTRACTOR neglects to restore or make good such damages or injury, OWNER may, upon 48 hours' notice, proceed to restore or make good such damage or injury and to order the cost thereof deducted from any monies that are due, or may become due, to CONTRACTOR for this Work.

D. CONTRACTOR's duties and responsibilities for the safety and protection of the Work shall continue until such time as all the Work is completed and ENGINEER has issued a notice to OWNER and CONTRACTOR in accordance with paragraph 14.11 that the Work is Acceptable.

E. CONTRACTOR shall comply with the applicable requirements of OWNER's safety programs, if any. Any OWNER's safety programs that are applicable to the Work are identified or included in the Supplementary Conditions or Specifications.

F. CONTRACTOR shall inform OWNER and ENGINEER of the specific requirements of CONTRACTOR's safety program with which OWNER's and ENGINEER's employees and representatives must comply while at the Site.

G. CONTRACTOR's duties and responsibilities for safety and protection will continue until all the Work is completed, ENGINEER has issued a written notice to OWNER and CONTRACTOR in accordance with paragraph 14.11 that the Work is acceptable, and CONTRACTOR has left the Site (except as otherwise expressly provided in connection with Substantial Completion).

H. CONTRACTOR's duties and responsibilities for safety and protection will resume whenever CONTRACTOR or any Subcontractor or Supplier returns to the Site to fulfill warranty or correction obligations, or to conduct other tasks arising from the Contract Documents.

6.16 Safety Representative

A. CONTRACTOR shall be responsible to designate for itself and its employees, and its Subcontractors a qualified and experienced safety representative at the Site whose duties and responsibilities shall be the prevention of accidents and the maintaining and supervising of safety precautions and programs.

6.17 Hazard Communication Program

A. CONTRACTOR shall be responsible for coordinating any exchange of safety data sheets or other hazard communication information required to be made available to or exchanged between or among employers at the Site in accordance with applicable Laws or Regulations.

6.18 Emergencies

A. In emergencies affecting the safety or protection of persons or the Work or property at the Site or adjacent thereto, CONTRACTOR, without special instruction or authorization from OWNER or ENGINEER, is obligated to act to prevent threatened damage, injury or loss. CONTRACTOR shall give ENGINEER prompt written notice if CONTRACTOR believes that any significant changes in the Work or variations from the Contract Documents have been caused thereby. If ENGINEER determines that a change in the Contract Documents is required because of the action taken by CONTRACTOR in response to such an emergency, a Work Change Directive or Change Order will be issued to document the consequences of such action.

6.19 Shop Drawings and Samples

A. CONTRACTOR shall submit Shop Drawings required by the Contract Documents to ENGINEER for review, in accordance with an accepted schedule. All Submittals will be identified as ENGINEER may require and in the number of copies specified in the Specifications. The data shown on the Shop Drawings will be complete with respect to quantities, dimensions, specified performance and design criteria, materials and similar data to show ENGINEER the materials and equipment CONTRACTOR proposes to provide and to enable ENGINEER to review the information for the limited purposes required by paragraph 6.21.

B. CONTRACTOR shall also submit all samples required by the Contract Documents to ENGINEER for review in accordance with an accepted schedule. Each Sample will be identified clearly as to material, Supplier, pertinent data such as catalog numbers, the use for which intended, and other data as ENGINEER may require to enable ENGINEER to review the Submittal for the limited purposes required by paragraph 6.21. The number of each sample to be submitted will be as specified in the Specifications.

6.20 Submittal Procedures

A. Before submitting each Shop Drawing or Sample, CONTRACTOR shall have determined and verified:

1. all field measurements, quantities, dimension, specified performance criteria, installation requirements, manufacturer's recommendations, material, catalog numbers and similar information with respect thereto,

2. all materials with respect to intended use, fabrication, shipping, handling, storage, assembly and installation pertaining to the performance of the Work, and

3. all information relative to CONTRACTOR's responsibilities in respect of means, methods, techniques, sequences and procedures of construction and safety precautions and programs incident thereto.

B. CONTRACTOR shall have reviewed and coordinated each Shop Drawing or Sample with other Shop Drawings and Samples and with the requirements of the Work and the Contract Documents.

C. Each Submittal will bear a stamp or specific written indication that CONTRACTOR has satisfied CONTRACTOR's obligations under the Contract Documents with respect to review and approval of that Submittal.

D. At the time of each submission, CONTRACTOR shall in writing call ENGINEER's attention to any deviations that the Shop Drawings or Samples may have from the requirements of the Contract Documents. This notice shall be both a written communication separate from the Shop Drawing's or Sample submittal; and, in addition, by a specific notation made on each Shop Drawing or Sample submitted to ENGINEER for review of each such variation.

E. CONTRACTOR shall make corrections required by ENGINEER and shall return the required number of corrected copies of Shop Drawings and submit, as required, new Samples for review. CONTRACTOR shall direct specific attention in writing to revisions other than the corrections called for by ENGINEER on previous Submittals.

F. CONTRACTOR shall furnish required Submittals with sufficient information and accuracy to obtain required approval of an item with no more than three submittals. ENGINEER will record ENGINEER's time for reviewing a fourth or subsequent submittal of Shop Drawings, sample, or other item requiring approval, and CONTRACTOR shall be responsible for ENGINEER's charges to OWNER for such time. OWNER may impose a set-off against payments due to CONTRACTOR to secure reimbursement for such charges.

G. If CONTRACTOR requests a change of a previously approved Submittal item, CONTRACTOR shall be responsible for ENGINEER's charges to OWNER for its review time, and OWNER may impose a set-off against payments due to CONTRACTOR to secure reimbursement for such charges, unless the need for such change is beyond the control of CONTRACTOR.

6.21 Engineer's Review

A. ENGINEER will review Shop Drawings and Samples in accordance with the Schedule of Submittals accepted by ENGINEER as required by paragraph 2.05. ENGINEER's review shall be only for conformance with the design concept of the Project and for compliance with the information given in the Contract Documents and shall not extend to means, methods, sequences, techniques or procedures of construction or to safety precautions or programs incident thereto. The review of a separate item as such will not indicate review of the assembly in which the item functions.

B. ENGINEER's review of Shop Drawings or samples shall not relieve CONTRACTOR from responsibility for any variations from the Contract Documents unless CONTRACTOR has in writing called ENGINEER's attention to such variation at the time of submission and ENGINEER has given written concurrence to the specific variation, nor shall any concurrence by ENGINEER relieve CONTRACTOR from responsibility for errors or omissions in the Shop Drawings. ENGINEER's review shall not relieve CONTRACTOR from responsibility for complying with the requirements of paragraph 6.20.

C. Where a Shop Drawing or sample is required by the Contract Documents or the Schedule of Submittals accepted by ENGINEER per paragraph 2.05, no related Work shall be commenced until the Submittal has been reviewed by the ENGINEER.

6.22 Continuing the Work

A. CONTRACTOR shall carry on the Work and adhere to the Progress Schedule during all disputes or disagreements with OWNER. No Work shall be delayed or postponed pending resolution of any disputes or disagreements, except as CONTRACTOR and OWNER may otherwise agree in writing.

6.23 Contractor's General Warranty and Guarantee

A. CONTRACTOR warrants and guarantees to OWNER, ENGINEER, and ENGINEER's Consultants that all work will be in accordance with the Contract Documents and will not be defective. CONTRACTOR's warranty and guarantee excludes defects or damage caused by:

1. abuse, modification, or improper maintenance or operation by persons other than CONTRACTOR, Subcontractors, Suppliers, or their employees, agents, or representatives, or any person or entity for whom CONTRACTOR is responsible; or

2. normal wear and tear under normal usage.

B. CONTRACTOR's obligation to perform and complete the Work in accordance with the Contract Documents shall be absolute. None of the following will constitute an acceptance of Work that is not in accordance with the Contract Documents or a release of CONTRACTOR's obligation to perform the Work in accordance with the Contract Documents:

1. observations by ENGINEER;

2. recommendation of any progress or final payment by ENGINEER;

3. the issuance of a certificate of Substantial Completion or any payment by OWNER to CONTRACTOR under the Contract Documents;

4. use or occupancy of any part of the Work by OWNER;

5. any acceptance by OWNER or failure to do so;

6. any review or approval of a Shop Drawing or Sample Submittal or the issuance of a notice of acceptability by ENGINEER per paragraph 14.11;

7. any inspection, test or approval by others; or

8. any correction of defective Work by OWNER.

C. If Contract requires the CONTRACTOR to accept the assignment of a contract entered into by OWNER, then the specific warranties, guarantees, and correction obligations contained in the assigned contract shall govern with respect to CONTRACTOR's performance obligations to OWNER for the Work described in the assigned Contract.

D. CONTRACTOR shall assign to OWNER all warranties extended to CONTRACTOR by material Suppliers and Subcontractors. If an assignment of warranty requires the material Supplier or Subcontractor to consent to same, then CONTRACTOR shall secure the material Supplier's or Subcontractor's consent to assign said warranties to OWNER.

E. The warranties provided in this section shall be in addition to, and not in limitation of, any other warranty or remedy required by law.

6.24 Indemnification

A. To the fullest extent permitted by law, CONTRACTOR shall indemnify, defend (with counsel acceptable to OWNER) and hold harmless OWNER, ENGINEER and any additional indemnitees identified in the Supplementary Conditions and their respective directors, officers, members, partners, affiliates, employees, agents and successors, from and against any and all liabilities, claims, causes of action, lawsuits, liens, injuries, damages, losses and expenses (collectively "Demands") to the extent caused by, arising out of, resulting from or occurring in connection with:

1. CONTRACTOR's breach of, or failure to comply with, the Agreement, the Contract Documents, or any other contract that it enters into regarding the Work, including any default in performance; or

2. Personal injury or death to any person (including, but not limited to, CONTRACTOR, CONTRACTOR's employees, Subcontractors, Subcontractors' employees, and material Suppliers) or injury to or destruction of property (including claims for loss of use) caused by, arising out of, resulting from, or in any way connected with

   a. the Work,

   b. any activity associated with the Work, or

   c. the operations or acts of commission or omission of CONTRACTOR, CONTRACTOR's employees, Subcontractors, Subcontractors' employees, material suppliers, or anyone for whom CONTRACTOR is legally liable in the performance of Work, whether arising before or after completion of the Work.

B. To the extent caused by, arising out of, resulting from, or occurring in connection with the provisions of the above paragraph 6.24.A, CONTRACTOR's indemnity obligations under this Agreement shall include, but are not limited to:

1. Indemnity for all damages and judgment interest, all costs and fees, including, but not limited to, all defense costs, expenses and actual attorneys' fees, and all settlement payments relating to, arising out of, resulting from or in any way connected with any demand requiring indemnity by this Agreement;

2. All expenses, including but not limited to, costs, expenses and actual attorneys' fees, incurred in securing and enforcing indemnity from CONTRACTOR if CONTRACTOR fails or refuses promptly to fulfill any of the indemnity obligations under this Agreement;

3. All indemnification obligations imposed upon OWNER or ENGINEER, or both, arising out of or in connection with the Work; and

4. Indemnification for any penalties and/or fines arising or resulting from CONTRACTOR's or any SUBCONTRACTOR's failure to comply with laws and/or regulations applicable to its/their Work.

C. Contractor's duty to indemnify under Subpart A.2. of Article 6.24 is limited to the negligence of Contractor, Contractor's employees, Subcontractors, Subcontractor's employees, material Suppliers, or anyone for whom Contractor is legally liable in the performance of the Work, whether arising before or after the completion of the Work.

D. The indemnification rights under this Agreement shall not be construed to negate, abridge, or otherwise reduce any other right or obligations of indemnity which would otherwise exist.

E. OWNER, at its option, may select counsel to defend any demand brought against it without impairing any obligation of the CONTRACTOR to provide indemnification.

F. The indemnification provisions under this Agreement shall survive the completion or termination of this Agreement.

G. In the case of claims by any employee of CONTRACTOR, anyone directly or indirectly employed by CONTRACTOR, or anyone for whose acts CONTRACTOR may be liable, the indemnification obligations under this Agreement shall not be limited in any way by any limitation on the amount or type of damages, compensation or benefits payable by or for CONTRACTOR under workers' compensation acts. Such obligations shall not be construed to negate, abridge or reduce other rights or obligations of indemnity that would otherwise exist as to a party or person described in this Agreement.

H. Indemnification, additional insured and hold harmless obligations of CONTRACTOR and Subcontractor under the Contract Documents shall survive the termination of this Agreement.

I. CONTRACTOR and Subcontractors will compel their insurance company to waive subrogation against OWNER, all ENGINEERS and all CONTRACTORS and Subcontractors identified as additional insureds in the Contract Documents, including any municipal entity now existing or newly created during the term of the Contract Documents.

6.25 Delegation of Professional Design Services

A. CONTRACTOR will not be required to provide professional design services unless such services are specifically required by the Contract Documents for a portion of the Work or unless such services are required to carry out CONTRACTOR's responsibilities for construction means, methods, techniques, sequences or procedures. CONTRACTOR shall not be required to provide professional services in violation of applicable Laws and Regulations.

B. If professional design services or certifications by a design professional related to systems, materials, equipment, structures, means, methods, techniques or sequences of construction are specifically required of CONTRACTOR by the Contract Documents, OWNER and ENGINEER will specify all performance and design criteria that such services must satisfy. CONTRACTOR shall cause such services or certifications to be provided by a professional properly licensed in the state in which the project is located, whose signature and seal shall appear on all drawings, calculations, specifications, certifications, and other Submittals prepared by such professional. Shop Drawings and other Submittals related to the Work designed or certified by such professional, if prepared by others, shall bear such professional's written approval when submitted to ENGINEER.

C. OWNER and ENGINEER shall be entitled to rely upon the adequacy, accuracy, and completeness of the services, certifications, or approvals performed by such design professionals.

D. Pursuant to this paragraph 6.25, ENGINEER's review or approval of design calculations and design drawings will be only for the limited purpose of checking for conformance with performance and design criteria given and the design concept expressed in the Contract Documents. ENGINEER's review or approval of Shop Drawings and other Submittals (except design calculations and design drawings) will be only for the purpose stated in paragraph 6.21.

E. CONTRACTOR shall not be responsible for the adequacy of the performance or design criteria specified by OWNER or ENGINEER.

Article 7 Work by Others

7.01 Related Work at Site

A. In addition to and apart from the Work under the Contract Documents, the OWNER may perform other work at or adjacent to the Site. Such other work may be performed by OWNER's employees, or through contracts between the OWNER and third parties. OWNER may also arrange to have third-party utility owners perform work on their utilities and facilities at or adjacent to the Site.

B. If any part of CONTRACTOR's Work depends on proper execution or results upon the work of any such other contractor or utility owner, CONTRACTOR shall inspect and promptly report to ENGINEER in writing any delays, defects or deficiencies in such other work that render it unavailable, or unsuitable for such proper execution and results of CONTRACTOR's Work. CONTRACTOR's failure to so report shall constitute an acceptance of the other work as fit and proper for integration with CONTRACTOR's Work except for latent or non-apparent defects and deficiencies in the other work.

C. CONTRACTOR shall afford each contractor who is party to such a direct contract, and each utility owner, (and OWNER, if OWNER is performing the additional work with OWNER's employees), proper and safe access to the Site and a reasonable opportunity for the introduction and storage of materials and equipment and the execution of such other work and shall properly connect and coordinate the Work with theirs. Unless otherwise provided in the Contract Documents, CONTRACTOR shall do all cutting, fitting and patching of CONTRACTOR's Work that may be required to make its several parts come together properly and integrate with such other work. CONTRACTOR shall 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 ENGINEER and the others whose work will be affected.

D. If the performance of additional work by other contractors, utility owner, or OWNER was not noted in the Contract Documents, written notice thereof shall be given to CONTRACTOR prior to starting any such additional work. If CONTRACTOR believes that the performance of such additional work by OWNER or others involves additional expense to CONTRACTOR, or requires an extension of the Contract Time, CONTRACTOR may make a Claim therefor as provided in paragraph 11.01. Claims for delay or inconveniences due to operations of such other parties for work noted in the Contract Documents will not be allowed.

Article 8 Owner's Responsibilities

8.01 Communication to Contractor

A. Except as otherwise provided in these General Conditions, OWNER shall issue all communications to CONTRACTOR through ENGINEER.

8.02 Replacement of Engineer

A. In case of termination of the employment of ENGINEER, OWNER shall appoint an engineer against whom CONTRACTOR makes no reasonable objection, whose status under the Contract Documents shall be that of the former ENGINEER.

8.03 Furnishing Data

A. OWNER shall furnish the data required of OWNER under the Contract Documents promptly.

8.04 Pay When Due

A. OWNER shall make payments to CONTRACTOR promptly after they are due as provided in paragraphs 14.05 and 14.11.

8.05 Lands and Easements; Reports and Tests

A. OWNER's duties in respect to providing lands and easements and providing engineering surveys to establish reference points are set forth in paragraphs 4.01 and 4.05. Paragraph 4.02 refers to OWNER's identifying and making available to CONTRACTOR copies of reports of investigations and tests of subsurface and latent physical conditions at the Site.

8.06 Change Orders

A. In connection with OWNER's rights to request changes in the Work in accordance with Article 10, OWNER (especially in certain instances as provided in paragraph 10.01) is obligated to execute Change Orders.

8.07 Inspections, Tests, and Approvals

A. OWNER'S responsibility in respect to certain inspections, tests and approvals is set forth in paragraph 13.02.

8.08 Limitation on Owner's Responsibility

A. OWNER shall not supervise, direct or have control or authority over, nor be responsible for, CONTRACTOR's means, methods, techniques, sequences or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of CONTRACTOR to comply with Laws and Regulations applicable to the furnishing or performance of the Work. OWNER will not be responsible for CONTRACTOR's failure to perform or furnish the Work in accordance with the Contract Documents.

8.09 Undisclosed Hazardous Materials

A. OWNER's responsibility in respect of undisclosed Constituents of Concern uncovered or revealed at the Site is set forth in paragraph 4.06.

8.10 Owner'S Designated Representative

A. OWNER shall designate a person to act as its representatives during the performance of the Work. OWNER's designated representative will attend meetings and perform on behalf of OWNER all obligations required of OWNER under the provisions of the Contract Documents.

Article 9 Engineer's Status During Construction

9.01 Owner's Representative

A. ENGINEER will be OWNER's representative during the construction period. The duties and responsibilities and the limitations of authority of ENGINEER as OWNER'S representative during construction shall be as set forth in the Contract Documents.

9.02 Visits to Site

A. ENGINEER may make visits to the Site at intervals appropriate to the various stages of construction to observe the progress and quality of the executed Work, and to determine solely for the benefit of OWNER, in general, if the Work is proceeding in accordance with the technical requirements of the Contract Documents. It will not be the responsibility of ENGINEER to make exhaustive or continuous on Site inspections to check the quality or quantity of the Work.

9.03 Resident Project Representative

A. If OWNER and ENGINEER agree, ENGINEER will furnish a Resident Project Representative to assist ENGINEER in providing more continuous observation of the Work. A Resident Project Representative will act as directed by and under the supervision of ENGINEER and will confer with ENGINEER regarding his actions. Resident Project Representative's dealings in matters pertaining to the on Site Work shall in general be only with ENGINEER and CONTRACTOR, and dealings with Subcontractors shall only be through or with the full knowledge of CONTRACTOR. The Resident Project Representative's duties and responsibilities include:

1. Schedules

    a. Review the Progress Schedule, Schedule of Submittals and Schedule of Values prepared by CONTRACTOR.

2. Conferences

    a. Arrange a schedule of progress meetings and other job conferences as required in consultation with ENGINEER and OWNER, and notify those expected to attend in advance.

3. Liaison

    a. Serve as ENGINEER's liaison with CONTRACTOR, working principally through CONTRACTOR's superintendent and assist him in understanding the intent of the technical aspects of the Contract Documents. Assist ENGINEER in serving as OWNER's liaison with CONTRACTOR when CONTRACTOR's operations affect OWNER's on Site operations.

4. Shop Drawings and Samples

    a. Advise ENGINEER and CONTRACTOR, or CONTRACTOR’s superintendent, immediately of the commencement of any Work requiring a Shop Drawing or Sample submission if the submission was identified on the schedule and has not been reviewed by ENGINEER.

5. Review of Work, Rejection of Defective Work, Inspections, and Tests:

    a. Conduct on Site observations of the Work and report to ENGINEER whenever Resident Project Representative believes that technical aspects of any executed Work is unsatisfactory, faulty or defective or does not meet the requirements of any inspections, tests or approval required to be made or has been damaged prior to final payment; and advise ENGINEER when Resident Project Representative believes that any partially completed portion of the Work should be corrected or rejected or should be uncovered for observation, or requires special testing, inspection or approval.

    b. Observe, record and report to ENGINEER appropriate details relative to test procedures and startups.

    c. Accompany visiting inspectors representing public or other agencies having jurisdiction over the Project, record the outcome of these inspections and report to ENGINEER.

6. Modifications

a. Consider CONTRACTOR's suggestions for modifications in Plans or Specifications and report them to ENGINEER.

7. Reports

a. Prepare periodic reports as required of progress of the Work and CONTRACTOR's compliance with the approved Progress Schedule and Schedule of Submittals.

8. Completion

a. Verify that all items on final list of items requiring completion or correction have been completed or corrected and make recommendations to ENGINEER concerning acceptance.

9. Exceptions

a. Resident Project Representative:

(1) Shall not authorize any deviation from the Contract Documents or approve any substitute materials or equipment.

(2) Shall not approve or accept any portion of the completed Work.

(3) Shall not undertake any of the responsibilities of CONTRACTOR, Subcontractors or CONTRACTOR's superintendent, or expedite the Work.

(4) Shall not advise on or issue directions relative to any aspect of the means, methods, techniques, sequences or procedures of construction unless such is specifically called for in the Contract Documents.

(5) Shall not advise on or issue directions as to safety precautions and programs in connection with the Work.

(6) Shall not advise on or issue directions regarding CONTRACTOR’s failure to comply with Laws and Regulations applicable to the furnishing or performance of the Work.

9.04 Clarifications and Interpretations

A. ENGINEER will issue with reasonable promptness such written clarifications or interpretations of the Contract Documents as ENGINEER may determine necessary, which shall be consistent with or reasonably inferable from the overall intent of the Contract Documents.

9.05 Authorized Variations in Work - Field Order

A. ENGINEER may authorize minor adjustments in the Work to avoid obstructions or interferences which do not involve an adjustment in the Contract Price or the Contract Time, and which are consistent with the overall intent of the Contract Documents. These may be accomplished by a Field Order and shall be binding on OWNER, and also on CONTRACTOR who shall perform the change promptly. If OWNER or CONTRACTOR believes that a Field Order justifies an adjustment in the Contract Price or Contract Times, or both, and the parties are unable to agree on entitlement to or on the amount or extent, if any, of any such adjustment, a request for a Change Proposal may be made therefore as provided in paragraph 10.06 or a Claim may be submitted as set forth in paragraph 11.01.

9.06 Rejecting Defective Work

A. ENGINEER will have authority to disapprove or reject completed portions of the Work which ENGINEER believes to be defective and will also have authority to require special inspection or testing of the Work as provided in paragraph 13.04, whether or not the Work is fabricated, installed or completed.

9.07 Shop Drawings, Change Orders, and Payments

A. ENGINEER's responsibility for Shop Drawings and samples are set forth in paragraphs 6.19 through 6.21 inclusive.

B. ENGINEER's responsibilities as to Change Orders are set forth in Articles 10, 11, and 12.

C. ENGINEER's responsibilities in respect of Applications for Payment are set forth in Article 14.

9.08 Determinations for Unit Price Work

A. ENGINEER will determine the actual quantities and classifications of Unit Price Work performed by CONTRACTOR. ENGINEER will review with CONTRACTOR ENGINEER's preliminary determinations on such matters before rendering a written decision thereon (by recommendation of an Application for Payment or otherwise). ENGINEER's written decision thereon will be final and binding (except as modified by ENGINEER to reflect changed factual conditions or more accurate data) upon OWNER and CONTRACTOR, subject to the provisions of paragraph 10.06.

9.09 Decisions on Disagreements, Claims

A. ENGINEER will be the initial interpreter of the requirements of the Contract Documents and judge of the acceptability of the Work performed thereunder. Claims, disputes and other matters relating to the acceptability of the Work, or the interpretation of the requirements of the Contract Documents pertaining to the execution and progress of the Work, shall be referred initially to ENGINEER in writing with a request for a formal decision in accordance with this paragraph 9.09.

B. ENGINEER will, with reasonable promptness, render a written decision on the issue referred. If OWNER or CONTRACTOR believe that any such decision entitles them to an adjustment in the Contract Price, or Contract Times, or both, a Claim may be made under paragraph 11.01.

C. ENGINEER's written decision on the issue referred will be final and binding on OWNER and CONTRACTOR, subject to the provisions of paragraph 11.01.

D. In this capacity ENGINEER will not show partiality to OWNER or CONTRACTOR and will not be liable in connection with any interpretation or decision rendered in good faith in such capacity.

9.10 Limitations on Engineer's Responsibilities

A. Neither ENGINEER's authority to act under this Article 9 or elsewhere in the Contract Documents, nor any decision made by ENGINEER in good faith either to exercise or not exercise such authority, shall give rise to any duty or responsibility of ENGINEER to OWNER or CONTRACTOR, any Subcontractor, any manufacturer, fabricator, Supplier, distributor, surety, or any other person, employee, or agent of any of them.

B. ENGINEER will not supervise, direct, control or have authority over, or be responsible for CONTRACTOR's means, methods, techniques, sequences or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of CONTRACTOR to comply with Laws and Regulations applicable to the furnishing or performance of the Work. ENGINEER will not be responsible for CONTRACTOR's failure to perform the Work in accordance with the Contract Documents. These limitations on authority and responsibility shall also apply to ENGINEER's Consultant's, Resident Project Representative and assistants.

C. ENGINEER will not be responsible for the acts or omissions of CONTRACTOR or of any Subcontractor, Supplier, or of any other individual or entity performing any of the Work.

D. ENGINEER will not be responsible to CONTRACTOR or any Subcontractor, or Supplier, or to their agents or employees for injuries, damages, claims, losses, or expenses (including attorney's fees) of whatsoever kind resulting from or caused by any act or omission of ENGINEER in preparation for, arising from, relating to, or concerning the Project. Such acts or omissions include, but are not limited to, ENGINEER's negligence, tortuous conduct, errors, omissions, strict liability, breach of contract, or breach of warranty. ENGINEER makes no representations to CONTRACTOR, Subcontractors, Suppliers or their agents or employees regarding or respecting any work performed by ENGINEER in preparation for, arising from, relating to, or concerning the Project.

E. Neither CONTRACTOR, its agents or employees, nor any Subcontractors or Suppliers or their agents or employees, are intended beneficiaries of ENGINEER's agreement with OWNER, nor are such parties intended beneficiaries of ENGINEER's duties or responsibilities arising therefrom. ENGINEER disclaims all duties to CONTRACTOR, Subcontractors, Suppliers or their agents or employees arising from, relating to, or concerning ENGINEER's involvement in the Project. OWNER and CONTRACTOR further agree to notify all CONTRACTOR's, Subcontractors or Suppliers of this disclaimer of ENGINEER's liability and require them to abide by this disclaimer.

Article 10 Amending the Contract Documents; Changes in the Work

10.01 Amending and Supplementing Contract Documents

A. The Contract Documents may be amended or supplemented by a Change Order, a Work Change Directive, or a Field Order.

1. Change Orders:

a. If an amendment or supplement to the Contract Documents includes a change in the Contract Price or the Contract Times, such amendment or supplement must be set forth in a Change Order. A Change Order also may be used to establish amendments and supplements of the Contract Documents that do not affect the Contract Price or Contract Times.

b. OWNER and CONTRACTOR may amend those terms and conditions of the Contract Documents that do not involve;

(1) the performance or acceptability of the Work,

(2) the design (as set forth in the Drawings, Specifications, or otherwise), or

(3) other engineering or technical matters, without the recommendation of ENGINEER. Such an amendment shall be set forth in a Change Order.

2. Work Change Directives.

a. A Work Change Directive will not change the Contract Price or the Contract Times but is evidence that the parties expect that the modification ordered or documented by a Work Change Directive will be incorporated in a subsequently issued Change Order, following negotiations by the parties as to the Work Change Directive's effect, if any, on the Contract Price and Contract Times; or, if negotiations are unsuccessful, by a determination under the terms of the Contract Documents governing adjustments, expressly including paragraph 10.04 regarding change of Contract Price.

b. CONTRACTOR must submit any Change Proposal seeking an adjustment of the Contract Price or the Contract Times, or both, no later than 30 days after the issuance of the Work Change Directive.

c. OWNER must submit any Claim seeking an adjustment of the Contract Price or the Contract Times, or both, no later than 60 days after issuance of the Work Change Directive.

3. Field Orders.

a. ENGINEER may authorize minor changes in the Work if the changes do not involve an adjustment in the Contract Price or the Contract Times and are compatible with the design concept of the completed Project as a functioning whole as indicated by the Contract Documents. Such changes will be accomplished by a Field Order and will be binding on OWNER and CONTRACTOR, which shall perform the Work involved promptly.

b. If CONTRACTOR believes that a Field Order justifies an adjustment in the Contract Price or Contract Times, or both, then before proceeding with the Work at issue, CONTRACTOR shall submit a Change Proposal as provided herein.

10.02 Owner-Authorized Changes in the Work

A. Without invalidating the Contract and without notice to any surety, OWNER may, at any time or from time to time, order additions, deletions, or revisions in the Work. Such changes shall be supported by ENGINEER's recommendation, to the extent the change involves the design (as set forth in the Drawings, Specifications, or otherwise), or other engineering or technical matters. Such changes may be accomplished by a Change Order, if OWNER and CONTRACTOR have agreed as to the effect, if any, of the changes on Contract Times or Contract Price; or by a Work Change Directive.

B. Upon receipt of any such document, CONTRACTOR shall promptly proceed with the Work involved; or, in the case of a deletion in the Work, promptly cease construction activities with respect to such deleted Work. Added or revised Work shall be performed under the applicable conditions of the Contract Documents. Nothing in this paragraph 10.02 shall obligate CONTRACTOR to undertake work that CONTRACTOR reasonably concludes cannot be performed in a manner consistent with CONTRACTOR's safety obligations under the Contract Documents or Laws and Regulations.

10.03 Unauthorized Changes in the Work

A. CONTRACTOR shall not be entitled to an increase in the Contract Price or an extension of the Contract Times with respect to any work performed that is not required by the Contract Documents, as amended, modified, or supplemented, except in the case of an emergency as provided in paragraph 6.18 or in the case of uncovering Work as provided in paragraph 13.03.

10.04 Change of Contract Price

A. The Contract Price may only be changed by a Change Order. Any Change Proposal for an adjustment in the Contract Price shall comply with the provisions of paragraph 10.06. Any Claim for an adjustment of Contract Price shall comply with the provisions of paragraph 11.01.

B. An adjustment in the Contract Price will be determined as follows:

1. where the Work involved is covered by Unit Prices contained in the Contract Documents, then by application of such Unit Prices to the quantities of the items involved (subject to the provisions of paragraph 12.03); or

2. where the Work involved is not covered by Unit Prices contained in the Contract Documents, then by a mutually agreed lump sum (which may include an allowance for overhead and profit not necessarily in accordance with paragraph 10.04.C.2); or

3. where the Work involved is not covered by Unit Prices contained in the Contract Documents and the parties do not reach mutual agreement to a lump sum, then on the basis of the Cost of the Work (determined as provided in paragraph 12.01) plus a CONTRACTOR's fee for overhead and profit (determined as provided in paragraph 10.04.C).

C. CONTRACTOR's Fee: When applicable, the CONTRACTOR's fee for overhead and profit shall be determined as follows:

1. a mutually acceptable fixed fee; or

2. if a fixed fee is not agreed upon, then a fee based on the following percentages of the various portions of the Cost of the Work:

a. for costs incurred under paragraph 12.01.B.1 and 12.01.B.2, the CONTRACTOR's fee shall be 15 percent;

b. for costs incurred under paragraph 12.01.B.3, the CONTRACTOR's fee shall be five percent;

c. where one or more tiers of subcontracts are on the basis of Cost of the Work plus a fee and no fixed fee is agreed upon, the intent of paragraphs 10.04.C.2.a and 10.04.C.2.b is that the CONTRACTOR's fee shall be based on:

(1) a fee of 15 percent of the costs incurred under paragraphs 12.01.B.1 and 12.01.B.2 by the Subcontractor that actually performs the Work, at whatever tier, and

(2) with respect to CONTRACTOR itself and to any Subcontractors of a tier higher than that of the Subcontractor that actually performs the Work, a fee of 5 percent of the amount (fee plus underlying costs incurred) attributable to the next lower tier Subcontractor;

provided, however, that for any such subcontracted work the maximum total fee to be paid by OWNER shall be no greater than 27 percent of the costs incurred by the Subcontractor that actually performs the Work;

d. no fee shall be payable on the basis of costs itemized under paragraphs 12.01.B.4, 12.01.B.5, and 12.01.C;

e. the amount of credit to be allowed by CONTRACTOR to OWNER for any change which results in a net decrease in cost will be the amount of the actual net decrease in cost plus a deduction in CONTRACTOR's fee by an amount equal to 5 percent of such net decrease; and

f. when both additions and credits are involved in any one change, the adjustment in CONTRACTOR's fee shall be computed on the basis of the net change in accordance with paragraphs 10.04.C.2.a through 10.04.C.2.e, inclusive.

10.05 Change of Contract Times

A. The Contract Times may only be changed by a Change Order. Any Change Proposal for an adjustment in the Contract Times shall comply with the provisions of paragraph 10.06. Any Claim for an adjustment in the Contract Times shall comply with the provisions of paragraph 11.01.

B. An adjustment of the Contract Times shall be subject to the limitations set forth in paragraph 12.04, concerning delays in CONTRACTOR's progress.

10.06 Change Proposals

A. CONTRACTOR shall submit a Change Proposal to ENGINEER to request an adjustment in the Contract Times or Contract Price; appeal an initial decision by ENGINEER concerning the requirements of the Contract Documents or relating to the acceptability of the Work under the Contract Documents; contest a set-off against payment due; or seeking other relief under the Contract. The Change Proposal shall specify any proposed change in Contract Times or Contract Price, or both, or other proposed relief, and explain the reason for the proposed change, with citations to any governing or applicable provisions of the Contract Documents. Each Change Proposal will address only 1 issue, or a set of closely related issues.

1. Procedures. CONTRACTOR shall submit each Change Proposal to ENGINEER promptly (but in no event later than 5 days) after the start of the event giving rise thereto, or after such initial decision. CONTRACTOR shall submit supporting data, including the proposed change in Contract Price or Contract Time (if any) to ENGINEER and OWNER within 15 days after the submittal of the Change Proposal. The supporting data shall be accompanied by a written statement that the supporting data are accurate and complete, and that any requested time or price adjustment is the entire adjustment to which CONTRACTOR believes it is entitled as a result of said event. ENGINEER will advise OWNER regarding the

Change Proposal and consider any comments or response from OWNER regarding the Change Proposal.

2. ENGINEER's Action. ENGINEER will review each Change Proposal and, within 30 days after receipt of the CONTRACTOR's supporting data, either deny the Change Proposal in whole, approve it in whole, or deny it in part and approve it in part. Such actions shall be in writing, with a copy provided to OWNER and CONTRACTOR. If ENGINEER does not take action on the Change Proposal within 30 days, then either OWNER or CONTRACTOR may at any time thereafter submit a letter to the other party indicating that as a result of the ENGINEER's inaction the Change Proposal is deemed denied, thereby commencing the time for appeal of the denial under paragraph 11.01.

3. Binding Decision. ENGINEER's decision will be final and binding upon OWNER and CONTRACTOR, unless OWNER or CONTRACTOR appeals the decision by filing a Claim under paragraph 11.01.

B. Resolution of Certain Change Proposals: If the Change Proposal does not involve the design (as set forth in the Drawings, Specifications, or otherwise), the acceptability of the Work, or other engineering or technical matters, then ENGINEER will notify the parties that the ENGINEER is unable to resolve the Change Proposal. For purposes of further resolution of such a Change Proposal, such notice shall be deemed a denial, and CONTRACTOR may choose to seek resolution under the terms of paragraph 11.01.

10.07 Execution of Change Orders

A. OWNER and CONTRACTOR shall execute appropriate Change Orders covering:

1. changes in the Contract Price or Contract Times which are agreed to by the Parties, including any undisputed sum or amount of time for Work actually performed in accordance with a Work Change Directive;

2. changes in Contract Price resulting from an OWNER set-off, unless CONTRACTOR has duly contested such set-off;

3. changes in the Work which are:

a. ordered by OWNER pursuant to paragraph 10.02,

b. required because of OWNER's acceptance of defective Work under paragraph 13.08 or OWNER's correction of defective Work under paragraph 13.09, or

c. agreed to by the parties, subject to the need for ENGINEER's recommendation if the change in the Work involves the design (as set forth in the Drawings, Specifications, or otherwise), or other engineering or technical matters; and

4. changes in the Contract Price or Contract Times, or other changes, which embody the substance of any final and binding results under paragraph 10.06, or Article 16.

B. If OWNER or CONTRACTOR refuses to execute a Change Order that is required to be executed under the terms of this paragraph 10.07, it shall be deemed to be of full force and effect, as if fully executed.

10.08 Notification to Surety

A. If the provisions of any bond require notice to be given to a surety of any change affecting the general scope of the Work or the provisions of the Contract Documents (including, but not limited to, Contract Price or Contract Times), the giving of any such notice will be CONTRACTOR's responsibility. The amount of each applicable bond will be adjusted to reflect the effect of any such change.

Article 11 Claims

11.01 Claims

A. Claims Process: The following disputes between OWNER and CONTRACTOR shall be submitted to the Claims process set forth in this Article:

1. Appeals by OWNER or CONTRACTOR of ENGINEER's decisions regarding Change Proposals;

2. OWNER demands for adjustments in the Contract Price or Contract Times, or other relief under the Contract Documents; and

3. Disputes that ENGINEER has been unable to address because they do not involve the design (as set forth in the Drawings, Specifications, or otherwise), the acceptability of the Work, or other engineering or technical matters.

B. Submittal of Claim: The party submitting a Claim shall deliver it directly to the other party to the Contract promptly (but in no event later than 10 days) after the start of the event giving rise thereto; in the case of appeals regarding Change Proposals within 30 days of the decision under appeal. The party submitting the Claim shall also furnish a copy to the ENGINEER, for its information only. The responsibility to substantiate a Claim shall rest with the party making the Claim. In the case of a Claim by CONTRACTOR seeking an increase in the Contract Times or Contract Price, or both, CONTRACTOR shall certify that the Claim is made in good faith, that the supporting data are accurate and complete, and that to the best of CONTRACTOR's knowledge and belief the amount of time or money requested accurately reflects the full amount to which CONTRACTOR is entitled.

C. Review and Resolution: The party receiving a Claim shall review it thoroughly, giving full consideration to its merits. The two parties shall seek to resolve the Claim through the exchange of information and direct negotiations. The parties may extend the time for resolving the Claim by mutual agreement. All actions taken on a Claim shall be stated in writing and submitted to the other party, with a copy to ENGINEER.

D. Mediation:

1. At any time after initiation of a Claim, OWNER and CONTRACTOR may mutually agree to mediation of the underlying dispute. The agreement to mediate shall stay the Claim submittal and response process.

2. If OWNER and CONTRACTOR agree to mediation, then after 60 days from such agreement, either OWNER or CONTRACTOR may unilaterally terminate the mediation process, and the Claim submittal and decision process shall resume as of the date of the termination. If the mediation proceeds but is unsuccessful in resolving the dispute, the Claim submittal and decision process shall resume as of the date of the conclusion of the mediation, as determined by the mediator.

3. OWNER and CONTRACTOR shall each pay one-half of the mediator's fees and costs.

E. Partial Approval: If the party receiving a Claim approves the Claim in part and denies it in part, such action shall be final and binding unless within 30 days of such action the other party invokes the procedure set forth in Article 16 for final resolution of disputes.

F. Denial of Claim: If efforts to resolve a Claim are not successful, the party receiving the Claim may deny it by giving written notice of denial to the other party. If the receiving party does not take action on the Claim within 90 days, then either OWNER or CONTRACTOR may at any time thereafter submit a letter to the other party indicating that as a result of the inaction, the Claim is deemed denied, thereby commencing the time for appeal of the denial. A denial of the Claim shall be final and binding unless within 30 days of the denial the other party invokes the procedure set forth in Article 16 for final resolution of disputes.

G. Final and Binding Results: If the parties reach a mutual agreement regarding a Claim, whether through approval of the Claim, direct negotiations, mediation, or otherwise; or if a Claim is approved in part and denied in part, or denied in full, and such actions become final and binding; then the results of the agreement or action on the Claim shall be incorporated in a Change Order to the extent they affect the Contract, including the Work, the Contract Times, or the Contract Price.

Article 12 Cost of the Work; Allowances; Unit Price Work

12.01 Cost of Work

A. Purposes for Determination of Cost of the Work: The term Cost of the Work means the sum of all costs necessary for the proper performance of the Work at issue, as further defined below. The provisions of this paragraph 12.01 are used to determine the value of a Change Order, Change Proposal, Claim, set-off, or other adjustment in Contract Price. When the value of any such adjustment is determined on the basis of Cost of the Work, CONTRACTOR is entitled only to those additional or incremental costs required because of the change in the Work or because of the event giving rise to the adjustment.

B. Costs Included: Except as otherwise may be agreed to in writing by OWNER, costs included in the Cost of the Work shall be in amounts no higher than those prevailing in the locality of the Project, shall not include any of the costs itemized in paragraph 12.01.C, and shall include only the following items:

1. Payroll costs for employees in the direct employ of CONTRACTOR in the performance of the Work under schedules of job classifications agreed upon by OWNER and CONTRACTOR. Such employees shall include, without limitation, superintendents, foremen, and other personnel employed full time on the Work. Payroll costs for employees not employed full time on the Work shall be apportioned on the basis of their time spent on the Work. Payroll costs shall include, but not be limited to, salaries and wages plus the cost of fringe benefits, which shall include social security contributions, unemployment, excise, and payroll taxes, workers' compensation, health and retirement benefits, bonuses, sick leave, and vacation and holiday pay applicable thereto. The expenses of performing Work outside of regular working hours, on Saturday, Sunday, or legal holidays, shall be included in the above to the extent authorized by OWNER.

2. Costs of all materials and equipment furnished and incorporated in the Work, including costs of transportation and storage thereof, and Suppliers' field services required in connection therewith. All cash discounts shall accrue to CONTRACTOR unless OWNER deposits funds with CONTRACTOR with which to make payments, in which case the cash discounts shall accrue to OWNER. All trade discounts, rebates, and refunds and returns from sale of surplus materials and equipment shall accrue to OWNER, and CONTRACTOR shall make provisions so that they may be obtained.

3. Payments made by CONTRACTOR to Subcontractors for Work performed by Subcontractors. If required by OWNER, CONTRACTOR shall obtain competitive bids from Subcontractors acceptable to OWNER and CONTRACTOR and shall deliver such bids to OWNER, who will then determine, with the advice of ENGINEER, which bids, if any, will be acceptable. If any subcontract provides that the Subcontractor is to be paid on the basis of Cost of the Work plus a fee, the Subcontractor's Cost of the Work and fee shall be determined in the same manner as CONTRACTOR's Cost of the Work and fee as provided in this paragraph 12.01.

4. Costs of special consultants (including but not limited to engineers, architects, testing laboratories, surveyors, attorneys, and accountants) employed for services specifically related to the Work.

5. Supplemental costs including the following:

    a. Cost, including transportation and maintenance, of all materials, supplies, equipment, machinery, appliances, office, and temporary facilities at the Site, and hand tools not owned by the workers, which are consumed in the performance of the Work, and cost, less market value, of such items used but not consumed which remain the property of CONTRACTOR.

    b. Rentals of all construction equipment and machinery, and the parts thereof, whether rented from CONTRACTOR or others in accordance with rental agreements approved by OWNER with the advice of ENGINEER, and the costs of transportation, loading, unloading, assembly, dismantling, and removal thereof. All such costs shall be in accordance with the terms of said rental agreements. The rental of any such equipment, machinery, or parts shall cease when the use thereof is no longer necessary for the Work.

        (1) The rental rate established for each piece of CONTRACTOR owned equipment, including appurtenances and attachments to the equipment, used will be determined by use of the Rental Rate Blue Book for Construction Equipment, Volume 1, 2 or 3, as applicable; the edition which is current at the time the Work was started will apply. The established rental rate will be equal to the "Monthly" rate divided by 176; modified by the rate adjustment factor and the applicable map adjustment factor, plus the "Estimated Operating Costs per Hour."

(2) For equipment not listed in the Rental Rate Blue Book, Volume 1, 2 or 3, the rental rate will be determined by using the rate listed for a similar piece of equipment or by proportioning a rate listed so that the capacity, size, horsepower, and age are properly considered.

(3) For equipment for which there are no comparables in the Rental Rate Blue Book, Volume 1, 2 or 3, the monthly rate shall be reasonable, but not more than 5 percent of the current list price, or invoice, of the equipment. The base hourly rate shall then be determined by dividing the monthly rate by 176 to which 20 percent will be added to the sum which will account for adjustments and operating costs.

c. Sales, consumer, use, and other similar taxes related to the Work, and for which CONTRACTOR is liable, as imposed by laws and regulations.

d. Deposits lost for causes other than negligence of CONTRACTOR, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable, and royalty payments and fees for permits and licenses.

e. Losses and damages (and related expenses) caused by damage to the Work, not compensated by insurance or otherwise, sustained by CONTRACTOR in connection with the performance of the Work (except losses and damages within the deductible amounts of property insurance established in accordance with paragraph 5.03), provided such losses and damages have resulted from causes other than the negligence of CONTRACTOR, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable. Such losses shall include settlements made with the written consent and approval of OWNER. No such losses, damages, and expenses shall be included in the Cost of the Work for the purpose of determining

f. The cost of utilities, fuel, and sanitary facilities at the Site.

g. The costs of premiums for all bonds and insurance that CONTRACTOR is required by the Contract Documents to purchase and maintain.

C. Costs Excluded: The term Cost of the Work shall not include any of the following items:

1. Payroll costs and other compensation of CONTRACTOR's officers, executives, principals (of partnerships and sole proprietorships), general managers, safety managers, engineers, architects, estimators, attorneys, auditors, accountants, purchasing and contracting agents, expediters, timekeepers, clerks, and other personnel employed by CONTRACTOR, whether at the Site or in CONTRACTOR's principal or branch office for general administration of the Work and not specifically included in the agreed upon schedule of job classifications referred to in paragraph 12.01.B.1 or specifically covered by paragraph 12.01.B.4. The payroll costs and other compensation excluded here are to be considered administrative costs covered by the CONTRACTOR's fee.

2. Expenses of CONTRACTOR's principal and branch offices other than CONTRACTOR's office at the Site.

3. Any part of CONTRACTOR's capital expenses, including interest on CONTRACTOR's capital employed for the Work and charges against CONTRACTOR for delinquent payments.

4. Costs due to the negligence of CONTRACTOR, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable, including but not limited to, the correction of defective Work, disposal of materials or equipment wrongly supplied, and making good any damage to property.

5. Other overhead or general expense costs of any kind and the costs of any item not specifically and expressly included in paragraph 12.01.B.

D. CONTRACTOR's Fee: When the value of any Work covered by a Change Order, Change Proposal, Claim, set-off, or other adjustment in Contract Price is determined on the basis of Cost of the Work, CONTRACTOR's fee shall be determined as set forth in paragraph 10.04.C.

E. Documentation: Whenever the Cost of the Work for any purpose is to be determined pursuant to this Article 12, CONTRACTOR will establish and maintain records thereof in accordance with generally accepted accounting practices and submit in a form acceptable to ENGINEER on a daily basis, an itemized cost breakdown together with supporting data.

12.02 Allowances

A. It is understood that CONTRACTOR has included in the Contract Price all allowances so named in the Contract Documents and shall cause the Work so covered to be performed for such sums and by such persons or entities as may be acceptable to OWNER and ENGINEER.

B. Cash Allowances: CONTRACTOR agrees that:

1. the cash allowances include the cost to CONTRACTOR (less any applicable trade discounts) of materials and equipment required by the allowances to be delivered at the Site, and all applicable taxes; and

2. CONTRACTOR's costs for unloading and handling of the Site, labor, installation, overhead, profit, and other expenses contemplated for the cash allowances have been included in the Contract Price and not in the allowances, and no demand for additional payment on account of any of the foregoing will be valid.

C. Contingency Allowance: CONTRACTOR agrees that a contingency allowance, if any, is for the sole use of OWNER to cover unanticipated costs.

D. Prior to final payment, an appropriate Change Order will be issued as recommended by ENGINEER to reflect actual amounts due CONTRACTOR on account of Work covered by allowances, and the Contract Price shall be correspondingly adjusted.

12.03 Unit Price Work

A. Where the Contract Documents provide that all or part of the Work is to be Unit Price Work, initially the Contract Price will be deemed to include for all Unit Price Work an amount equal to the sum of the unit price for each separately identified item of Unit Price Work times the estimated quantity of each item as indicated in the Proposal.

B. The estimated quantities of items of Unit Price Work are not guaranteed and are solely for the purpose of comparison of Bids and determining an initial Contract Price. Payments to CONTRACTOR for Unit Price Work will be based on actual quantities.

C. Each Unit Price will be deemed to include an amount considered by CONTRACTOR to be adequate to cover CONTRACTOR's overhead and profit for each separately identified item.

D. ENGINEER will determine the actual quantities and classifications of Unit Price Work performed by CONTRACTOR. ENGINEER will review with CONTRACTOR the ENGINEER's preliminary determinations on such matters before rendering a written decision thereon (by recommendation of an Application for Payment or otherwise). ENGINEER's written decision thereon will be final and binding (except as modified by ENGINEER to reflect changed factual conditions or more accurate data) upon OWNER and CONTRACTOR, subject to the provisions of the following paragraph 12.03.E.

E. Within 30 days of ENGINEER's written decision under the preceding paragraph 12.03.D, CONTRACTOR may submit a Change Proposal, or OWNER may file a Claim, seeking and adjustment in the Contract Price if:

1. the quantity of any item of Unit Price Work performed by CONTRACTOR differs materially and significantly from the estimate quantity of such item indicated in the Proposal (in no event will any change in quantities of less than 25% be considered a material or significant change from the estimated quantities); and

2. there is no corresponding adjustment with respect to any other item of Work.

12.04 Delays in Contractor's Progress

A. If OWNER, ENGINEER, or anyone for whom OWNER is responsible, delays, disrupts, or interferes with the performance or progress of the Work, then CONTRACTOR shall be entitled to request an equitable adjustment in the Contract Times and Contract Price. However, CONTRACTOR's entitlement to an adjustment of the Contract Times or Contract Price is expressly conditioned on such adjustment being essential to CONTRACTOR's ability to complete the Work within the Contract Times.

B. CONTRACTOR shall not be entitled to an adjustment in Contract Price or Contract Times for delay, disruption, or interference caused by or within the control of CONTRACTOR. Delay, disruption, and interference attributable to and within the control of a SUBCONTRACTOR or Supplier shall be deemed to be within the control of CONTRACTOR.

C. If CONTRACTOR's performance or progress is delayed, disrupted, or interfered with by unanticipated causes not the fault and beyond the control of OWNER, CONTRACTOR, and those for which they are responsible, then CONTRACTOR shall be entitled to an equitable adjustment in Contract Times. CONTRACTOR's entitlement to an adjustment of the Contract Times is conditioned on such adjustment being essential to CONTRACTOR's ability to complete the Work within the Contract Times. Such an adjustment shall be CONTRACTOR's sole and exclusive remedy for the delays, disruption, and interference described in this paragraph. Causes of delay, disruption, or interference that may give rise to an adjustment in Contract Times under this paragraph include only the following:

1. severe and unavoidable natural catastrophes such as fires, floods, epidemics, and earthquakes;

2. acts or failures to act of utility owners (other than those performing other works at or adjacent to the Site by arrangement with the OWNER, as specified in paragraph 7.01); and

3. acts of war or terrorism.

D. CONTRACTOR's entitlement to an adjustment of Contract Times or Contract Price is limited as follows:

1. CONTRACTOR's entitlement to an adjustment of the Contract Times is conditioned on the delay, disruption, or interference adversely affecting an activity on the critical path to completion of the Work, as of the time of the delay, disruption, or interference.

2. CONTRACTOR shall not be entitled to an adjustment in Contract Price for any delay, disruption, or interference if such delay is concurrent with a delay, disruption, or interference caused by or within the control of CONTRACTOR. Such a concurrent delay by CONTRACTOR shall not preclude an adjustment of Contract Times to which CONTRACTOR is otherwise entitled.

3. Adjustments of Contract Times or Contract Price are subject to the provisions of Article 10.

E. Each CONTRACTOR request or Change Proposal seeking an increase in Contract Times or Contract Price must be supplemented by supporting data that sets forth in detail the following:

1. The circumstances that form the basis for the requested adjustment;

2. The date upon which each cause of delay, disruption, or interference began to affect the progress of the Work;

3. The date upon which each cause of delay, disruption, or interference ceased to affect the progress of the Work;

4. The number of days' increase in Contract Times claimed as a consequence of each such cause of delay, disruption, or interference; and

5. The impact on Contract Price, in accordance with the provisions of Paragraph 10.04.

CONTRACTOR shall also furnish such additional supporting documentation as OWNER or ENGINEER may require including, where appropriate, a revised Progress Schedule indicating all the activities affected by the delay, disruption, or interference, and an explanation of the effect of the delay, disruption, or interference on the critical path to completion of the Work

F. Delays, disruption, and interference to the performance or progress of the Work resulting from the existence of a differing subsurface or physical condition, an Underground Facility that was not shown or indicated by the Contract Documents, or not shown or indicated with reasonable accuracy, and those resulting from Hazardous Environmental Conditions, are governed by paragraphs 4.03 and 4.06.

G. Paragraph 7.01 governs delays, disruption, and interference to the performance or progress of the Work resulting from the performance of certain other work at or adjacent to the Site.

H. CONTRACTOR shall not be entitled to any adjustment in Contract Price or Contract Times for any delay, disruption, or interference if such delay is concurrent with a delay, disruption, or interference caused by or within the control of CONTRACTOR.

I. CONTRACTOR must submit any Change Proposal seeking an adjustment in Contract Price or Contract Times under this paragraph within 5 days of the commencement of the delaying, disrupting, or interfering event.

J. Where CONTRACTOR is prevented from completing any part of the Work within the Contract Time (or Milestones) due to delay beyond the control of both OWNER and CONTRACTOR, an extension of the Contract Times (or Milestones) in an amount equal to the time lost due to such delay shall be CONTRACTOR's sole and exclusive remedy for such delay. In no event shall OWNER or ENGINEER be liable to CONTRACTOR, any Subcontractor, any Supplier, or any other person or organization, or to any surety or employee or any agent of them, for damages, including but not limited to all fees and charges of ENGINEERS, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs, arising out of or resulting from:

1. delays caused by or within the control of CONTRACTOR (or Subcontractor or Supplier);

2. delays beyond the control of both OWNER and CONTRACTOR, including but not limited to fires, floods, epidemics, abnormal weather conditions, acts of God, or acts of neglect by utility owners or other contractors performing other work;

K. Nor shall OWNER or ENGINEER or each of them be liable to CONTRACTOR for any claims, costs, losses or damages sustained by CONTRACTOR on or in connection with any other project or anticipated project.

L. Nothing in this paragraph 12.04 bars a change in Contract Price to compensate CONTRACTOR due to delay, interference, or disruption directly attributable to actions or inactions of OWNER or anyone for whom OWNER is responsible. Except for an adjustment to the Contract Times and Contract Price, the CONTRACTOR shall not be entitled to and hereby waives any and all damages that it may suffer by reason of such delay or for any Act of God, including but not limited lost profits, overhead, and other consequential damages.

Article 13 Tests and Inspection; Correction, Removal or Acceptance of Defective Work

13.01 Access to Work

A. OWNER, ENGINEER and ENGINEER's representatives, other representatives of OWNER, testing agencies and governmental agencies with jurisdictional interests will have access to the Work at reasonable times for their observation, inspection and testing. CONTRACTOR shall provide proper and safe conditions for such access and advise OWNER and ENGINEER of CONTRACTOR's Site safety procedures and programs so that OWNER and ENGINEER may comply therewith as applicable.

13.02 Tests and Inspections

A. CONTRACTOR shall give ENGINEER and testing agency at least 24-hour notice, unless otherwise specified, of readiness of the Work for all required inspections, tests or approvals, and shall cooperate with inspection and testing personnel to facilitate required inspections or tests.

B. If any Law and Regulation, code, or order of any public body having jurisdiction requires any Work or part thereof to specifically be inspected, tested or approved, CONTRACTOR shall assume full responsibility therefor, pay all costs in connection therewith and furnish ENGINEER the required certificates of inspection, testing or approval.

C. CONTRACTOR shall also be responsible for and shall pay all costs in connection with any inspection or testing required in connection with OWNER's or ENGINEER's acceptance of a manufacturer, fabricator, Supplier or distributor of materials or equipment proposed to be incorporated in the Work, or of materials or equipment submitted for approval prior to CONTRACTOR's purchase thereof for incorporation in the Work.

D. The cost of all other inspections, tests and approvals required by the Contract Documents shall be paid by OWNER unless otherwise specified.

E. All inspections, tests or approvals other than those required by law, ordinance, rule, regulation, code or order of any public body having jurisdiction shall be performed by organizations acceptable to OWNER and CONTRACTOR or by ENGINEER if so specified.

F. Cost of materials to be used in inspection and transportation costs shall be paid for by the CONTRACTOR.

G. Neither observations by ENGINEER nor inspections, tests or approvals by others shall relieve CONTRACTOR from his obligations to perform the Work in accordance with the Contract Documents.

13.03 Uncovering Work

A. If any Work that is to be tested, inspected or approved is covered without written concurrence of ENGINEER, or contrary to the written request of ENGINEER, it shall, if requested by ENGINEER, be uncovered by CONTRACTOR for ENGINEER's observation. Such uncovering shall be at CONTRACTOR's expense unless CONTRACTOR has given ENGINEER timely written notice of his intention to cover such Work and ENGINEER has not acted with reasonable promptness in response to such notice.

B. If ENGINEER considers it necessary or advisable that covered Work be observed by ENGINEER or inspected or tested by others, CONTRACTOR, at ENGINEER's request, shall uncover, expose or otherwise make available for observation, inspection or testing as ENGINEER may require, that portion of the Work in question, furnishing all necessary labor, material, and equipment. Except as otherwise specified in paragraph 13.04, the cost of Work shall be paid for as follows:

1. If it is found that such Work is defective, CONTRACTOR shall bear all the expenses of such uncovering, exposure, observation, inspection and testing, and of satisfactory reconstruction, (including, but not limited to, fees and charges of engineers, architects, attorneys, and other professionals) and an appropriate deductive Change Order shall be issued. If the parties are unable to agree as to the amount or extent of any change in Contract Price or Contract Time, OWNER may make a Claim as provided in paragraph 11.01.

2. If, however, such Work is not found to be defective, CONTRACTOR shall be allowed an increase in the Contract Price or an extension of the Contract Time or both, directly attributable to such uncovering, exposure, observation, inspection, testing, and reconstruction. If the parties are unable to agree as to the amount or extent of any change in Contract Price or Contract Time, CONTRACTOR may make a Claim as provided in paragraph 11.01.

13.04 Defective Work

A. CONTRACTOR's Obligation: It is CONTRACTOR's obligation to assure that the Work is not defective.

B. ENGINEER's Authority: ENGINEER has the authority to determine whether Work is defective, and to reject defective Work.

13.05 Owner May Stop the Work

A. If the Work is defective, or CONTRACTOR fails to supply sufficient skilled workers or suitable materials or equipment, or fails to furnish or perform the Work in such a way that the completed Work will conform to the Contract Documents, OWNER may order CONTRACTOR to stop the Work, or any portion thereof, until the cause for such order has been eliminated; however, this right of OWNER to stop the Work shall not give rise to any duty on the part of OWNER to exercise this right for the benefit of CONTRACTOR, any Subcontractor, Supplier, any other individual or entity, or any surety for, or employee or agent of any of them.

13.06 Correction or Removal of Defective Work

A. If required by ENGINEER or OWNER, CONTRACTOR shall promptly either correct all defective Work, whether or not fabricated, installed or completed, or if the Work has been rejected by ENGINEER, remove it from the Site and replace it with non-defective Work. CONTRACTOR shall pay all claims, costs, losses, damages and expenses caused by or resulting from such correction or removal (including, but not limited to all costs of repair or replacement of work of others) and shall take no action that would void or otherwise impair OWNER's special warranty or guarantee, if any, on such Work.

13.07 Guarantee Period

A. If within 1 year after the date of Substantial Completion (or such longer period of time as may be prescribed by Laws or Regulations or by the terms of any applicable special guarantee required by the Contract Documents), or by any specific provision of the Contract Documents, any Work is found to be defective, CONTRACTOR shall promptly, without cost to OWNER and in accordance with OWNER's written instructions:

1. repair defective land or areas;

2. correct such defective Work;

3. if the defective Work has been rejected by OWNER, remove it from the Site and replace it with Work that is not defective, and

4. satisfactorily correct or repair or remove and replace any damage to other Work or the work of others or other land or areas resulting therefrom.

B. If CONTRACTOR does not promptly comply with the terms of such instructions, or in an emergency where delay would cause serious risk of loss or damage, OWNER may have the defective Work corrected or the rejected Work removed and replaced, and all claims, costs, losses, damages and expenses caused by or resulting from such removal and replacement (including but not limited to all costs of repair or replacement or work of others) shall be paid by CONTRACTOR.

C. Repair or replacements made under the guarantee shall bear an additional 1 year guarantee dated from the acceptance of repair or replacement.

13.08 Acceptance of Defective Work

A. If, instead of requiring correction or removal and replacement of defective Work, OWNER (and, prior to ENGINEER'S recommendation of final payment, also ENGINEER) prefers to accept it, OWNER may do so. CONTRACTOR shall pay all claims, costs, losses, damages and expenses attributable to OWNER's evaluation of and determination to accept such defective Work (such costs to be approved by ENGINEER as to reasonableness). In such case, if acceptance occurs prior to ENGINEER's recommendation of final payment, a Change Order shall be issued incorporating the necessary revisions in the Contract Documents with respect to the Work; and OWNER shall be entitled to an appropriate reduction in the Contract Price. If the acceptance occurs after such recommendation, an appropriate amount shall be paid by CONTRACTOR to OWNER.

13.09 Owner May Correct Defective Work

A. If CONTRACTOR fails within a reasonable time after written notice from ENGINEER to correct defective Work, or to remove and replace rejected Work as required by ENGINEER in accordance with paragraph 13.06, or if CONTRACTOR fails to perform the Work in accordance with the Contract Documents (including any requirements of the Progress Schedule), OWNER may, after 48 hours' written notice to CONTRACTOR and his Surety without prejudice to any other remedy he may have, correct and remedy any such deficiency.

B. In exercising his rights and remedies under this paragraph 13.09, OWNER shall proceed expeditiously. To the extent necessary to complete corrective and remedial action, OWNER may exclude CONTRACTOR from all or part of the Site, take possession of all or part of the Work, and suspend CONTRACTOR's services related thereto, take possession of CONTRACTOR's tools, appliances, construction equipment and machinery at the Site and incorporate in the Work all materials and equipment stored at the Site or for which OWNER has paid CONTRACTOR but which are stored elsewhere. CONTRACTOR shall allow OWNER, OWNER's representatives, agents and employees, OWNER's other contractors, and ENGINEER's consultants such access to the Site as may be necessary to enable OWNER to exercise his rights and remedies under this paragraph 13.09.

C. All claims, costs, losses, damages and expenses incurred or sustained by OWNER in exercising such rights and remedies shall be charged against CONTRACTOR and a Change Order shall be issued incorporating the necessary revisions in the Contract Documents with respect to the Work. OWNER shall be entitled to an appropriate reduction in the Contract Price equivalent to such claims, costs, losses, damages and expenses including but not be limited to all costs of repair or replacement of work of others destroyed or damaged by correction, removal or replacement of CONTRACTOR's defective Work.

D. CONTRACTOR shall not be allowed an extension of the Contract Time because of any delay in performance of the Work attributable to the exercise by OWNER of OWNER's rights under this Article 13.

Article 14 Payments to Contractor and Completion

14.01 Schedules

A. At least 10 days prior to submitting the first Application for Payment, CONTRACTOR shall submit to ENGINEER a final Schedule of Submittals, and, where applicable, a Schedule of Values for the Work. These schedules shall be satisfactory in form and substance to ENGINEER as provided in Article 2.

B. The Schedule of Values shall include quantities and unit prices aggregating the Contract Price and shall subdivide the Work into component parts. Each unit cost so established shall include its proportionate share of CONTRACTOR's general operating charges such as profit, overhead, supervision, insurance, bond premiums, interest, equipment cost, depreciation and rental, contingencies, expendable tools, equipment and supplies. The total cost of the items and quantities CONTRACTOR lists in the Schedule of Values shall equal the total Contract Price established in the Proposal.

C. The Schedule of Values shall include a complete set of detailed work sheets on bid take off and bid summary covering estimated general conditions expense (field overhead), general overhead, profit mark ups and revisions leading to the final bid amount.

D. When the Schedule of Values is approved by the ENGINEER, it shall become part of the Agreement and shall be used as the basis for CONTRACTOR progress payments.

E. Progress payments based upon Unit Price Work will be based upon the number of units completed.

14.02 Application for Progress Payment

A. At least 20 days before each Application for Payment falls due (but not more often than once a month), CONTRACTOR shall submit to ENGINEER for review an Application for Payment, Contractor's Declaration, Payment Schedule, and updated Progress Schedules indicating the anticipated completion dates of the various stages of the Work and estimated payments during the next 3 months. Contractor's Application for Payment shall be filled out on the form provided in the Contract Documents and signed by CONTRACTOR covering the Work completed as of the date of the Application for Payment and accompanied by such supporting documentation as is required by the Contract Documents and as ENGINEER or OWNER may reasonably require. The Payment Schedule shall be on the form provided in the Contract Documents or in a format acceptable to the ENGINEER or OWNER. On the second and all subsequent payments, partial Waivers of Lien and Sworn Statement shall be required for all Work completed and paid for on previous certificates.

B. If payment is requested on the basis of materials and equipment not incorporated in the Work but delivered and suitably stored at the Site or at another location agreed to in writing, the Application for Payment shall also be accompanied by such data, satisfactory to OWNER, as will establish OWNER's title to the material and equipment and protect OWNER's interest therein, including applicable insurance. A receipted vendor's invoice showing the quantities of materials and the amounts paid will be required and shall accompany the Application for Payment.

C. Retainage with respect to progress payments will be in accordance with paragraph 14.03, and it will be retained until after completion of the entire Work and its final acceptance. When the amount to be retained is reduced to less than 10 percent, CONTRACTOR shall file with OWNER the written consent of the Surety to such reduction and shall furnish an affidavit that all CONTRACTOR's indebtedness by reason of the Contract has been paid.

14.03 Retainage

A. On Contracts with a dollar value of $30,000 and greater or on Contracts that provide for more than 3 progress payments, progress payments and retainage shall be governed by the provisions of any statutes, rules or regulations regarding retention and these are incorporated herein by reference and made a part of this Contract.

B. If there are no statutes, rules, or regulations applicable to retention, retainage shall be 10%, or such an amount as OWNER deems necessary.

14.04 Review of Applications for Progress Payment

A. ENGINEER will, within 10 days after receipt of each Contractor's Application for Payment and Payment Schedule, including each resubmittal, either indicate in writing a recommendation of payment and present an Engineer's Certificate for Payment to OWNER, or may return the Application to CONTRACTOR indicating in writing ENGINEER's reasons for refusing to recommend payment. In the latter case, CONTRACTOR may make the necessary corrections and resubmit the Application.

B. ENGINEER's recommendation of any payment requested in CONTRACTOR's Application for Payment will constitute a representation by ENGINEER to OWNER, based on ENGINEER's review of the Contractor's Application for Payment and Certificate for Payment and the accompanying data and schedules, as an experienced and qualified design professional that to the best of ENGINEER's knowledge, information and belief;

1. the Work has progressed to the point indicated;

2. the quality of the Work is in accordance with the technical aspects of the Contract Documents subject to an evaluation of the Work as a functioning Project upon Substantial Completion, to the results of any subsequent tests called for in the Contract Documents, a final determination of quantities and classifications for any Unit Price Work under paragraph 12.03, and any qualifications stated in the recommendation; and

3. the conditions precedent to CONTRACTOR's being entitled to such payment appear to have been fulfilled in so far as it is ENGINEER's responsibility to observe the Work.

C. However, by recommending any such payment ENGINEER will not thereby be deemed to have represented that:

1. exhaustive or continuous on-Site inspections have been made to check the quality or the quantity of the Work; or

2. involved detailed inspections of the Work beyond the responsibilities specifically assigned to ENGINEER in the Contract; or

3. there may not be other matters or issues between the parties that might entitle CONTRACTOR to be paid additionally by OWNER or entitle OWNER to withhold payment to CONTRACTOR.

D. Neither ENGINEER's review of CONTRACTOR's Work for the purpose of recommending payments nor ENGINEER's recommendation of any payment, including final payment, will impose responsibility on ENGINEER:

1. to supervise, direct or control the Work;

2. for the means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto;

3. for the failure of CONTRACTOR to comply with Laws and Regulations applicable to the furnishing or performance of Work;

4. for any failure of CONTRACTOR to perform or furnish Work in accordance with the Contract Documents;

5. to make any examination to ascertain how or for what purposes CONTRACTOR has used the moneys paid on account of the Contract Price;

6. to determine that title to any Work, materials, or equipment has passed to OWNER free and clear of Liens.

E. ENGINEER may refuse to recommend the whole or any part of any payment if, in ENGINEER's opinion, it would be incorrect to make such representations as stated above to OWNER. ENGINEER may also refuse to recommend any such payment, or, because of subsequently discovered evidence or the results of subsequent inspections or tests, nullify any such payment previously recommended to such extent as may be necessary in ENGINEER's opinion to protect OWNER from loss because:

1. the Work is defective, or completed Work has been damaged requiring correction or replacement;

2. the Contract Price has been reduced because of Change Orders;

3. OWNER has been required to correct defective Work in accordance with paragraph 1309, or has accepted defective Work in accordance with paragraph 13.08;

4. OWNER has been required to remove or remediate a Hazardous Environmental Condition for which CONTRACTOR is responsible;

5. ENGINEER has actual knowledge of the occurrence of any of the events enumerated in paragraph 15.02.

14.05 Payment Becomes Due

A. Thirty (30) days after presentation of the Application for Payment to OWNER with ENGINEER's recommendation, the amount recommended will (subject to the provisions of paragraph 14.05.B) become due, (or only if OWNER is a public agency, within 15 days after OWNER receives the funds which are to be provided by a department or agency of the federal or state government, whichever is later, or in accordance with any time periods required by any applicable statute, rule or regulation) and when due will be paid by OWNER to CONTRACTOR.

B. OWNER may refuse to make payment of the full amount recommended by ENGINEER because:

1. Claims have been made against OWNER based on CONTRACTOR's conduct in the performance or furnishing of the Work, or OWNER has incurred costs, losses, or damages resulting from CONTRACTOR's conduct in the performance or furnishing of the Work, including but not limited to claims, costs, losses, or damages from workplace injuries,

adjacent property damage, non-compliance with Laws and Regulations, and patent infringement;

2. CONTRACTOR has failed to take reasonable and customary measures to avoid damage, delay, disruption, and interference with other work at or adjacent to the Site;

3. CONTRACTOR has failed to provide and maintain required bonds or insurance;

4. OWNER has been required to remove or remediate a Hazardous Environmental Condition for which CONTRACTOR is responsible;

5. OWNER has incurred extra charges or engineering costs related to Submittal reviews, evaluations of proposed substitutes, tests and inspections, or return visits to manufacturing or assembly facilities;

6. The Work is defective, requiring correction or replacement;

7. OWNER has been required to correct defective Work in accordance with paragraph 13.09, or has accepted defective Work pursuant to paragraph 13.08;

8. The Contract Price has been reduced by Change Orders;

9. An event has occurred that would constitute a default by CONTRACTOR and therefore justify a termination for cause;

10. Liquidated or other damages have accrued as a result of CONTRACTOR's failure to achieve Milestones, Substantial Completion, or final completion of the Work;

11. Liens have been filed in connection with the Work, except where CONTRACTOR has delivered a specific bond satisfactory to OWNER to secure the satisfaction and discharge of such Liens;

12. there are other items as set forth in the Contract Documents entitling OWNER to a set off against the amount recommended; or

13. OWNER has actual knowledge of the occurrence of any of the events enumerated in paragraphs 14.04.E.1 through 14.04.E.5.

C. If OWNER refuses to make payment of the full amount recommended by ENGINEER, OWNER will give CONTRACTOR immediate written notice (with a copy to ENGINEER) stating the reasons for such action and promptly pay CONTRACTOR any amount remaining after deduction of the amount so withheld. OWNER shall promptly pay CONTRACTOR the amount so withheld, or any adjustment thereto agreed to by OWNER and CONTRACTOR, when CONTRACTOR corrects, to OWNER's satisfaction, the reasons for such action. The reduction imposed shall be binding on CONTRACTOR unless CONTRACTOR duly submits a Change Proposal contesting the reduction.

D. If it is subsequently determined that OWNER's refusal of payment was not justified, the amount wrongfully withheld shall be treated as an amount due as determined by paragraph 14.05.

14.06 Contractor's Warranty of Title

A. CONTRACTOR warrants and guarantees that title to all Work, materials and equipment covered by any Application for Payment, whether incorporated in the Project or not, will pass to OWNER at the time of payment free and clear of all Liens, claims, security interests and encumbrances (hereafter in these General Conditions referred to as "Liens").

14.07 Substantial Completion

A. When CONTRACTOR considers the entire Work ready for its intended use CONTRACTOR shall notify OWNER and ENGINEER in writing that the entire Work is substantially complete and request that ENGINEER issue a Certificate of Substantial Completion. CONTRACTOR shall at the same time submit to OWNER and ENGINEER an initial draft of punch list items to be completed or corrected before final payment.

B. Promptly after CONTRACTOR's notification, OWNER, CONTRACTOR, and ENGINEER shall make an inspection of the Work to determine the status of completion. If ENGINEER does not consider the Work substantially complete, ENGINEER will notify CONTRACTOR in writing giving the reasons therefor.

C. Once ENGINEER considers the Work substantially complete, ENGINEER will deliver to OWNER a preliminary Certificate of Substantial Completion which shall fix the date of Substantial Completion. ENGINEER shall attach to the certificate a punch list of items to be completed or corrected before final payment. OWNER shall have 7 days after receipt of the preliminary certificate during which to make written objection to ENGINEER as to any provisions of the certificate or attached punch list. If, after considering the objections to the provisions of the preliminary certificate, ENGINEER concludes that the Work is not substantially complete, ENGINEER will, within 14 days after submission of the preliminary certificate to OWNER, notify CONTRACTOR in writing that the Work is not substantially complete, stating the reasons therefore. If OWNER does not object to the provisions of the certificate, or if despite consideration of OWNER's objections ENGINEER concludes that the Work is substantially complete, then ENGINEER will, within said 14 days, execute and deliver to OWNER and CONTRACTOR a final Certificate of Substantial Completion (with a revised punch list of items to be completed or corrected) reflecting such changes from the preliminary certificate as ENGINEER believes justified after consideration of any objections from OWNER.

D. At the time of receipt of the preliminary Certificate of Substantial Completion, OWNER and CONTRACTOR will confer regarding OWNER's use or occupancy of the Work following Substantial Completion, review the builder's risk insurance policy with respect to the end of the builder's risk coverage, and confirm the transition to coverage of the Work under a permanent property insurance policy held by OWNER. Unless OWNER and CONTRACTOR agree otherwise in writing, OWNER shall bear responsibility for security, operation, protection of the Work, property insurance, maintenance, heat, and utilities upon OWNER's use or occupancy of the Work.

E. After Substantial Completion the CONTRACTOR shall promptly begin work on the punch list of items to be completed or corrected prior to final payment. In appropriate cases CONTRACTOR may submit monthly Applications for Payment for completed punch list items, following the progress payment procedures set forth above.

F. OWNER shall have the right to exclude CONTRACTOR from the Site after the date of Substantial Completion subject to allowing CONTRACTOR reasonable access to remove its property and complete or correct items on the punch list.

14.08 Partial Utilization

A. Use by OWNER of completed portions of the Work may be accomplished prior to Substantial Completion of all the Work subject to the following:

1. OWNER at any time may request CONTRACTOR in writing to permit OWNER to use any part of the Work which OWNER believes to be substantially complete and which may be so used without significant interference with construction of the other parts of the Work. If CONTRACTOR agrees, CONTRACTOR will certify to OWNER and ENGINEER that said part of the Work is substantially complete and request ENGINEER to issue a certificate of Substantial Completion for that part of the Work. Within a reasonable time thereafter OWNER, CONTRACTOR and ENGINEER shall make an inspection of that part of the Work to determine its status of completion.

    a. If ENGINEER does not consider that part of the Work to be substantially complete, ENGINEER will notify OWNER and CONTRACTOR in writing giving his reasons therefor.

    b. If ENGINEER considers that part of the Work to be substantially complete, ENGINEER will execute and deliver to OWNER and CONTRACTOR a certificate to that effect, fixing the date of Substantial Completion for that part of the Work, attaching thereto a punch list of items to be completed or corrected before final payment.

2. Prior to issuing a certificate of Substantial Completion for that part of the Work, ENGINEER will deliver to OWNER and CONTRACTOR a written recommendation as to the division of responsibilities pending final payment between OWNER and CONTRACTOR with respect to security, operation, safety, maintenance, utilities and insurance for that part of the Work, which shall become binding upon OWNER and CONTRACTOR at the time of issuing the definitive certificate of Substantial Completion for that part of the Work unless OWNER and CONTRACTOR shall have otherwise agreed in writing and so informed ENGINEER.

3. OWNER shall have the right to exclude CONTRACTOR from any part of the Work which ENGINEER has so certified to be substantially complete, but OWNER shall allow CONTRACTOR reasonable access to complete or correct items on the punch list.

4. In lieu of the issuance of a certificate of Substantial Completion as to part of the Work, OWNER may take over operation of a facility constituting part of the Work whether or not it is Substantially Complete if such facility is functionally and separately usable; provided that prior to any such takeover, OWNER and CONTRACTOR have agreed as to the division of responsibilities between OWNER and CONTRACTOR for security, operation, safety, maintenance, correction period, heat, utilities and insurance with respect to such facility.

14.09 Final Inspection

A. Upon written notice from CONTRACTOR that the Work is complete, ENGINEER will make a final inspection with OWNER and CONTRACTOR and will notify CONTRACTOR in writing of all particulars in which this inspection reveals that the Work is incomplete or defective. CONTRACTOR shall immediately take such measures as are necessary to complete such Work or remedy such deficiencies.

14.10 Final Application for Payment

A. After CONTRACTOR has completed all corrections to the satisfaction of ENGINEER and delivered all maintenance and operating instructions, schedules, guarantees, Bonds, certificates of inspection, marked up record documents and other documents (all as required by the Contract Documents), and after ENGINEER has indicated that the Work is acceptable, subject to the provisions of paragraph 14.13, CONTRACTOR may make application for final payment following the procedure for progress payments.

B. The final Application for Payment shall be accompanied by all documentation called for in the Contract Documents and such other data and schedules as ENGINEER may reasonably require, consent of Surety, if any, to final payment, together with complete and legally effective releases or waivers, satisfactory to OWNER, of all Liens arising out of or filed in connection with the Work.

C. In lieu of the releases or waivers of Lien, if approved by OWNER, CONTRACTOR may furnish receipts or releases in full; an affidavit of CONTRACTOR that the releases and receipts include all labor, services, material and equipment for which a Lien could be filed, and that all payrolls, material and equipment bills, and other indebtedness connected with the Work for which OWNER or his property might in any way be responsible, have been paid or otherwise satisfied.

D. If any Subcontractor, manufacturer, fabricator, Supplier or distributor fails to furnish a release or receipt in full, CONTRACTOR may furnish a Bond or other collateral satisfactory to OWNER to indemnify OWNER against any Claim or Lien.

14.11 Final Payment and Acceptance

A. If, on the basis of ENGINEER's observation of the Work during construction and final inspection, and ENGINEER's review of the final Application for Payment and accompanying documentation (all as required by the Contract Documents), ENGINEER is satisfied that to the best of ENGINEER’s knowledge, information and belief as a design professional that the Work has been completed and CONTRACTOR has fulfilled all of his obligations under the Contract Documents, ENGINEER will, within 10 days after receipt of the final Application for Payment, indicate in writing ENGINEER’s Certificate for Payment and present the application to OWNER for payment. At that time ENGINEER will give written notice to OWNER and CONTRACTOR that the Work is acceptable subject to the provisions of paragraph 14.13.

B. Otherwise, ENGINEER will return the Application to CONTRACTOR, indicating in writing the reasons for refusing to recommend final payment, in which case CONTRACTOR shall make the necessary corrections and resubmit the Application.

C. If the Application and accompanying documentation are appropriate as to form and substance, OWNER shall, within 45 days (or within the time period required by any applicable statute, rule or regulation) after receipt thereof pay CONTRACTOR the amount recommended by ENGINEER less any amounts of OWNER claimed set-offs allowed under the Contract Documents, including but not limited to any applicable liquidated damages as determined by OWNER. If OWNER rejects the Application, OWNER shall do so in writing stating the appropriate sections of the Contract Documents upon which the rejection is based. CONTRACTOR may take the necessary remedial actions and resubmit the Application.

14.12 Final Completion Delayed

A. If, through no fault of CONTRACTOR, final completion of the Work is significantly delayed, and if ENGINEER so confirms, OWNER shall, upon receipt of CONTRACTOR's final Application for Payment and recommendation of ENGINEER, and without terminating the Agreement, make payment of the balance due for that portion of the Work fully completed and accepted. If the remaining balance to be held by OWNER for Work not fully completed or corrected is less than the retainage stipulated in the Agreement, and if Bonds have been furnished as required in paragraph 5.01, the written consent of the Surety to the payment of the balance due for that portion of the Work fully completed and accepted shall be submitted by CONTRACTOR to ENGINEER with the Application for such payment. Such payment shall be made under the terms and conditions governing final payment, except that it shall not constitute a waiver of Claims.

14.13 Waiver of Claims

A. The making and acceptance of final payment shall constitute:

1. a waiver of all Claims by OWNER against CONTRACTOR, except Claims arising from unsettled Liens, from defective Work appearing after final inspection pursuant to paragraph 14.09, or from failure to comply with the Contract Documents or the terms of any special guarantees specified therein; and shall not constitute a waiver by OWNER of any rights in respect of CONTRACTOR's existing or continuing obligations under the Contract Documents; and,

2. a waiver of all Claims by CONTRACTOR against OWNER other than those previously made in writing and still pending in accordance with Article 16.

14.14 Late Payments

A. All monies not paid when due hereunder, except monies involving Federal and/or State Loans, Grants, or other sources which are delinquent because of no fault of the OWNER, shall bear interest at the maximum rate allowed by law at the time and place of the Project.

Article 15 Suspension of Work and Termination

15.01 Owner May Suspend Work

A. OWNER may, at any time and without cause, suspend the Work or any portion thereof for a period as OWNER may deem necessary by notice in writing to CONTRACTOR and ENGINEER. If it should become necessary to stop work for an indefinite period, CONTRACTOR shall store all materials in such manner that they will not become an obstruction, nor become damaged in any way, and CONTRACTOR shall take every precaution to prevent damage or deterioration of the Work performed; provide suitable drainage by opening ditches and drains, and erect temporary structures where necessary. CONTRACTOR may request an increase in the Contract Price or an extension of the Contract Time, or both, directly attributable to any suspension if he makes a Claim therefor as provided in paragraph 11.01.

15.02 Owner May Terminate for Cause

A. The occurrence of any one or more of the following events will constitute a default by CONTRACTOR and justify termination for cause:

1. CONTRACTOR commences a voluntary case under any chapter of the Bankruptcy Code (Title 11, United States Code), as now or hereafter in effect, or if CONTRACTOR takes any equivalent or similar action by filing a petition or otherwise under any other federal or state law in effect at such time;

2. a petition is filed against CONTRACTOR under any chapter of the Bankruptcy Code as now or hereinafter in effect at the time of filing, or if a petition is filed seeking any such equivalent or similar relief against CONTRACTOR under any other federal or state law in effect at the time relating to bankruptcy or insolvency;

3. CONTRACTOR makes a general assignment for the benefit of creditors;

4. a trustee, receiver, custodian or agent of CONTRACTOR is appointed under applicable law or under contract, whose appointment or authority to take charge of property of CONTRACTOR is for the purpose of enforcing a Lien against such property or for the purpose of general administration of such property for the benefit of CONTRACTOR's creditors;

5. CONTRACTOR admits in writing an inability to pay its debts generally as they become due;

6. CONTRACTOR persistently fails to perform the Work in accordance with the Contract Documents (including, but not limited to, failure to supply sufficient skilled workers or suitable materials or equipment or failure to adhere to the Progress Schedule established under paragraph 2.05 as revised from time to time);

7. CONTRACTOR disregards Laws and Regulations of any public body having jurisdiction;

8. CONTRACTOR disregards the authority of ENGINEER or OWNER; or,

9. CONTRACTOR otherwise violates any provisions of the Contract Documents.

B. OWNER may, after giving CONTRACTOR (and the Surety, if there be one) 7 days' written notice, and to the extent permitted by Laws and Regulations, terminate the services of CONTRACTOR, exclude CONTRACTOR from the Site, take possession of the Work and of all CONTRACTOR's tools, appliances, construction equipment, and machinery at the site and use the same to the full extent they could be used by CONTRACTOR (without liability to CONTRACTOR for trespass or conversion), incorporate in the Work all materials and equipment stored at the Site or for which OWNER has paid CONTRACTOR but which are stored elsewhere, finish the Work as OWNER may deem expedient, and/or enforce the rights available to OWNER under any applicable Performance Bond.

C. In such case, CONTRACTOR shall not be entitled to receive any further payment until the Work is finished. If the unpaid balance of the Contract Price exceeds all claims, costs, losses, damages and expenses sustained by OWNER arising out of or resulting from completing the Work, such excess will be paid to CONTRACTOR. If such claims, costs, losses, damages and expenses exceed such unpaid balance, CONTRACTOR shall pay the difference to OWNER. Such claims, costs, losses, damages and expenses incurred by OWNER will be reviewed as to reasonableness by ENGINEER and when so approved, incorporated in a Change Order, but when exercising any rights or remedies under this paragraph, OWNER shall not be required to obtain the lowest price for the Work performed.

D. Where CONTRACTOR's services have been so terminated by OWNER, the termination shall not affect any rights or remedies of OWNER against CONTRACTOR or its Surety then existing or which may thereafter accrue. Any retention or payment of monies due CONTRACTOR by OWNER will not release CONTRACTOR from liability.

15.03 Termination for Convenience

A. Upon 7 days' written notice to CONTRACTOR and ENGINEER, OWNER may, without cause and without prejudice to any other right or remedy, elect to terminate the Agreement. In such case, CONTRACTOR shall be paid (without duplication of any items):

1. for completed and acceptable Work executed in accordance with the Contract Documents prior to the effective date of termination;

2. for actual expenses sustained prior to the effective date of termination in performing services and furnishing labor, materials or equipment as required by the Contract Documents in connection with uncompleted Work; and

3. for reasonable expenses directly attributable to protecting work as a result of termination.

B. CONTRACTOR shall not be paid on account of loss of anticipated profits or revenue or other economic loss arising out of or resulting from such termination.

C. Upon such termination, CONTRACTOR shall:

1. Immediately discontinue Work on the date and to the extent specified in the notice except to the extent necessary to protect Work in place;

2. Place no further orders for materials, services, or facilities, other than as may be necessary or required for completion of such portion of Work under the Contract that is not terminated;

3. Promptly make every reasonable effort to obtain cancellation upon terms reasonably satisfactory to OWNER of all purchase orders and subcontracts to the extent they relate to the performance of Work terminated or assign to OWNER those orders and subcontracts and revoke agreements specified in such notice;

4. Reasonably assist OWNER, as specifically requested in writing, in the maintenance, protection and disposition of property acquired by OWNER under the Contract Documents, as may be necessary;

5. Complete performance of any Work which is not terminated; and

6. Deliver to OWNER an affidavit regarding the identity of potential unpaid Subcontractors or Suppliers and the amounts due to each.

15.04 Contractor May Stop Work or Terminate

A. If OWNER has failed to pay CONTRACTOR any sum finally determined to be due in accordance with the time limits specified in paragraph 14.05, CONTRACTOR may upon 7 days' written notice to OWNER and ENGINEER, stop the Work until payment of all amounts then due.

B. If through no act or fault of CONTRACTOR, the Work is suspended for a period of more than 90 days by OWNER, or under an order of court or other public authority, then CONTRACTOR may, upon 7 days written notice to OWNER and ENGINEER and provided OWNER or ENGINEER does not remedy such suspension or failure within that time, terminate the Agreement and recover from OWNER payment on the same terms as provided in paragraph 15.03.

C. The provisions of this paragraph 15.04 shall not relieve CONTRACTOR of his obligations under paragraph 6.22 to carry on the Work in accordance with the Progress Schedule and without delay during disputes and disagreements with OWNER.

Article 16 Final Resolution of Disputes

16.01 Methods and Procedures

A. Disputes Subject to Final Resolution: The following disputed matters are subject to final resolution under the provisions of this Article:

1. A timely appeal of an approval in part and denial in part of a Claim, or of a denial in full; and

2. Disputes between OWNER and CONTRACTOR concerning the Work or obligations under the Contract Documents and arising after final payment has been made.

B. Final Resolution of Disputes: For any dispute subject to resolution under this Article, OWNER or CONTRACTOR may:

1. elect in writing to invoke the dispute resolution process provided for in the Supplementary Conditions; or

2. agree with the other party to submit the dispute to another dispute resolution process; or

3. if no dispute resolution process is provided for in the Supplementary Conditions or mutually agreed to, the following dispute resolution process shall be followed:

a. The parties shall submit the dispute to mediation under the mediation procedures outlined in the Construction Industry Arbitration Rules and Mediation Procedures of the American Arbitration Rules.

b. If the dispute is not resolved by mediation, the parties shall proceed to resolve the dispute by arbitration in accordance with the Construction Industry Arbitration Rules and Mediation Procedures of the American Arbitration Association. The decision of the arbitrator(s) shall be final and binding and is enforceable in a court of competent jurisdiction.

Article 17 Miscellaneous

17.01 Giving Notice

A. Whenever any provision of the Contract Documents requires the giving of written notice to OWNER, ENGINEER, or CONTRACTOR, it shall be deemed to have been validly given only if delivered:

1. in person to the individual or to a member of the firm or to an officer of the corporation for whom it is intended;

2. by registered or certified mail postage prepaid to, the last business address known to the giver of the notice;

3. or delivered in person to such person by a commercial courier service or otherwise to the recipient's place of business; or

4. by secure file transfer with receipt documentation or other document control software.

17.02 Computation of Time

A. When any period of time is referred to in the Contract Documents by days, it shall be computed to exclude the first and include the last day of such period. If the last day of any such period falls on a Saturday or Sunday, or on a day made a legal holiday by the Law of the applicable jurisdiction, such day shall be omitted from the computation.

17.03 General

A. The duties and obligations imposed by these General Conditions and the rights and remedies available hereunder to the parties hereto are in addition to, and shall not be construed in any way as a limitation of, any rights and remedies available to any or all of them which are otherwise imposed or available by Law or Regulation, by special warranty or guarantee, or by other provisions of the Contract Documents. The provisions of this paragraph shall be as effective as if repeated specifically in the Contract Documents in connection with each particular duty, obligation, right and remedy to which they apply.

B. All representations, warranties and guarantees made in the Contract Documents shall survive final payment and termination or completion of this Agreement.

17.04 Professional Fees and Court Costs Included

A. Whenever reference is made to "claims, costs, losses, damages and expenses," it shall include in each case, but not be limited to, all fees and charges of engineers, architects, attorneys and other professionals and all court or arbitration or other dispute resolution costs.

17.05 Nondiscrimination of Employment

A. The CONTRACTOR shall covenant and agree not to discriminate against any employee or applicant for employment, to be employed in the performance of this Contract, with respect to his hire, tenure, terms, conditions or privileges of employment, or any matter directly or indirectly related to employment, because of race, color, sex, age, religion, national origin or ancestry, height, weight, or marital status, or any other classification protected by law, and to require a similar covenant on the part of any Subcontractor employed in the performance of the Contract.

17.06 Post Completion Date Engineering and Inspection Costs

A. All engineering and inspection costs incurred after the specified completion date shall be paid by CONTRACTOR to OWNER prior to final payment authorization. However, CONTRACTOR shall not be charged with any post completion date engineering and inspection costs when the delay in completion of the Work is due to the following and CONTRACTOR has promptly given written notice of such delay to OWNER or ENGINEER:

1. to any preference, priority or allocation order duly issued by OWNER;

2. to unforeseeable causes beyond the control and without the fault or negligence of CONTRACTOR, including but not restricted to, acts of God, or of the public enemy, acts of OWNER, acts of another contractor in the performance of a Contract with OWNER, fires, floods, epidemics, quarantine restrictions, strikes, freight embargoes, and abnormal and unforeseeable weather; and,

3. to any delays of Subcontractors or Suppliers occasioned by any of the causes specified in this Article.

B. Charges after the specified completion date shall be made at such times and in such amounts as ENGINEER shall invoice OWNER, provided, however said charges shall be in accordance with ENGINEER's current rate schedule at the time the costs are incurred. Engineering and inspection costs so incurred shall be deducted from CONTRACTOR's progress payments.

17.07 Waiver of Consequential Damages

A. CONTRACTOR and OWNER waive Claims against each other for consequential damages arising out of or relating to this Contract or the Work. This mutual waiver includes but is not limited to:

1. damages incurred by OWNER for rental expenses, for losses of use, income, profit, financing, business and reputation, and for loss of management or employee productivity or of the services of such persons; and

2. damages incurred by CONTRACTOR for principal office expenses including the compensation of personnel stationed there, for losses of financing, business and reputation, and for loss of profit in connection with any other project or anticipated project.

B. This mutual waiver is applicable, without limitation, to all consequential damages due to either party's termination or default. Nothing contained in this Section shall be deemed to preclude an award of liquidated damages, when applicable, in accordance with the requirements of the Contract Documents. CONTRACTOR also waives any Claim for consequential damages against ENGINEER where such Claims arise out of or relate in any way to the Project or the Contract Documents.

17.08 No Waiver

A. A party's non-enforcement of any provision shall not constitute a waiver of that provision, nor shall it affect the enforceability of that provision or of the remainder of this Contract.

17.09 Controlling Law

A. This Contract is to be governed by the Law of the state in which the Project is located.

17.10 Headings

A. Article and paragraph headings are inserted for convenience only and do not constitute parts of these General Conditions.

End of Section

Section 00 7300
Supplementary Conditions

These Supplementary Conditions amend or supplement Section 00 7200, General Conditions, as indicated below. All provisions which are not amended or supplemented by this section remain in full force and effect. The terms used in these Supplementary Conditions have the meanings assigned to them in the General Conditions.

SGC-1.01 Defined Terms

The definition for "Substantial Completion" in Article 1.01 of the General Conditions shall be revised as follows:

> Substantial Completion -- The Work (or a specified part thereof) has progressed to the point where, in the opinion of ENGINEER as evidenced by the Certificate of Substantial Completion, it is sufficiently complete, in accordance with the Contract Documents, so that the Work (or specified part) can be utilized for the purposes for which it was intended; or if no such certificate is issued, when the Work is complete and ready for final payment as evidenced by ENGINEER's written recommendation of final payment in accordance with paragraph 14.11. The terms "substantially complete" and "substantially completed" as applied to all or part of the Work refer to Substantial Completion thereof.

SGC-4.02 Subsurface and Physical Conditions; Investigations and Reports

Add a new paragraph immediately after the first paragraph of paragraphs 4.02 of the General Conditions, which is to read as follows:

> In the preparation of Plans and Specifications, ENGINEER has relied upon the following reports and tests of subsurface and latent physical conditions at the site or otherwise affecting cost, progress or performance of the Work:

SGC-5.03.D Additional Insured

Add the following language at the end of Article 5.03.A.4 of the General Conditions:

A. OWNER's Name: Little Traverse Bay Bands of Odawa Indians

Additional named insured on OWNER's and CONTRACTOR's Protective Policy shall include:

1. Wade Trim, Inc.

SGC-5.04 Limits of Liability

The required limits of liability for insurance coverages requested in Article 5.03 of the General Conditions shall be not less than the following:

SGC-5.04.A Worker's Compensation

Coverage A – Compensation	Statutory
Coverage B – Employer's Liability	
Each Accident	$ 100,000
Disease – Policy Limit	$ 100,000
Disease – Each Employee	$ 100,000

SGC-5.04.B Comprehensive General Liability

General Aggregate	$1,000,000
Products – Com/Ops Aggregate	$1,000,000
Personal and Advertising Injury	$ 500,000
Each Occurrence	$ 500,000
Fire Damage (any one fire)	$ 50,000
Medical Expense (any one person)	$ 5,000

SGC-5.04.C Comprehensive Automobile Liability

Bodily Injury	$ 500,000
Property Damage	$ 200,000
or combined single limit	$1,000,000

SGC-5.04.D OWNER's Protective – Coverage shall be Occurrence Form

General Aggregate	$1,000,000
Each Occurrence	$1,000,000

SGC-5.04.E Builder's Risk-Installation Floater

Cost to Replace at Time of Loss

SGC-5.04.F. Umbrella or Excess Liability $2,000,000

SGC-5.04.G. Railroad Protective Liability – Railroad Coverage

Each Occurrence	$2,000,000
Aggregate	$2,000,000

SGC- 12.04 Lump Sum Work

Add the following new paragraph after Article 12.03 of the General Conditions, which is to read as follows:

12.04 Lump Sum Work

A. When additional work or deletion of work, which is covered by a lump sum item, is required due to a modification, not a normal overrun or underrun in estimated quantities, payment or credit for the work will be based upon apparent unit prices which will be derived by dividing the lump sum price by the estimated plan quantities.

Renumber subsequent paragraphs accordingly.

SGC-16.01 Methods and Procedures

Replace the following language at the end of Article 16.01.B.3.b:

A. Replace "a court of competent jurisdiction" with "the Little Traverse Bay Bands Tribal Court".

SGC-18 Liquidated Damages

Liquidated damages, if applicable, are referenced in the Proposal and Agreement. The requirements for liquidated damages should be included herein.

Article 18 – Liquidated Damages

A. If CONTRACTOR shall fail to Substantially Complete the Work within the Contract Time, or extension of time granted by OWNER, then CONTRACTOR will pay to OWNER the amount for liquidated damages as specified in the Agreement for each calendar day that CONTRACTOR shall be in default after the time stipulated in the Contract Documents. The liquidated damages charged shall be deducted from CONTRACTOR's progress payments.

B. CONTRACTOR shall not be charged with liquidated damages or any excess cost when the delay in Substantial Completion of the Work is due to the following and CONTRACTOR has given written notice of such delay within seven (7) calendar days to OWNER or ENGINEER.

1. To any preference, priority or allocation order duly issued by the OWNER.

2. To unforeseeable causes 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 abnormal and unforeseeable weather; and

3. To any delays of subcontractors occasioned by any of the causes specified in Items A and B of this article.

Housing and Urban Development (HUD) Requirements

The following 2 CFR Part 200 Subpart D and Appendix II to Part 200 are incorporated into the General Conditions where applicable.

End of Section

Title 2 —Grants and Agreements
Subtitle A —Office of Management and Budget Guidance for Grants and Agreements
Chapter II —Office of Management and Budget Guidance
Part 200 —Uniform Administrative Requirements, Cost Principles, and Audit Requirements for Federal Awards
Subpart D —Post Federal Award Requirements

Source: 85 FR 49543, Aug. 13, 2020, unless otherwise noted.
Authority: 31 U.S.C. 503
Source: 78 FR 78608, Dec. 26, 2013, unless otherwise noted.

Procurement Standards

PROCUREMENT STANDARDS

§ 200.317 Procurements by states.

When procuring property and services under a Federal award, a State must follow the same policies and procedures it uses for procurements from its non-Federal funds. The State will comply with §§ 200.321, 200.322, and 200.323 and ensure that every purchase order or other contract includes any clauses required by § 200.327. All other non-Federal entities, including subrecipients of a State, must follow the procurement standards in §§ 200.318 through 200.327.

§ 200.318 General procurement standards.

(a) The non-Federal entity must have and use documented procurement procedures, consistent with State, local, and tribal laws and regulations and the standards of this section, for the acquisition of property or services required under a Federal award or subaward. The non-Federal entity's documented procurement procedures must conform to the procurement standards identified in §§ 200.317 through 200.327.

(b) Non-Federal entities must maintain oversight to ensure that contractors perform in accordance with the terms, conditions, and specifications of their contracts or purchase orders.

(c)

(1) The non-Federal entity must maintain written standards of conduct covering conflicts of interest and governing the actions of its employees engaged in the selection, award and administration of contracts. No employee, officer, or agent may participate in the selection, award, or administration of a contract supported by a Federal award if he or she has a real or apparent conflict of interest. Such a conflict of interest would arise when the employee, officer, or agent, any member of his or her immediate family, his or her partner, or an organization which employs or is about to employ any of the parties indicated herein, has a financial or other interest in or a tangible personal benefit from a firm considered for a contract. The officers, employees, and agents of the non-Federal entity may neither solicit nor accept gratuities, favors, or anything of monetary value from contractors or parties to subcontracts. However, non-Federal entities may set standards for situations in which the financial interest is not substantial or the gift is an unsolicited item of nominal value. The standards of conduct must provide for disciplinary actions to be applied for violations of such standards by officers, employees, or agents of the non-Federal entity.

(2) If the non-Federal entity has a parent, affiliate, or subsidiary organization that is not a State, local government, or Indian tribe, the non-Federal entity must also maintain written standards of conduct covering organizational conflicts of interest. Organizational conflicts of interest means that because of relationships with a parent company, affiliate, or subsidiary organization, the non-Federal entity is unable or appears to be unable to be impartial in conducting a procurement action involving a related organization.

(d) The non-Federal entity's procedures must avoid acquisition of unnecessary or duplicative items. Consideration should be given to consolidating or breaking out procurements to obtain a more economical purchase. Where appropriate, an analysis will be made of lease versus purchase alternatives, and any other appropriate analysis to determine the most economical approach.

(e) To foster greater economy and efficiency, and in accordance with efforts to promote cost-effective use of shared services across the Federal Government, the non-Federal entity is encouraged to enter into state and local intergovernmental agreements or inter-entity agreements where appropriate for procurement or use of common or shared goods and services. Competition requirements will be met with documented procurement actions using strategic sourcing, shared services, and other similar procurement arrangements.

(f) The non-Federal entity is encouraged to use Federal excess and surplus property in lieu of purchasing new equipment and property whenever such use is feasible and reduces project costs.

(g) The non-Federal entity is encouraged to use value engineering clauses in contracts for construction projects of sufficient size to offer reasonable opportunities for cost reductions. Value engineering is a systematic and creative analysis of each contract item or task to ensure that its essential function is provided at the overall lower cost.

(h) The non-Federal entity must award contracts only to responsible contractors possessing the ability to perform successfully under the terms and conditions of a proposed procurement. Consideration will be given to such matters as contractor integrity, compliance with public policy, record of past performance, and financial and technical resources. See also § 200.214.

(i) The non-Federal entity must maintain records sufficient to detail the history of procurement. These records will include, but are not necessarily limited to, the following: Rationale for the method of procurement, selection of contract type, contractor selection or rejection, and the basis for the contract price.

(j)

(1) The non-Federal entity may use a time-and-materials type contract only after a determination that no other contract is suitable and if the contract includes a ceiling price that the contractor exceeds at its own risk. Time-and-materials type contract means a contract whose cost to a non-Federal entity is the sum of:

(i) The actual cost of materials; and

(ii) Direct labor hours charged at fixed hourly rates that reflect wages, general and administrative expenses, and profit.

(2) Since this formula generates an open-ended contract price, a time-and-materials contract provides no positive profit incentive to the contractor for cost control or labor efficiency. Therefore, each contract must set a ceiling price that the contractor exceeds at its own risk. Further, the non-Federal entity awarding such a contract must assert a high degree of oversight in order to obtain reasonable assurance that the contractor is using efficient methods and effective cost controls.

(k) The non-Federal entity alone must be responsible, in accordance with good administrative practice and sound business judgment, for the settlement of all contractual and administrative issues arising out of procurements. These issues include, but are not limited to, source evaluation, protests, disputes, and claims. These standards do not relieve the non-Federal entity of any contractual responsibilities under its contracts. The Federal awarding agency will not substitute its judgment for that of the non-Federal entity unless the matter is primarily a Federal concern. Violations of law will be referred to the local, state, or Federal authority having proper jurisdiction.

[85 FR 49543, Aug. 13, 2020, as amended at 86 FR 10440, Feb. 22, 2021]

§ 200.319 Competition.

(a) All procurement transactions for the acquisition of property or services required under a Federal award must be conducted in a manner providing full and open competition consistent with the standards of this section and § 200.320.

(b) In order to ensure objective contractor performance and eliminate unfair competitive advantage, contractors that develop or draft specifications, requirements, statements of work, or invitations for bids or requests for proposals must be excluded from competing for such procurements. Some of the situations considered to be restrictive of competition include but are not limited to:

(1) Placing unreasonable requirements on firms in order for them to qualify to do business;

(2) Requiring unnecessary experience and excessive bonding;

(3) Noncompetitive pricing practices between firms or between affiliated companies;

(4) Noncompetitive contracts to consultants that are on retainer contracts;

(5) Organizational conflicts of interest;

(6) Specifying only a "brand name" product instead of allowing "an equal" product to be offered and describing the performance or other relevant requirements of the procurement; and

(7) Any arbitrary action in the procurement process.

(c) The non-Federal entity must conduct procurements in a manner that prohibits the use of statutorily or administratively imposed state, local, or tribal geographical preferences in the evaluation of bids or proposals, except in those cases where applicable Federal statutes expressly mandate or encourage geographic preference. Nothing in this section preempts state licensing laws. When contracting for architectural and engineering (A/E) services, geographic location may be a selection criterion provided its application leaves an appropriate number of qualified firms, given the nature and size of the project, to compete for the contract.

(d) The non-Federal entity must have written procedures for procurement transactions. These procedures must ensure that all solicitations:

(1) Incorporate a clear and accurate description of the technical requirements for the material, product, or service to be procured. Such description must not, in competitive procurements, contain features which unduly restrict competition. The description may include a statement of the qualitative nature of the material, product or service to be procured and, when necessary, must set forth those minimum essential characteristics and standards to which it must conform if it is to satisfy its intended use. Detailed product specifications should be avoided if at all possible. When it is impractical or uneconomical to make a clear and accurate description of the technical requirements, a "brand name or equivalent" description may be used as a means to define the performance or other salient requirements of procurement. The specific features of the named brand which must be met by offers must be clearly stated; and

(2) Identify all requirements which the offerors must fulfill and all other factors to be used in evaluating bids or proposals.

(e) The non-Federal entity must ensure that all prequalified lists of persons, firms, or products which are used in acquiring goods and services are current and include enough qualified sources to ensure maximum open and free competition. Also, the non-Federal entity must not preclude potential bidders from qualifying during the solicitation period.

(f) Noncompetitive procurements can only be awarded in accordance with § 200.320(c).

§ 200.320 Methods of procurement to be followed.

The non-Federal entity must have and use documented procurement procedures, consistent with the standards of this section and §§ 200.317, 200.318, and 200.319 for any of the following methods of procurement used for the acquisition of property or services required under a Federal award or sub-award.

(a) ***Informal procurement methods.*** When the value of the procurement for property or services under a Federal award does not exceed the *simplified acquisition threshold (SAT),* as defined in § 200.1, or a lower threshold established by a non-Federal entity, formal procurement methods are not required. The non-Federal entity may use informal procurement methods to expedite the completion of its transactions and minimize the associated administrative burden and cost. The informal methods used for procurement of property or services at or below the SAT include:

(1) ***Micro-purchases*** —

(i) ***Distribution.*** The acquisition of supplies or services, the aggregate dollar amount of which does not exceed the micro-purchase threshold (See the definition of *micro-purchase* in § 200.1). To the maximum extent practicable, the non-Federal entity should distribute micro-purchases equitably among qualified suppliers.

(ii) ***Micro-purchase awards.*** Micro-purchases may be awarded without soliciting competitive price or rate quotations if the non-Federal entity considers the price to be reasonable based on research, experience, purchase history or other information and documents it files accordingly. Purchase cards can be used for micro-purchases if procedures are documented and approved by the non-Federal entity.

(iii) ***Micro-purchase thresholds.*** The non-Federal entity is responsible for determining and documenting an appropriate micro-purchase threshold based on internal controls, an evaluation of risk, and its documented procurement procedures. The micro-purchase threshold used by the non-Federal entity must be authorized or not prohibited under State, local, or tribal laws or regulations. Non-Federal entities may establish a threshold higher than the Federal threshold established in the Federal Acquisition Regulations (FAR) in accordance with paragraphs (a)(1)(iv) and (v) of this section.

(iv) ***Non-Federal entity increase to the micro-purchase threshold up to $50,000.*** Non-Federal entities may establish a threshold higher than the micro-purchase threshold identified in the FAR in accordance with the requirements of this section. The non-Federal entity may self-certify a threshold up to $50,000 on an annual basis and must maintain documentation to be made available to the Federal awarding agency and auditors in accordance with § 200.334. The self-certification must include a justification, clear identification of the threshold, and supporting documentation of any of the following:

(A) A qualification as a low-risk auditee, in accordance with the criteria in § 200.520 for the most recent audit;

(B) An annual internal institutional risk assessment to identify, mitigate, and manage financial risks; or,

(C) For public institutions, a higher threshold consistent with State law.

(v) ***Non-Federal entity increase to the micro-purchase threshold over $50,000.*** Micro-purchase thresholds higher than $50,000 must be approved by the cognizant agency for indirect costs. The non-federal entity must submit a request with the requirements included in paragraph (a)(1)(iv) of this section. The increased threshold is valid until there is a change in status in which the justification was approved.

(2) ***Small purchases*** —

(i) ***Small purchase procedures.*** The acquisition of property or services, the aggregate dollar amount of which is higher than the micro-purchase threshold but does not exceed the simplified acquisition threshold. If small purchase procedures are used, price or rate quotations must be obtained from an adequate number of qualified sources as determined appropriate by the non-Federal entity.

(ii) ***Simplified acquisition thresholds.*** The non-Federal entity is responsible for determining an appropriate simplified acquisition threshold based on internal controls, an evaluation of risk and its documented procurement procedures which must not exceed the threshold established in the FAR. When applicable, a lower simplified acquisition threshold used by the non-Federal entity must be authorized or not prohibited under State, local, or tribal laws or regulations.

(b) ***Formal procurement methods.*** When the value of the procurement for property or services under a Federal financial assistance award exceeds the SAT, or a lower threshold established by a non-Federal entity, formal procurement methods are required. Formal procurement methods require following documented procedures. Formal procurement methods also require public advertising unless a non-competitive procurement can be used in accordance with § 200.319 or paragraph (c) of this section. The following formal methods of procurement are used for procurement of property or services above the simplified acquisition threshold or a value below the simplified acquisition threshold the non-Federal entity determines to be appropriate:

(1) ***Sealed bids.*** A procurement method in which bids are publicly solicited and a firm fixed-price contract (lump sum or unit price) is awarded to the responsible bidder whose bid, conforming with all the material terms and conditions of the invitation for bids, is the lowest in price. The sealed bids method is the preferred method for procuring construction, if the conditions.

(i) In order for sealed bidding to be feasible, the following conditions should be present:

(A) A complete, adequate, and realistic specification or purchase description is available;

(B) Two or more responsible bidders are willing and able to compete effectively for the business; and

(C) The procurement lends itself to a firm fixed price contract and the selection of the successful bidder can be made principally on the basis of price.

(ii) If sealed bids are used, the following requirements apply:

(A) Bids must be solicited from an adequate number of qualified sources, providing them sufficient response time prior to the date set for opening the bids, for local, and tribal governments, the invitation for bids must be publicly advertised;

(B) The invitation for bids, which will include any specifications and pertinent attachments, must define the items or services in order for the bidder to properly respond;

(C) All bids will be opened at the time and place prescribed in the invitation for bids, and for local and tribal governments, the bids must be opened publicly;

(D) A firm fixed price contract award will be made in writing to the lowest responsive and responsible bidder. Where specified in bidding documents, factors such as discounts, transportation cost, and life cycle costs must be considered in determining which bid is lowest. Payment discounts will only be used to determine the low bid when prior experience indicates that such discounts are usually taken advantage of; and

(E) Any or all bids may be rejected if there is a sound documented reason.

(2) ***Proposals.*** A procurement method in which either a fixed price or cost-reimbursement type contract is awarded. Proposals are generally used when conditions are not appropriate for the use of sealed bids. They are awarded in accordance with the following requirements:

(i) Requests for proposals must be publicized and identify all evaluation factors and their relative importance. Proposals must be solicited from an adequate number of qualified offerors. Any response to publicized requests for proposals must be considered to the maximum extent practical;

(ii) The non-Federal entity must have a written method for conducting technical evaluations of the proposals received and making selections;

(iii) Contracts must be awarded to the responsible offeror whose proposal is most advantageous to the non-Federal entity, with price and other factors considered; and

(iv) The non-Federal entity may use competitive proposal procedures for qualifications-based procurement of architectural/engineering (A/E) professional services whereby offeror's qualifications are evaluated and the most qualified offeror is selected, subject to negotiation of fair and reasonable compensation. The method, where price is not used as a selection factor, can only be used in procurement of A/E professional services. It cannot be used to purchase other types of services though A/E firms that are a potential source to perform the proposed effort.

(c) ***Noncompetitive procurement.*** There are specific circumstances in which noncompetitive procurement can be used. Noncompetitive procurement can only be awarded if one or more of the following circumstances apply:

(1) The acquisition of property or services, the aggregate dollar amount of which does not exceed the micro-purchase threshold (see paragraph (a)(1) of this section);

(2) The item is available only from a single source;

(3) The public exigency or emergency for the requirement will not permit a delay resulting from publicizing a competitive solicitation;

(4) The Federal awarding agency or pass-through entity expressly authorizes a noncompetitive procurement in response to a written request from the non-Federal entity; or

(5) After solicitation of a number of sources, competition is determined inadequate.

§ 200.321 Contracting with small and minority businesses, women's business enterprises, and labor surplus area firms.

(a) The non-Federal entity must take all necessary affirmative steps to assure that minority businesses, women's business enterprises, and labor surplus area firms are used when possible.

(b) Affirmative steps must include:

(1) Placing qualified small and minority businesses and women's business enterprises on solicitation lists;

(2) Assuring that small and minority businesses, and women's business enterprises are solicited whenever they are potential sources;

(3) Dividing total requirements, when economically feasible, into smaller tasks or quantities to permit maximum participation by small and minority businesses, and women's business enterprises;

(4) Establishing delivery schedules, where the requirement permits, which encourage participation by small and minority businesses, and women's business enterprises;

(5) Using the services and assistance, as appropriate, of such organizations as the Small Business Administration and the Minority Business Development Agency of the Department of Commerce; and

(6) Requiring the prime contractor, if subcontracts are to be let, to take the affirmative steps listed in paragraphs (b)(1) through (5) of this section.

§ 200.322 Domestic preferences for procurements.

(a) As appropriate and to the extent consistent with law, the non-Federal entity should, to the greatest extent practicable under a Federal award, provide a preference for the purchase, acquisition, or use of goods, products, or materials produced in the United States (including but not limited to iron, aluminum, steel, cement, and other manufactured products). The requirements of this section must be included in all subawards including all contracts and purchase orders for work or products under this award.

(b) For purposes of this section:

(1) "Produced in the United States" means, for iron and steel products, that all manufacturing processes, from the initial melting stage through the application of coatings, occurred in the United States.

(2) "Manufactured products" means items and construction materials composed in whole or in part of non-ferrous metals such as aluminum; plastics and polymer-based products such as polyvinyl chloride pipe; aggregates such as concrete; glass, including optical fiber; and lumber.

§ 200.323 Procurement of recovered materials.

A non-Federal entity that is a state agency or agency of a political subdivision of a state and its contractors must comply with section 6002 of the Solid Waste Disposal Act, as amended by the Resource Conservation and Recovery Act. The requirements of Section 6002 include procuring only items designated in guidelines of the Environmental Protection Agency (EPA) at 40 CFR part 247 that contain the highest percentage of recovered materials practicable, consistent with maintaining a satisfactory level of competition, where the purchase price of the item exceeds $10,000 or the value of the quantity acquired during the preceding fiscal year exceeded $10,000; procuring solid waste management services in a manner that maximizes energy and resource recovery; and establishing an affirmative procurement program for procurement of recovered materials identified in the EPA guidelines.

§ 200.324 Contract cost and price.

(a) The non-Federal entity must perform a cost or price analysis in connection with every procurement action in excess of the Simplified Acquisition Threshold including contract modifications. The method and degree of analysis is dependent on the facts surrounding the particular procurement situation, but as a starting point, the non-Federal entity must make independent estimates before receiving bids or proposals.

(b) The non-Federal entity must negotiate profit as a separate element of the price for each contract in which there is no price competition and in all cases where cost analysis is performed. To establish a fair and reasonable profit, consideration must be given to the complexity of the work to be performed, the risk borne by the contractor, the contractor's investment, the amount of subcontracting, the quality of its record of past performance, and industry profit rates in the surrounding geographical area for similar work.

(c) Costs or prices based on estimated costs for contracts under the Federal award are allowable only to the extent that costs incurred or cost estimates included in negotiated prices would be allowable for the non-Federal entity under subpart E of this part. The non-Federal entity may reference its own cost principles that comply with the Federal cost principles.

(d) The cost plus a percentage of cost and percentage of construction cost methods of contracting must not be used.

§ 200.325 Federal awarding agency or pass-through entity review.

(a) The non-Federal entity must make available, upon request of the Federal awarding agency or pass-through entity, technical specifications on proposed procurements where the Federal awarding agency or pass-through entity believes such review is needed to ensure that the item or service specified is the one being proposed for acquisition. This review generally will take place prior to the time the specification is incorporated into a solicitation document. However, if the non-Federal entity desires to have the review accomplished after a solicitation has been developed, the Federal awarding agency or pass-through entity may still review the specifications, with such review usually limited to the technical aspects of the proposed purchase.

(b) The non-Federal entity must make available upon request, for the Federal awarding agency or pass-through entity pre-procurement review, procurement documents, such as requests for proposals or invitations for bids, or independent cost estimates, when:

(1) The non-Federal entity's procurement procedures or operation fails to comply with the procurement standards in this part;

(2) The procurement is expected to exceed the Simplified Acquisition Threshold and is to be awarded without competition or only one bid or offer is received in response to a solicitation;

(3) The procurement, which is expected to exceed the Simplified Acquisition Threshold, specifies a “brand name” product;

(4) The proposed contract is more than the Simplified Acquisition Threshold and is to be awarded to other than the apparent low bidder under a sealed bid procurement; or

(5) A proposed contract modification changes the scope of a contract or increases the contract amount by more than the Simplified Acquisition Threshold.

(c) The non-Federal entity is exempt from the pre-procurement review in paragraph (b) of this section if the Federal awarding agency or pass-through entity determines that its procurement systems comply with the standards of this part.

(1) The non-Federal entity may request that its procurement system be reviewed by the Federal awarding agency or pass-through entity to determine whether its system meets these standards in order for its system to be certified. Generally, these reviews must occur where there is continuous high-dollar funding, and third-party contracts are awarded on a regular basis;

(2) The non-Federal entity may self-certify its procurement system. Such self-certification must not limit the Federal awarding agency's right to survey the system. Under a self-certification procedure, the Federal awarding agency may rely on written assurances from the non-Federal entity that it is complying with these standards. The non-Federal entity must cite specific policies, procedures, regulations, or standards as being in compliance with these requirements and have its system available for review.

§ 200.326 Bonding requirements.

For construction or facility improvement contracts or subcontracts exceeding the Simplified Acquisition Threshold, the Federal awarding agency or pass-through entity may accept the bonding policy and requirements of the non-Federal entity provided that the Federal awarding agency or pass-through entity has made a determination that the Federal interest is adequately protected. If such a determination has not been made, the minimum requirements must be as follows:

(a) A bid guarantee from each bidder equivalent to five percent of the bid price. The “bid guarantee” must consist of a firm commitment such as a bid bond, certified check, or other negotiable instrument accompanying a bid as assurance that the bidder will, upon acceptance of the bid, execute such contractual documents as may be required within the time specified.

(b) A performance bond on the part of the contractor for 100 percent of the contract price. A “performance bond” is one executed in connection with a contract to secure fulfillment of all the contractor's requirements under such contract.

(c) A payment bond on the part of the contractor for 100 percent of the contract price. A “payment bond” is one executed in connection with a contract to assure payment as required by law of all persons supplying labor and material in the execution of the work provided for in the contract.

§ 200.327 Contract provisions.

The non-Federal entity's contracts must contain the applicable provisions described in appendix II to this part.

Title 2 —Grants and Agreements
Subtitle A —Office of Management and Budget Guidance for Grants and Agreements
Chapter II —Office of Management and Budget Guidance
Part 200 —Uniform Administrative Requirements, Cost Principles, and Audit Requirements for Federal Awards

Source: 85 FR 49543, Aug. 13, 2020, unless otherwise noted.
Source: 85 FR 49539, Aug. 13, 2020, unless otherwise noted.
Authority: 31 U.S.C. 503
Source: 78 FR 78608, Dec. 26, 2013, unless otherwise noted.

Appendix II to Part 200—Contract Provisions for Non-Federal Entity Contracts Under Federal Awards

In addition to other provisions required by the Federal agency or non-Federal entity, all contracts made by the non-Federal entity under the Federal award must contain provisions covering the following, as applicable.

(A) Contracts for more than the simplified acquisition threshold, which is the inflation adjusted amount determined by the Civilian Agency Acquisition Council and the Defense Acquisition Regulations Council (Councils) as authorized by 41 U.S.C. 1908, must address administrative, contractual, or legal remedies in instances where contractors violate or breach contract terms, and provide for such sanctions and penalties as appropriate.

(B) All contracts in excess of $10,000 must address termination for cause and for convenience by the non-Federal entity including the manner by which it will be effected and the basis for settlement.

(C) Equal Employment Opportunity. Except as otherwise provided under 41 CFR Part 60, all contracts that meet the definition of "federally assisted construction contract" in 41 CFR Part 60–1.3 must include the equal opportunity clause provided under 41 CFR 60–1.4(b), in accordance with Executive Order 11246, "Equal Employment Opportunity" (30 FR 12319, 12935, 3 CFR Part, 1964–1965 Comp., p. 339), as amended by Executive Order 11375, "Amending Executive Order 11246 Relating to Equal Employment Opportunity," and implementing regulations at 41 CFR part 60, "Office of Federal Contract Compliance Programs, Equal Employment Opportunity, Department of Labor."

(D) Davis-Bacon Act, as amended (40 U.S.C. 3141–3148). When required by Federal program legislation, all prime construction contracts in excess of $2,000 awarded by non-Federal entities must include a provision for compliance with the Davis-Bacon Act (40 U.S.C. 3141–3144, and 3146–3148) as supplemented by Department of Labor regulations (29 CFR Part 5, "Labor Standards Provisions Applicable to Contracts Covering Federally Financed and Assisted Construction"). In accordance with the statute, contractors must be required to pay wages to laborers and mechanics at a rate not less than the prevailing wages specified in a wage determination made by the Secretary of Labor. In addition, contractors must be required to pay wages not less than once a week. The non-Federal entity must place a copy of the current prevailing wage determination issued by the Department of Labor in each solicitation. The decision to award a contract or subcontract must be conditioned upon the acceptance of the wage determination. The non-Federal entity must report all suspected or reported violations to the Federal awarding agency. The contracts must also include a provision for compliance with the Copeland "Anti-Kickback" Act (40 U.S.C. 3145), as supplemented by Department of Labor regulations (29 CFR Part

3, "Contractors and Subcontractors on Public Building or Public Work Financed in Whole or in Part by Loans or Grants from the United States"). The Act provides that each contractor or subrecipient must be prohibited from inducing, by any means, any person employed in the construction, completion, or repair of public work, to give up any part of the compensation to which he or she is otherwise entitled. The non-Federal entity must report all suspected or reported violations to the Federal awarding agency.

(E) Contract Work Hours and Safety Standards Act (40 U.S.C. 3701–3708). Where applicable, all contracts awarded by the non-Federal entity in excess of $100,000 that involve the employment of mechanics or laborers must include a provision for compliance with 40 U.S.C. 3702 and 3704, as supplemented by Department of Labor regulations (29 CFR Part 5). Under 40 U.S.C. 3702 of the Act, each contractor must be required to compute the wages of every mechanic and laborer on the basis of a standard work week of 40 hours. Work in excess of the standard work week is permissible provided that the worker is compensated at a rate of not less than one and a half times the basic rate of pay for all hours worked in excess of 40 hours in the work week. The requirements of 40 U.S.C. 3704 are applicable to construction work and provide that no laborer or mechanic must be required to work in surroundings or under working conditions which are unsanitary, hazardous or dangerous. These requirements do not apply to the purchases of supplies or materials or articles ordinarily available on the open market, or contracts for transportation or transmission of intelligence.

(F) Rights to Inventions Made Under a Contract or Agreement. If the Federal award meets the definition of "funding agreement" under 37 CFR § 401.2 (a) and the recipient or subrecipient wishes to enter into a contract with a small business firm or nonprofit organization regarding the substitution of parties, assignment or performance of experimental, developmental, or research work under that "funding agreement," the recipient or subrecipient must comply with the requirements of 37 CFR Part 401, "Rights to Inventions Made by Nonprofit Organizations and Small Business Firms Under Government Grants, Contracts and Cooperative Agreements," and any implementing regulations issued by the awarding agency.

(G) Clean Air Act (42 U.S.C. 7401–7671q.) and the Federal Water Pollution Control Act (33 U.S.C. 1251–1387), as amended—Contracts and subgrants of amounts in excess of $150,000 must contain a provision that requires the non-Federal award to agree to comply with all applicable standards, orders or regulations issued pursuant to the Clean Air Act (42 U.S.C. 7401–7671q) and the Federal Water Pollution Control Act as amended (33 U.S.C. 1251–1387). Violations must be reported to the Federal awarding agency and the Regional Office of the Environmental Protection Agency (EPA).

(H) Debarment and Suspension (Executive Orders 12549 and 12689)—A contract award (see 2 CFR 180.220) must not be made to parties listed on the governmentwide exclusions in the System for Award Management (SAM), in accordance with the OMB guidelines at 2 CFR 180 that implement Executive Orders 12549 (3 CFR part 1986 Comp., p. 189) and 12689 (3 CFR part 1989 Comp., p. 235), "Debarment and Suspension." SAM Exclusions contains the names of parties debarred, suspended, or otherwise excluded by agencies, as well as parties declared ineligible under statutory or regulatory authority other than Executive Order 12549.

(I) Byrd Anti-Lobbying Amendment (31 U.S.C. 1352)—Contractors that apply or bid for an award exceeding $100,000 must file the required certification. Each tier certifies to the tier above that it will not and has not used Federal appropriated funds to pay any person or organization for influencing or attempting to influence an officer or employee of any agency, a member of Congress, officer or employee of Congress, or an employee of a member of Congress in connection with obtaining any Federal contract, grant or any

other award covered by 31 U.S.C. 1352. Each tier must also disclose any lobbying with non-Federal funds that takes place in connection with obtaining any Federal award. Such disclosures are forwarded from tier to tier up to the non-Federal award.

(J) See § 200.323.

(K) See § 200.216.

(L) See § 200.322.

[78 FR 78608, Dec. 26, 2013, as amended at 79 FR 75888, Dec. 19, 2014; 85 FR 49577, Aug. 13, 2020]

Division 01
General Requirements

Section 01 2200
Unit Prices

Part 1 General

1.01 Scope

A. This Section describes the method of measurement and basis of payment for all items of Work included in the Contract and specified in the Proposal. CONTRACTOR shall provide labor, material, tools, equipment and services required to complete the Work specified herein and indicated on the Plans.

B. OWNER WILL MAKE NO ALLOWANCES FOR ITEMS NOT INCLUDED IN THE PROPOSAL.

1.02 Items of the Proposal

PART A – WELL AND WELL HOUSE

Item 1
Mobilization, 5% Max will be paid for at the Contract Unit Price on a Lump Sum basis. Price paid shall be payment in full for labor, material, and equipment necessary for preparatory work and operations, including, but not limited to, those necessary for the movement of personnel, equipment, supplies, and incidentals to the project site; for the establishment of CONTRACTOR's, ENGINEER's, and OWNER's field offices, and other facilities necessary to undertake the work on the project; and for other work and operations which must be performed, or for expenses incurred, prior to beginning work on the various contract items on the project site. It shall also include preconstruction costs, including insurance and bonds, exclusive of bidding costs, which are necessary direct costs to the project and are of a general nature rather than directly attributable to other pay items under the contract. Payment for mobilization will be based upon the following schedule:

Partial Payment Schedule

Percentage of Original Contract Amount Earned	Percentage of Bid Price for Mobilization Allowed
5	50
10	75
25	100

Item 2
Pitless Adapter and Submersible Well Pump will be paid for at the Contract Unit Price on a Lump Sum basis. Price paid shall be payment in full for labor, material, and equipment necessary for installation as shown on the Plans and shall include, but is not limited to, well pump, check valve, pull pipe, support bar, watertight cap with vent, pitless adaptor, submersible cable and all other items of work necessary to complete the job whether specifically mentioned or implied.

Item 3
Galvanized Drop Pipe will be paid for at the Contract Unit Price per Linear Foot. Price paid shall be payment in full for labor, material, and equipment necessary for drop pipe, and shall include, but is not limited to, piping, joining, fittings, guides, and all other items of work necessary to complete the job whether specifically mentioned or implied. Measurement for drop pipe will be taken from bottom of pitless adapter to top of well pump with no deduction for check valve.

Item 4
VFD Control System will be paid for at the Contract Unit Price on a Lump Sum basis. Price paid shall be payment in full for labor, material, and equipment required for furnishing, installing and programming a variable frequency drive controller for the three (3) well pumps and shall include,

but is not limited to, all wiring, connection to well house electrical system, connection to wells, and other items necessary to complete the job, whether specifically mentioned or implied.

Item 5
3-inch HDPE Water Main will be paid for at the Contract Unit Price per Linear Foot. Price paid shall be payment in full for labor, material, and equipment necessary for furnishing and installing water main and shall include, but is not limited to, specials and fittings, excavation, sheeting and bracing, shoring, draining, dewatering, laying, jointing, bedding, testing, disinfecting, backfilling (including backfill with special materials where specified), disposal of excess excavated material, temporary blow-offs, thrust blocks, encasement, barricading, restoration, final cleanup, connections to existing mains and other items necessary to complete the job, whether specifically mentioned or implied.

Item 6
Silt Fence will be paid for at the Contract Unit Price per Linear Foot. Price paid shall be payment in full for labor, material, and equipment required for furnishing, installing, and maintaining silt fence and shall include, but is not limited to, all excavation, preparation, furnishing and installing stakes and posts, connection to posts, trenching and toeing-in, backfilling, maintaining silt fence, removal of silt fence at project completion, protection of existing improvements, miscellaneous restoration and cleanup, and other items necessary to complete the job, whether specifically mentioned or implied.

Item 7
Demolition and Removal of Ex Well House will be paid for at the Contract Unit Price on a Lump Sum basis. Price paid shall be payment in full for labor, material, and equipment required for removal of existing well house structure in compliance with applicable tribal permits, rules and/or regulations and shall include, but is not limited to, excavation, demolition, removal, and disposal of building structures including floors, footings, foundations, above-ground interior and exterior walls, and roof; the removal and disposal of interior/exterior equipment, removal and disposal of interior/exterior mercury-containing materials including fluorescent, high-pressure sodium, mercury vapor, metal halide light bulbs, and thermostats containing a liquid filled capsule; removal and disposal of PCB-containing materials, including capacitors, ballasts, and transformers; removal and disposal of asbestos-containing materials including insulation, drywall, plaster, roofing materials, ceiling tiles, fireproofing material; disconnecting and removal of water, sewer, electric, gas, and telephone connections interior/exterior to building; and other items necessary to complete the job, whether specifically mentioned or implied.

Item 8
Remove Water Main will be paid for at the Contract Unit Price on Lump Sum basis. Price paid shall be payment in full for labor, material, and equipment necessary for removing existing water main and shall include, but is not limited to, all excavation, removal and disposal of existing water main, backfilling, disposal of excess excavated material, final cleanup, and all other items necessary to complete the work, whether specifically mentioned or implied.

Item 9
Well House, Structure and Foundation will be paid for at the Contract Unit Price on a Lump Sum basis. Price paid shall be payment in full for all labor, material, and equipment necessary to furnish and erect the well house building, and shall include, but is not limited to excavation and subgrade preparation, furnishing and installing all building materials and erecting the well house structure including pouring interior concrete floor slab, exterior concrete slabs, installing and grouting masonry blocks, steel reinforcement, exterior walls, sheathing, vinyl siding, roofing, electrical, lighting, valves, gauges, meters, pressure tanks, eyewash station, HVAC equipment, interior piping and fittings, disinfecting, testing, and all other items necessary to complete the job, whether specifically mentioned or implied per the well house building details indicated on sheet S1.0 and S2.0 of the Plans.

Item 10

Well House, Electrical will be paid for at the Contract Unit Price on a Lump Sum basis. Price paid shall be payment in full for all labor, material, and equipment necessary to furnish and install a complete new electrical system for the new wellhouse, new well #1, and also existing wells #2A & #2B. This shall include, but is not limited to, a new/larger electrical service (coordinate with elec. utility) with service rated manual transfer switch and receptacle for a future/portable generator (by Owner); new electrical power distribution system/equipment/circuiting/etc.; new interior/exterior lighting; new power to new well #1 and existing wells #2A & #2B; install new well controls including new well control panel (which will be designed/built by the well contractor and installed by electrical contractor) and new circuits to new/existing well pumps; a new phone service (coordinate with phone utility).

Item 11

Well House, Mechanical HVAC & Plumbing System will be paid for at the Contract Unit Price on a Lump Sum basis. Price paid shall be payment in full for all labor, material, and equipment necessary to furnish and install a complete new mechanical & plumbing system for the new wellhouse. This shall include, but is not limited to, a new electric unit heater/t-stat, new exhaust fan & intake louver/damper controlled by a reverse acting t-stat, new industrial grade dehumidifier, new floor drains and below grade sanitary piping to 5 feet of the building limits, new 3/4" Cold Water with RPZ backflow preventer tapped off water main (downstream of the meter) to new HoseBib (with vacuum breaker).

Item 12

Well House, Valves, Tanks, and Interior Piping will be paid for at the Contract Unit Price on a Lump Sum basis. Price paid shall be payment in full for all labor, material, and equipment necessary to furnish and install all valves, pressures tanks and interior piping within the new well house in accordance with the Plans. This shall include, but is not limited to, hand gate valves, ball valves, piping, pipe fittings, bends, tees, reducers, magnetic flow meter, pressure tanks, gauges, taps, transducer, PRV valve and other items necessary to complete the job, whether specifically mentioned or implied.

Items 13-14

Connection to Ex Water Main, of the size specified, will be paid for at the Contract Unit Price per Each. Price paid shall be payment in full for labor, material, and equipment necessary for connecting new water main to existing water main and shall include, but is not limited to, water main pipe, fittings, adapters, necessary excavation, sheeting and bracing, shoring, draining, dewatering, laying, jointing, bedding, testing, disinfecting, filling, backfilling (including backfill with special materials where specified), disposal of excess backfill and fill material, connection to new water main, capping old water main, thrust blocks, restoration, cleanup, and other items necessary to complete the job, whether specifically mentioned or implied. Connection to existing water main will be measured per each connection made. Connection to existing water main is not paid for separately where a tapping sleeve, valve and well/valve box is being paid for.

Items 15-16

Gate Valve and Valve Box of the size specified in the Plans will be paid for at the Contract Unit Price per Each. Price paid shall be payment in full for labor, material, and equipment necessary for furnishing and installing valve and valve box, and shall include, but is not limited to, valve box, necessary excavation, connection to water main, backfilling, restraints, disposal of excess excavated material, thrust blocks, restoration, cleanup, and all other items necessary to complete the job, whether specifically mentioned or implied. Valves and valve boxes will be measured as units installed.

Items 17-18

Water Main, C-900 PVC of the size specified will be paid for at the Contract Unit Price per Linear Foot. Price paid shall be payment in full for labor, material, and equipment necessary for furnishing and installing water main and shall include, but is not limited to, specials and fittings, excavation, sheeting and bracing, shoring, draining, dewatering, laying, jointing, bedding, testing, disinfecting, backfilling (including backfill with special materials where specified), disposal of excess excavated material, temporary blow-offs, thrust blocks, encasement, barricading, restoration, final cleanup, connections to existing mains and other items necessary to complete the job, whether specifically mentioned or implied.

Item 19

6-inch Sanitary Cleanout, will be paid for at the Contract Unit Price per Each. Price paid shall be payment in full for labor, material, and equipment necessary for furnishing and installing sanitary cleanout per the detail in the Plans.

Item 20

6-inch, Sanitary Sewer, Sched 40 PVC, will be paid for at the Contract Unit Price per Linear Foot. Price paid shall be payment in full for labor, material, and equipment necessary for furnishing and installing sanitary sewer and shall include, but is not limited to, specials and fittings, excavation, sheeting and bracing, shoring, draining, dewatering, laying, jointing, bedding, backfilling, disposal of excess excavated material, and other items necessary to complete the job, whether specifically mentioned or implied.

Item 21

Aggregate Surface Course, Afton Stone, 6-inch, will be paid for at the Contract Unit Price per Square Yard. Price paid shall be payment in full for all labor, material, and equipment necessary for the aggregate surface course, compacted in place, and shall include, but is not limited to, all construction, protection of existing improvements, also compacting and fine grading of base course, also furnishing and applying chemical additives and water, also for barricading, and for all items necessary to complete the job, whether specifically mentioned or implied.

Item 22

Ditching, will be paid for at the Contract Unit Price per Linear Foot. Price paid shall be payment in full for all labor, material, and equipment necessary to construct the ditch section per the Plans and shall include, but is not limited to, all excavation and grading, and for all items necessary to complete the job, whether specifically mentioned or implied.

Item 23

Riprap, Plain, will be paid for at the Contract Unit Price per Square Yard. Price paid shall be payment in full for all labor, material, and equipment necessary for furnishing and placing the riprap over non-woven geotextile fabric and shall include, but is not limited to, all excavation and protection of existing improvements and for all items necessary to complete the job, whether specifically mentioned or implied.

Item 24

Restoration, 3" topsoil, seed, and mulch will be paid for at the Contract Unit Price on a Lump Sum basis. Price paid shall be payment in full for all labor, material, and equipment necessary to restore all areas disturbed by the Contractor as shown in Plans or as determined by ENGINEER, and shall include, but is not limited to all excavation, subgrade preparation, filling, shaping, grading, plowing, discing, raking, disposing of unsuitable material and excess material, furnishing fill and topsoil, placing topsoil, seed, fertilizers, and mulch, rolling, tamping, mowing, maintenance and care, and all items necessary to complete the job, whether specifically mentioned or implied. CONTRACTOR shall restore all areas disturbed by his operations.

PART B – WATER MAIN

Item 1

Mobilization, 5% Max will be paid for at the Contract Unit Price on a Lump Sum basis. Price paid shall be payment in full for labor, material, and equipment necessary for preparatory work and operations, including, but not limited to, those necessary for the movement of personnel, equipment, supplies, and incidentals to the project site; for the establishment of CONTRACTOR's, ENGINEER's, and OWNER's field offices, and other facilities necessary to undertake the work on the project; and for other work and operations which must be performed, or for expenses incurred, prior to beginning work on the various contract items on the project site. It shall also include preconstruction costs, including insurance and bonds, exclusive of bidding costs, which are necessary direct costs to the project and are of a general nature rather than directly attributable to other pay items under the contract. Payment for mobilization will be based upon the following schedule:

Partial Payment Schedule

Percentage of Original Contract Amount Earned	Percentage of Bid Price for Mobilization Allowed
5	50
10	75
25	100

Item 2

Silt Fence will be paid for at the Contract Unit Price per Linear Foot. Price paid shall be payment in full for labor, material, and equipment required for furnishing, installing, and maintaining silt fence and shall include, but is not limited to, all excavation, preparation, furnishing and installing stakes and posts, connection to posts, trenching and toeing-in, backfilling, maintaining silt fence, removal of silt fence at project completion, protection of existing improvements, miscellaneous restoration and cleanup, and other items necessary to complete the job, whether specifically mentioned or implied.

Item 3

Clearing and Grubbing will be paid for at the Contract Unit Price per Acre. Price paid shall be payment in full for labor, material, and equipment necessary for clearing and grubbing and shall include, but is not limited to, cutting, chipping, removing and disposing of trees, stumps, brush, hedges, roots, corduroy, logs, matted roots, other vegetation and debris, also the protection of plant life, existing structures and improvements not designated for removal, also the backfill, backfilling of holes, restoration, and for all items necessary to complete the job, whether specifically mentioned or implied.

Clearing and grubbing will be measured by horizontal area in acres, as specified. The area in acres of clearing and grubbing, within the limits shown on the Plans or authorized by ENGINEER will be computed as the area bounded by the outside line of the trees removed. The length of the clearing and grubbing area will be measured along the road centerline or reference line established by ENGINEER.

Item 4

Sidewalk, Rem, will be paid for at the Contract Unit Price per Square Foot. Price paid shall be payment in full for labor, material, and equipment necessary for the removal of concrete sidewalks, as shown on the Plans or as determined by ENGINEER and shall include, but is not limited to, sawcutting, removal and disposal of unsuitable materials, furnishing, placing and compacting backfill, protection of existing improvements, barricading, and for other items necessary to complete the job, whether specifically mentioned or implied.

Measurement for removal of concrete sidewalks will be determined by field measure of sidewalks removed.

Item 5
Pvmt, Rem, regardless of thickness, will be paid for at the Contract Unit Price per Square Yard. Price paid shall be payment in full for labor, material and equipment necessary for removing bituminous pavement, and shall include, but is not limited to, sawcutting, excavation, protection of existing improvements, removal and disposal of unsuitable material, barricading, miscellaneous restoration or cleanup, and other items necessary to complete the Work, whether specifically mentioned or implied.

Measurement for removal of bituminous pavement will be determined by field measure of bituminous pavement removed.

Items 6-7
Connection to Ex Water Main, of the size specified, will be paid for at the Contract Unit Price per Each. Price paid shall be payment in full for labor, material, and equipment necessary for connecting new water main to existing water main and shall include, but is not limited to, water main pipe, fittings, adapters, necessary excavation, sheeting and bracing, shoring, draining, dewatering, laying, jointing, bedding, testing, disinfecting, filling, backfilling (including backfill with special materials where specified), disposal of excess backfill and fill material, connection to new water main, capping old water main, thrust blocks, restoration, cleanup, and other items necessary to complete the job, whether specifically mentioned or implied. Connection to existing water main will be measured per each connection made. Connection to existing water main is not paid for separately where a tapping sleeve, valve and well/valve box is being paid for.

Item 8
2-inch Corp, Curb Stop and Box will be paid for at the Contract Unit Price per Each. Price paid shall be payment in full for labor, material, and equipment necessary for furnishing and installing corp stop and curb stop and box, and shall include, but is not limited to, saddle, valve, necessary excavation, connection to water main, backfilling, restraints, disposal of excess excavated material, restoration, cleanup, and all other items necessary to complete the job, whether specifically mentioned or implied.

Item 9-10
Gate Valve and Valve Box of the size specified will be paid for at the Contract Unit Price per Each. Price paid shall be payment in full for labor, material, and equipment necessary for furnishing and installing valve and valve box, and shall include, but is not limited to, valve box, necessary excavation, connection to water main, backfilling, restraints, disposal of excess excavated material, thrust blocks, restoration, cleanup, and all other items necessary to complete the job, whether specifically mentioned or implied. Valves and valve boxes will be measured as units installed.

Items 11
2-inch, Water Service Type K Copper, will be paid for at the Contract Unit Price per Linear Foot. Price paid shall be payment in full for labor, material, and equipment necessary for furnishing and installing water service and shall include, but is not limited to, specials and fittings, excavation, sheeting and bracing, shoring, draining, dewatering, laying, jointing, bedding, testing, disinfecting, backfilling (including backfill with special materials where specified), disposal of excess excavated material, temporary blow-offs, thrust blocks, encasement, barricading, restoration, final cleanup, connections to existing mains and other items necessary to complete the job, whether specifically mentioned or implied.

Items 12
6-inch, Water Main, C-900 PVC, of the size specified will be paid for at the Contract Unit Price per Linear Foot. Price paid shall be payment in full for labor, material, and equipment necessary for furnishing and installing water main and shall include, but is not limited to, specials and fittings, excavation, sheeting and bracing, shoring, draining, dewatering, laying, jointing, bedding, testing, disinfecting, backfilling (including backfill with special materials where specified), disposal of excess

excavated material, temporary blow-offs, thrust blocks, encasement, barricading, restoration, final cleanup, connections to existing mains and other items necessary to complete the job, whether specifically mentioned or implied.

Item 13
Yard Hydrant will be paid for at the Contract Unit Price per Each. Price paid shall be payment in full for labor, material, and equipment necessary for furnishing and installing a new yard hydrant per the Plans, and shall include, but is not limited to, 1-inch water service, water shutoff valve, connection into water main, furnishing and installing yard hydrant, backfilling, disposal of excess excavated material, restoration, cleanup, and all other items necessary to complete the job, whether specifically mentioned or implied.

Item 14
Blow-Off Hydrant will be paid for at the Contract Unit Price per Each. Price paid shall be payment in full for labor, material, and equipment necessary for furnishing and installing a new above-grade blow-off hydrant per the Plans, and shall include, but is not limited to, 2-inch water service, water shutoff valve, connection into water main, furnishing and installing blow-off hydrant, backfilling, disposal of excess excavated material, restoration, cleanup, and all other items necessary to complete the job, whether specifically mentioned or implied.

Item 15
Concrete Sidewalk, 4-inch, will be paid for at the Contract Unit Price per Square Foot. Price paid shall be payment in full for labor, material, and equipment necessary for sidewalks and shall include, but is not limited to, excavation, construction, protection of existing improvements, undercutting and backfilling the subgrade, compacting and fine grading subgrade, furnishing, placing, and compacting backfill and subbase, construction of expansion joints, also forming, placing, jointing, finishing and curing the concrete, providing protection against rain and cold weather, barricading, restoration, and other items necessary to complete the job, whether specifically mentioned or implied.

Measurement for sidewalks will be determined by field measure of sidewalks in place.

Item 16
Aggregate Base, 22A, of the type and thickness specified on the Plans, will be paid for at the Contract Unit Price per Ton. Price paid shall be payment in full for labor, material, and equipment necessary for the aggregate base course, compacted in place, and shall include, but is not limited to, excavation, construction, protection of existing improvements, furnishing, placing, and compacting backfill and subbase, also compacting and fine grading subgrade, also furnishing and applying chemical additives and water, also for barricading, and for other items necessary to complete the job, whether specifically mentioned or implied.

Measurement for aggregate base course will be in tons, with the installed tonnage determined by certified delivery tickets submitted to ENGINEER or his duly authorized representative. Delivery tickets shall indicate the scale weight of the material, including chemical additives and moisture content. For material having a moisture content in excess of six (6) percent, the excess over six (6) percent will be deducted from the scale weight of the material when the moisture content is six (6) percent. Material placed to conform to the cross section and width specified on the Plans or as determined by ENGINEER will be paid for at the tonnage basis. If the width of the base course is increased to accommodate CONTRACTOR in placing forms, etc., the additional material installed beyond the width specified on the Plans or as determined by ENGINEER, will be at CONTRACTOR's expense.

Item 17
HMA, Hand Patching, of the type and thickness specified on the Plans, will be paid for at the Contract Unit Price per Ton. Price paid shall be payment in full for labor, material, and equipment

necessary for the bituminous pavement and shall include, but is not limited to, excavation, protection of existing improvements, also compacting and fine grading subgrade, also furnishing, placing and compacting backfill and subbase, also the furnishing, placing, rolling and compacting the various bituminous lifts or courses, also the furnishing and applying of prime and bond coats, barricading, restoration, and for items necessary to complete the job, whether specifically mentioned or implied.

Measurement for bituminous pavement will be in tons, with the installed tonnage determined by certified batch plant delivery tickets submitted to ENGINEER or his duly authorized representative, at the time of placement.

Item 18
Restoration, 3" topsoil, seed, and mulch will be paid for at the Contract Unit Price on a Lump Sum basis. Price paid shall be payment in full for all labor, material, and equipment necessary to restore all areas disturbed by the Contractor as shown in Plans or as determined by ENGINEER, and shall include, but is not limited to all excavation, subgrade preparation, filling, shaping, grading, plowing, discing, raking, disposing of unsuitable material and excess material, furnishing fill and topsoil, placing topsoil, seed, fertilizers, and mulch, rolling, tamping, mowing, maintenance and care, and all items necessary to complete the job, whether specifically mentioned or implied. CONTRACTOR shall restore all areas disturbed by his operations.

Part 2 Products (Not Used)

Part 3 Execution (Not Used)

End of Section

Section 01 3300
Submittal Procedures

Part 1 General

1.01 General Requirements

A. CONTRACTOR shall submit Shop Drawings, product data, and Samples, as required by the individual Specification sections, to ENGINEER for review in accordance with the provisions of General Conditions.

1.02 Progress Schedules

A. CONTRACTOR shall submit one (1) electronic copy in PDF format of Progress Schedules indicating the starting and completion dates of the various stages of the Work and estimated payments to ENGINEER.

1. Proposed Progress Schedules shall be submitted to ENGINEER prior to the pre-construction meeting.

2. CONTRACTOR shall distribute hard copies of the Progress Schedules during the pre-construction meeting for discussion.

3. Progress Schedules shall be updated by CONTRACTOR and submitted electronically (in PDF format) to ENGINEER, as a part of applications for progress payments, through completion of the Work. Failure to update Progress Schedule may be the basis for rejection of Applications for Progress Payments.

1.03 Shop Drawing Schedule

A. CONTRACTOR shall submit one (1) electronic copy in PDF format of the Shop Drawing Schedule indicating the individual items and submission dates to ENGINEER.

1. A preliminary Shop Drawing Schedule in accordance with the requirements in the General Conditions shall be submitted by CONTRACTOR prior to the pre-construction meeting.

2. CONTRACTOR shall distribute hard copies of the Shop Drawing Schedule during the pre-construction meeting for discussion.

3. A final electronic copy of the Shop Drawing Schedule (in PDF format) shall be submitted by CONTRACTOR at least ten (10) days prior to submitting the first Application for a Payment.

1.04 Schedule of Values

A. CONTRACTOR, if applicable, shall submit one (1) electronic copy in PDF format Schedule of Values of the Work to ENGINEER.

1. A preliminary Schedule of Values shall be submitted by CONTRACTOR prior to the pre-construction meeting.

2. CONTRACTOR shall distribute hard copies of the Schedule of Values during the pre-construction meeting for discussion.

3. A final Schedule of Values (in PDF format), prepared in accordance with the General Conditions and presented in sufficient detail to serve as the basis for payments during construction, shall be submitted to ENGINEER for review at least ten (10) days prior to submitting the first Application for Payment.

1.05 Staking Schedule

A. CONTRACTOR shall submit one (1) electronic copy in PDF format of the staking schedule, in accordance with the "Construction Layout" specification section prior to the start of construction.

1. The staking schedule should be updated as outlined in the Specifications and submitted by CONTRACTOR to ENGINEER through completion of the Work.

1.06 Applications for Payment

A. CONTRACTOR shall submit one (1) electronic copy in PDF format Applications for Payment to ENGINEER in accordance with the provisions of Article 14 of the General Conditions.

B. Applications for Payment shall be made on forms provided by or approved by ENGINEER.

1. Sample CONTRACTOR's Application for Payment, Payment Schedule and ENGINEER's Certificate for Payment forms are included in the Contract Documents and can be obtained in digital format from ENGINEER.

C. Copies of these forms, with Project specific information completed by ENGINEER, will be given to CONTRACTOR at the preconstruction meeting or, if applicable, after approval of the final Schedule of Values.

D. CONTRACTOR shall submit a completed Payment Schedule with an executed Contractor's Application for Payment and Contractor's Declaration to ENGINEER not more often than once per month.

E. ENGINEER will certify payments with the use of Engineer's Certificate for Payment.

1.07 Shop Drawings

A. Shop Drawings shall be presented in a clear and thorough manner. Details shall be identified by reference to plan sheet number, detail number if applicable, and Specification section number, and article number.

1.08 Product Data

A. Product Data shall be presented in a clear and thorough manner identified the same as the Shop Drawings. Included with the information shall be performance characteristics and capacities depicting dimensions and clearances required.

B. Manufacturer's standard schematic drawings and diagrams shall be modified to delete information which is not applicable to the Work. Manufacturer's standard information shall be supplemented to provide information specifically applicable to the Work.

1.09 Samples

A. Samples shall be of sufficient size and quantity to clearly illustrate functional characteristics of the product with integrally related parts and attachment devices depicting full range of color, texture and pattern.

1.10 Submission Requirements

A. CONTRACTOR shall make Submittals in accordance with the approved schedule, and in such sequence as to cause no delay in the Work or in the work of any other Contractor. No damages will be awarded, or extension of time granted, due to the Shop Drawing and product data review process.

B. CONTRACTOR shall submit an entire package of Shop Drawings and Product Data information for major items of Work so that ENGINEER can review the package as a unit.

C. CONTRACTOR shall submit one (1) electronic copy in PDF format of Shop Drawings and Product Data information containing the following information at a minimum:

1. Field dimensions clearly identified as such.

2. Relation to adjacent or critical features of the Work or materials.

3. Applicable standards, such as ASTM or Federal Specification Numbers.

4. Identification of deviations from Contract Documents.

5. Identification of revisions on resubmittals.

6. Project Title, Date of Submission, Date of Previous Submission, and Specification Section number.

D. CONTRACTOR shall initial or sign Shop Drawings and Product Data submittals, certifying CONTRACTOR's review and approval of Submittal per the General Conditions; verification of products, field measurements, field construction criteria, and coordination of the information within the submittal with requirements of the Work and of Contract Documents.

E. ENGINEER shall initial or sign Shop Drawings and Product Data submittal and shall indicate the status of the Submittal, or requirements for resubmittal. ENGINEER shall return to CONTRACTOR one (1) electronic copy of the Shop Drawing and/or Product Data submittal (in PDF format) for distribution or for resubmission.

1.11 Engineer's Review

A. Upon receipt of any Submittal defined above, ENGINEER will:

1. Check each for completeness, clarity, correctness, cohesiveness, legibility, and reproducibility.

2. Review each only for general conformity with the Contract Documents as specified in the General Conditions.

B. After review of any Submittal, ENGINEER will appropriately affix a stamp, electronic notation box or other means, signifying the Submittal as having received full consideration and review.

C. The "status" of any such Submittal or portion thereof, as appropriate, will be evidenced by any one or more of the following notations clearly signified by a "X" or other similar mark placed in the box adjacent to the notation:

1. Notations for ENGINEER'S Review:
   - No Exceptions Taken
   - Note Markings
   - Comments Attached
   - Rejected

2. Notations for Response Required by CONTRACTOR:
   - None
   - Confirm
   - Resubmit

D. Notation Meanings:

1. Elements marked "No Exceptions Taken" indicate that CONTRACTOR may commence with construction, fabrication or purchase of such items provided CONTRACTOR.

2. Elements marked "Note Markings" indicate that the CONTRACTOR may commence with construction, fabrication or purchase of such items provided the CONTRACTOR.

   a. Proceeds in strict accordance with ENGINEER's notes and/or required corrections/deletions/additions indicated thereon;

   b. Pending appropriate response by CONTRACTOR as further noted.

3. Elements marked "Comments Attached" indicate that further comments or explanations have been affixed to the Submittal, which may require action(s) by CONTRACTOR as further noted.

4. Elements marked "Rejected" indicate that CONTRACTOR must make the required corrections as shown or noted and resubmit such items to ENGINEER for further review.

5. Elements marked "None" indicate that the Submittal requires no further action by CONTRACTOR.

6. Elements marked "Confirm" require CONTRACTOR to provide affirmation to ENGINEER regarding comments, notes, markings, etc. made by ENGINEER, and to affirm that CONTRACTOR will comply with the comments, notes, markings, etc.

7. Elements marked “Resubmit” indicate that CONTRACTOR may not commence with construction, fabrication or purchase of such items, and that CONTRACTOR must resubmit items for review that comply with the Contract Documents in the event that those originally submitted do not, or with any comments, notes, markings, etc. made by ENGINEER.

1.12 Resubmission Requirements

A. CONTRACTOR shall make all corrections or changes in the Submittals required by ENGINEER and resubmit. CONTRACTOR shall indicate any changes which have been made other than those requested by ENGINEER.

1.13 Manufacturer's Operation and Maintenance Data

A. CONTRACTOR shall submit one (1) electronic copy in PDF format and one (1) bound copy of all operation and maintenance data required per the various Specification sections.

1. Prior to 50% completion of the Project, CONTRACTOR shall have submitted one (1) acceptable copy to ENGINEER for review.

B. Final copies of the operation and maintenance data shall be bound in a suitable number of 3-inch or 4-inch, 3-ring hard cover binders. Permanently imprinted on the cover shall be the words "Manufacturer's Operation and Maintenance Data", Project title, location of the Project, and the date. A table of contents shall be provided in the front of each binder to list the various sections in the manual.

C. The information to be provided in each section of the manual, for each piece of equipment and project component shall include, but not be limited to, detailed equipment drawings; sections cut through all of the major equipment and subassemblies; installation and operational procedures; complete wiring and piping schematics; lubrication materials and procedures; maintenance procedures; and parts lists complete enough to permit identification of parts by nomenclature, manufacturer’s part number and use.

D. At the front of each section a maintenance schedule shall be provided for each piece of equipment in the section.

1. The schedule shall display the daily, weekly, monthly, semi-annual, annual or fraction thereof, lubrication and preventative maintenance required in order to meet warranty conditions and the manufacturer's recommendations for optimum performance and life of the unit.

2. A common schedule format is to be developed and used for all of the sections. Photocopies or reproductions of the manufacturer's literature will not be accepted.

1.14 Audio/Video Route Survey

A. When required in the Summary of Work, Section 01 1100, or the Proposal, CONTRACTOR shall furnish ENGINEER with an "Audio/Video Route Survey" record of the existing conditions prior to the start of construction. CONTRACTOR must enlist the services of a firm having a minimum of one (1) year experience in audio/video recording of construction projects.

B. Prior to beginning the audio/video recording, CONTRACTOR shall review with ENGINEER the Project requirements to ensure that the audio/video is adequate for its intended purpose. OWNER shall have the authority to designate areas for which coverage may be added or omitted. The audio/video recording shall be done prior to placement of materials or equipment on the construction area and furnished one (1) week prior to the pre-construction meeting.

C. Format:

1. Audio/Video route survey shall be submitted in the format(s) as specified in Section 01 1100, Summary of Work.

(1) Audio/video route survey submission shall be on USB media

(2) Format: USB – Video

(3) Video Encoding: Highest available bit rate (6-9 Megabit), 60 fields per second interlaced video

(4) Audio Encoding: Uncompressed stereo wave or stereo Dolby Digital (256 kilobit or better)

(5) Aspect Ratio: 4x3 (720x480 pixels)

(6) No Macrovision or other copy protection encoding. No region code or region code 1.

D. Complete coverage shall include all surface features located within the public right-of-way, easement areas and adjacent private properties up to building line when such properties lie within the zone of influence of construction and will be supported by appropriate audio description made simultaneously with video coverage. Such coverage shall include, but not be limited to, all existing driveways, sidewalks, curbs, ditches, roadways, landscaping, trees, culvert, headwalls, retaining walls, and buildings located within such zone of influence. Video coverage shall be clear enough to identify cracks, depressions, holes and other defects in existing surfaces.

E. Houses and buildings shall be identified visually by house number, when visible, in such a manner that structures of the proposed system can be located by reference. In all instances, however, location shall be identified by audio or visual means at intervals not-to-exceed 100 linear feet (30 m) in the general direction of travel.

F. When conventional wheeled vehicles are used, the distance from the camera lens to the ground shall be not less than 12 feet (3.5 m) to ensure proper perspective. The rate of speed in the general direction of travel of the conveyance used during recording shall not exceed 30 feet/minute (10 m/min). Panning rates and zoom-in, zoom-out rates shall be controlled sufficiently such that stop action during play-back will produce clarity of detail of the object viewed.

G. Video recordings must, by electronic means, display continuously and simultaneously generated transparent digital information in the upper left hand third of the screen to include the date and time of recording, as well as the corresponding engineering stationing numbers as shown on the Contract Drawings.

1. The date information will contain the month, day, and year. For example, mm/dd/yy, and be placed directly below the time information.

2. The time information shall consist of hours, minutes, and seconds, separated by colons. For example, hh:mm:ss.

H. Engineering stationing numbers must be continuous, accurate and correspond to the Project stationing and must include the standard engineering symbols. For example, Station 14+84.

I. Recording shall be done during times of good visibility. No recording shall be done during periods of visible precipitation, or when more than ten (10) percent of the ground area is covered with snow or standing water, unless otherwise authorized by OWNER.

J. In some instances, audio/video coverage may not be suitable for recording necessary details. In such instances, OWNER may specify still photographs to provide coverage. One (1) color photograph shall be provided in accordance with Article 1.15 of this Section with a suitable description of the photograph's location.

K. Any portion of the Audio/Video Route Survey of insufficient quality as determined by ENGINEER shall be redone by CONTRACTOR at no additional cost to OWNER.

L. Each USB shall be properly identified with the Project Title, location, time, and date in a manner acceptable to OWNER.

1.15 Photographs

A. When required in the Summary of Work, Section 01 1100, or the Proposal, Section 00 4243, CONTRACTOR shall furnish ENGINEER with a total of 6 to 10 digital color photographs each month during construction of the Project, unless some other number and times is specified in the Summary of Work.

B. Photos shall be in digital format (i.e., JPEF, TIFF, GIF, PNG or PDF) and shall have a minimum resolution of 300 dpi.

C. The following information shall be placed on the photo itself or embedded in the digital file:

1. Project Title
2. Contract Number
3. Description of photo's content
4. Date and Time of photo

D. CONTRACTOR shall submit photographs monthly along with the Application for Payment as described in Article 14 of the General Conditions.

Part 2 Products (Not Used)

Part 3 Execution (Not Used)

End of Section

Section 01 5000
Temporary Facilities and Controls

Part 1 General

1.01 Site Access and Parking

A. CONTRACTOR shall locate roads, drives, walks and parking facilities to provide uninterrupted access to construction offices, mobilization, Work, storage areas, and other areas required for execution of the Contract. Access drives and parking areas shall be hard surfaced unless otherwise approved by ENGINEER.

B. CONTRACTOR shall maintain driveways a minimum of 15 feet (5 m) wide between and around combustible materials in storage and mobilization areas.

C. CONTRACTOR shall maintain traffic areas as free as possible of excavated materials, construction equipment, products, snow, ice, and debris.

D. CONTRACTOR shall not utilize existing parking facilities for construction personnel or for CONTRACTOR's vehicles or equipment, unless written permission from owner of parking facility is obtained.

1.02 Trucking Route and Public Road Maintenance

A. Prior to the start of construction, CONTRACTOR shall submit for review a schedule and list indicating the streets and roads within the municipality that his equipment will use off the Project site.

B. CONTRACTOR shall comply with all safety requirements, weight restrictions and speed limits.

C. Gravel and dirt roads or streets used shall be maintained by grading, placing dust palliatives and maintenance gravel in sufficient quantities to eliminate dust and maintain traffic.

D. Paved streets shall be maintained in a reasonable state of cleanliness and CONTRACTOR shall remove accumulations of debris, dirt or mud caused by his operations. Removal shall be done in such a manner as to prevent the release of dust. This shall be done at least every day at the close of each day's operation or additionally when requested by ENGINEER.

E. Roads or streets damaged by CONTRACTOR’s operations, shall be repaired or removed and replaced to satisfactions of the agency having jurisdiction at no additional cost to the Project.

F. In order to insure adequate street maintenance and restoration as outlined above, CONTRACTOR may be required to deposit with the Agency having jurisdiction a cash Road Protection Bond.

1. This Bond, if required, will be held in escrow until final release is given by the Agency having jurisdiction. In the event CONTRACTOR fails or neglects to maintain or restore the streets to the satisfaction of the Agency having jurisdiction, the Agency having jurisdiction shall have the required maintenance or restoration work done and the cost incurred shall be deducted from the Road Protection Bond.

2. At the completion of the Project, the Agency having jurisdiction shall return the Road Protection Bond less any monies expended by the Agency having jurisdiction and shall render to CONTRACTOR an accounting of all monies so expended.

G. CONTRACTOR shall not store any equipment, supplies, construction material or excess excavated material on any roads or streets unless otherwise approved by ENGINEER.

1.03 Emergency Access

A. CONTRACTOR shall provide emergency access to property in the vicinity of the construction for police vehicles, fire equipment, ambulances or other emergency vehicles to protect life, health and property. Any areas damaged by emergency vehicles shall be restored by CONTRACTOR at no additional cost to OWNER.

1.04 Private or Public Roads, Sidewalks, and Parking Areas

A. Where public roads, driveways, parking areas and sidewalks are encountered throughout the community, CONTRACTOR shall maintain those portions affected by the construction operations in a passable condition until such time as final restoration of these improvements can be made as specified.

1. If, in the opinion of ENGINEER, the public safety is in danger or the necessity exists for maintaining traffic, ENGINEER may direct that backfilling be completed immediately.

2. In the event that the necessary backfill material and equipment are not available when direction is given for immediate backfill, the trench shall be backfilled with native material to provide for the necessary maintenance of traffic and safety; however, the native material shall be removed within 48 hours and the trench properly backfilled as specified.

B. Where private roads are encountered throughout the community, CONTRACTOR shall maintain those portions affected by its construction operations in a passable condition. These roads shall be maintained by the use of 21A road maintenance gravel, stone or slag.

1. In the event the original subbase has been destroyed, CONTRACTOR shall furnish and install 1-inch to 2-inch (25 to 50 mm) aggregate to stabilize the existing subbase.

2. Upon completion of the construction activities, CONTRACTOR shall shape and regrade these roads leaving them in a condition as good as or better then original, and adequate for normal travel.

1.05 Road Closing

A. No street, road or section thereof shall be closed to through traffic unless otherwise provided for on the Plans, Specifications, or authorized by the agency with jurisdiction over the roads. Prior to closing a street, road, or section thereof, CONTRACTOR shall provide ENGINEER with a copy of a detour plan approved by the agency having jurisdiction over the roads.

B. In the event roads or streets are to be closed, CONTRACTOR shall notify the local fire department, police department, local road authority, ambulance and emergency services, Department of Public Works, public transit authority and public school system daily as to what streets will be partly blocked or closed, the length of time the streets will be blocked

or closed and when the streets will be reopened to traffic. CONTRACTOR shall designate one responsible employee to carry out the requirements of this condition.

C. During the time that the road is closed, CONTRACTOR shall make provision for trash, leaf, and rubbish pickup.

1.06 Maintaining Traffic

A. CONTRACTOR shall provide access for local traffic to property along the Project by means of temporary roads, drives, culverts or other means approved by ENGINEER. CONTRACTOR shall grade, add surfacing materials, and dust palliatives to such temporary roads and drives as necessary for the proper maintenance of traffic.

B. Where the shoulder is used to maintain traffic, the shoulder shall be graded, surfaced, treated for dust, constructed, or reconstructed, as specified herein or as shown on the Plans.

1. If the construction work is suspended due to weather conditions, winter shut down or for any other reason, sufficient labor, materials and equipment shall be ready for immediate use at all times for the proper maintenance of traffic.

2. Surfacing materials and dust palliatives shall be applied at such times and locations and in such amounts as necessary to safely maintain traffic and as determined by ENGINEER.

C. Where shoulders are low, high, soft or rough, adequate provisions shall be taken to inform and protect the traveling public by means such as construction warning signs, barricades, lighted devices, etc. Such shoulder hazards shall be eliminated as soon as practicable.

D. CONTRACTOR shall furnish, erect and maintain all signs, barricades, lights, and traffic regulators, in accordance with the requirements of the current "Michigan Manual of Uniform Traffic Control Devices." Furnish flagmen and watchmen as are necessary to maintain and safeguard traffic along the entire Project.

1. Failure to comply with these requirements may be cause for the OWNER to issue a stop Work Order, which shall remain in effect until all necessary devices are in place and operational.

2. The issuance of a stop Work Order shall not be reason for granting additional compensation or an extension to the Contract Time.

3. Furnishing, installing, and maintaining traffic control devices shall be incidental to the Project unless otherwise provided for in the Proposal.

1.07 Existing Signs

A. No stop sign, traffic control or warning device or sign shall be taken down until the agency having jurisdiction over the roads has been notified and arrangements for the immediate reinstallation has been made.

B. CONTRACTOR shall provide temporary signs, traffic control devices, warning devices, or watchmen continuously from the time the item is removed until it is reinstalled.

C. Signs removed shall be replaced with signs meeting requirements of the agency having jurisdiction over the roads.

1.08 Temporary Electricity and Lighting

A. CONTRACTOR shall be responsible for and pay all costs for the installation and removal of circuit and branch wiring, with area distribution boxes located so that power and lighting is available throughout the construction by the use of construction-type power cords and shall pay all costs of electrical power used.

B. Electrical wiring and distribution shall conform to the National Electrical Code as adopted by the State of Michigan.

1.09 Telephone

A. CONTRACTOR is required by MIOSHA regulations to provide telephone service for contacting emergency services. Such emergency telephone service shall also be available for the use of OWNER and ENGINEER whether or not a field office is required for the Project. Emergency phone numbers are required to be posted per MIOSHA regulations.

B. CONTRACTOR shall pay all costs for installation, maintenance and removal, and service charges for local calls to provide service for his construction site office as well as for ENGINEER's field office. Toll charges for calls relating to Project business shall be at CONTRACTOR'S expense.

1.10 Use of Water

A. CONTRACTOR shall acquire any and all permits, post any bonds and pay all fees required by the local agency having jurisdiction prior to using any hydrant or any other source of water. CONTRACTOR shall reimburse the local community for water consumed during course of the Project at the current rate as set by the agency having jurisdiction.

1.11 Sanitary Provisions

A. CONTRACTOR shall be responsible for installation, maintenance and removal of temporary sanitary facilities per MIOSHA regulations for use of construction personnel including OWNER and ENGINEER. All rules and regulations of the State and local health officials shall be observed, with precautions taken to avoid creating unsanitary conditions.

1.12 Potable Water

A. CONTRACTOR shall furnish a supply of potable water per MIOSHA requirements, available for use of construction personnel including OWNER and ENGINEER.

1.13 Medical Services and First Aid

A. CONTRACTOR shall furnish first aid supplies and a person trained in first aid with a valid first aid certificate, per MIOSHA requirements, available for use of construction personnel including OWNER and ENGINEER. CONTRACTOR shall also furnish a communication system for contacting emergency services. Telephone numbers of the physician, hospital, or emergency services shall be conspicuously posted at the job site.

1.14 Postal Service

A. Several or all residents of this Project area may receive their mail at roadside mailboxes. Since the postal service will not deliver mail to a resident without a mailbox or a mailbox that is not in its proper position, CONTRACTOR shall relocate, replace and repair all

mailboxes and posts in a condition and height acceptable to the post office within 24 hours of the removal.

B. If required, CONTRACTOR shall furnish new posts for the mailboxes if the existing posts are broken or rotted to the extent that they cannot be reused.

C. Mailbox damaged by CONTRACTOR while carrying out his operations or by anyone else while the box is down due to CONTRACTOR's operation, shall be replaced by CONTRACTOR with a new mailbox meeting the postal officials' specifications and the resident's name and address neatly lettered with paint or other acceptable means to the satisfaction of the resident and postal authorities. Cost for relocating mailboxes shall be incidental to the Project unless otherwise specified in the Proposal.

Part 2 Products

2.01 Barricades, Arrow Boards, Temporary Pavement Markings, and Temporary Signs

A. Barricades, Arrow Boards, Temporary Pavement Markings, Temporary Signs, and other traffic control devices shall be in accordance with the current edition of the MDOT Standard Specifications for Construction, and the current edition of the Michigan Manual of Uniform Traffic Control Devices.

Part 3 Execution (Not Used)

End of Section

Section 01 5713
Temporary Erosion and Sediment Control

Part 1 General

1.01 Scope of Work

A. This Section includes furnishing, installing, maintaining, and removing at project completion, Soil Erosion and Sedimentation Control devices. Devices include silt fence, straw bales, turbidity barriers, temporary gravel construction entrance/exits, inlet filters, ditch sediment traps, etc.

1.02 Related Work Specified Elsewhere

A. Section 01 2200: Unit Prices
B. Section 01 8900: Site Construction Performance Requirements
C. Section 31 2200: Grading
D. Section 31 2313: Subgrade Preparation
E. Section 31 2333: Trenching and Backfilling
F. Section 32 9219: Seeding
G. Section 33 1100: Water Utility Distribution Piping
H. Section 33 3000: Sanitary Utility Sewerage Piping

1.03 Reference Standards

A. ASTM - American Society for Testing and Materials

1.04 Requirements of Regulatory Agencies

A. CONTRACTOR, at his expense, shall secure all permits, and post all bonds or deposits required to comply with the "Soil Erosion and Sedimentation Control," requirements, being Part 91 of PA 451 of 1994 as amended and the National Pollution Discharge Elimination System (NPDES) Rules for storm water discharges from construction activity.

B. Comply with requirements of the agency having jurisdiction. OWNER may withhold payment to CONTRACTOR equivalent to any fines resulting from non-compliance with applicable regulations.

1.05 Performance Requirements

A. Employ Best Management Practices as defined by standard EPA 832-R-92-005.

B. Put preventative measures in place as soon as possible after disturbance of surface cover and before precipitation occurs.

C. Control increased storm water runoff due to disturbance of surface cover due to construction activities for this Project.

D. Minimize wind, water, and vehicular erosion of soil on project site due to construction activities for this Project.

E. Prevent runoff into storm and sanitary sewer systems, including open drainage channels, in excess of actual capacity or amount allowed by authorities having jurisdiction, whichever is less. Anticipate runoff volume due to the most extreme short term and 24-hour rainfall event that might occur in 10 years.

F. Prevent erosion of soil and deposition of sediment on other properties caused by water leaving the project site due to construction activities for this Project. Prevent windblown soil from leaving the project site. Comply with fugitive dust ordinances of agencies having jurisdiction. Prevent tracking or flowing of mud and sediment onto public or private roads, sidewalks or pavements outside of the site.

G. Prevent sedimentation of waterways on or off the project site, including rivers, streams, lakes, ponds, open drainage ditches, storm sewers, and sanitary sewers. If sedimentation occurs, install or correct preventative measures immediately at no cost to OWNER. Comply with requirements of agencies having jurisdiction.

H. Maintain temporary preventative measures until permanent measures have been established. Remove temporary measures when permanent measures have been established.

I. If erosion or sedimentation occurs due to non-compliance with these requirements, remove deposited sediment or restore eroded areas at no cost to OWNER.

1.06 Submittals

A. Submit schedule of Soil Erosion and Sedimentation Control activities to agency having jurisdiction. Include events (with days and/or dates of the various activities) for review and approval prior to obtaining a permit.

B. CONTRACTOR must provide evidence of Storm Water Operator license.

Part 2 Products

2.01 Silt Fence

A. Polypropylene geotextile fabric, resistant to common soil chemicals, mildew, and insects; non-biodegradable; in longest lengths possible; meeting the following requirements:

1. Average Opening Size: 30 U.S. Std. Sieve 600 µm), maximum; ASTM D4751.

2. Permittivity: 0.05 sec^{-1}, minimum; ASTM D4491.

3. Ultraviolet Resistance: Retaining at least 70% of tensile strength; ASTM D4355 after 500 hours exposure.

4. Tensile Strength: 100 lb-f (445 N) minimum, in cross-machine direction; 124 lb-f (551 N) minimum in machine direction; ASTM D4632.

5. Elongation: 15 to 30%; ASTM D4632.
6. Tear Strength: 55 lb-f (244 N) minimum; ASTM D4533.

B. Posts shall be 2 by 2-inch (50 mm x 50 mm) cross section hardwood stakes, minimum 3-feet (1.0 m) long.

2.02 Erosion Control Blankets

A. Machine produced blanket with a consistent thickness of evenly distributed straw or coconut fiber as specified. Unless otherwise specified on the Plans, the erosion control blanket shall have the following minimum properties:

1. Double net 100% straw blanket.

2. Top and bottom photodegradable polypropylene netting, 1.64 lbs./1,000 sft. (0.8 kg/ m^2) approximate weight.

3. 100% agricultural straw 0.5 lbs/sy (.27 kg/m^2).

4. Stitch spacing: 1.5 inches (40 mm) on centers.

B. Pegs shall be 6-inch (150 mm) long, hardwood pegs.

2.03 Bonded Fiber Matrix

A. Bonded fiber matrix (BFM) shall consist of long strand, residual, softwood fibers joined together by a high-strength, nontoxic adhesive. BFM shall be 100% biodegradable, and be non-toxic to fish, wildlife, and humans. Upon drying the matrix shall form a high strength, porous and erosion resistant mat that shall not inhibit the germination and growth of plants. BFM shall retain its form despite re-wetting.

B. Bonded fiber matrix shall consist of:

1. Seed and Fertilizer per Section 32 9219, Seeding.

2. Wood Fiber Mulch: Thermo-mechanically defibrated long, softwood fibers manufactured from select northern softwood wood chips.

3. Polyacrylamide Binder: Site specific, fully biodegradable, polyacrylamides (PAM's) binders, with cross-linking long organic jute fibers

C. Materials shall be mixed at the rate of 80 lbs/acre (90 kg/Ha) of PAM binder and 2500 lbs/acre (2800 kg/Ha) of wood fiber mulch.

Part 3 Execution

3.01 Examination

A. Examine site and identify existing features that contribute to erosion resistance; maintain such existing features to the greatest extent possible.

B. Except in areas to be cleared, do not remove, cut, deface, injure or destroy trees or shrubs without ENGINEER's approval. Protect existing trees or shrubs that are to remain and which may be injured, bruised, defaced, or otherwise damaged by construction operations, with suitable fences or other means as approved by ENGINEER.

3.02 Preparation

A. Review the drawings and Storm Water Pollution Prevention Plan (SWPPP).

B. Revise SWPPP as necessary to address potential pollution from site identified after issuance of the SWPPP at no additional cost to Owner.

C. Conduct storm water pre-construction meeting with Site Contractor, all ground-disturbing Subcontractors, site Engineer of record or someone from their office familiar with the site and SWPPP, and state or local agency personnel in accordance with requirements of the special conditions.

D. Schedule work so that the soil surfaces are left exposed for the minimum amount of time. Place permanent soil and sedimentation control measures as soon as practical.

3.03 General

A. Do not discharge excavation ground water to the sanitary sewer, storm sewer, or to rivers, streams, etc. without authorization from the agency having jurisdiction. Construction site runoff will be prevented from entering any storm drain, river, stream, etc. directly by the use of silt fences or other suitable methods. CONTRACTOR shall provide erosion protection of surrounding soils.

B. Sedimentation control devices shall be installed prior to CONTRACTOR beginning Work. Soil erosion and sedimentation control devices shall be maintained in an effective functioning condition at all times during the course of the Work.

C. Immediately bring earthwork to final grade and protect sideslopes and backslopes from erosion. Plan and conduct earthwork to minimize duration of exposure of unprotected soils.

3.04 Installation - General

A. Install silt fences, ditch sediment traps, check dams, inlet filters, temporary gravel construction entrance/exits, turbidity barriers, erosion control blankets and other soil erosion control devices in accordance with the drawings and Storm Water Pollution Prevention Plan, or as may be dictated by site conditions in order to maintain the intent of the specifications and permits.

B. Deficiencies or changes on the drawings or SWPP shall be corrected or implemented as site conditions change. Changes during construction shall be noted in the SWPP and posted on the drawings.

C. OWNER has authority to limit surface area of erodible earth material exposed by clearing and grubbing, excavation, borrow and embankment operations and to direct CONTRACTOR to provide immediate permanent or temporary pollution control measures.

D. Remove temporary control devices after permanent measure are established. Remove and replace temporary control devices if they become ineffective at no additional cost to OWNER.

E. CONTRACTOR shall incorporate permanent erosion control features, paving, permanent slope stabilization, and vegetation into project at earliest practical time to minimize need for temporary controls.

F. CONTRACTOR shall permanently seed and mulch cut slopes as excavation proceeds to extent considered desirable and practical.

3.05 Dust Control

A. Keep dust down at all times, including during non-working periods. Sprinkle or treat, with dust suppressants, the soil at the site, haul roads, and other areas disturbed by operations. Dry power brooming is not permitted.

3.06 Installation of Erosion Control Blankets

A. Erosion control blankets shall be pegged at the pattern and rate as recommended by the manufacturer, however, at a minimum, blankets shall be pegged at the rate of 1.75 pegs per square yard (2pegs/m^2) of blanket, unless otherwise indicated on the plans.

3.07 Application of Bonded Fiber Matrix

A. The slope shall be prepared and graded prior to application of bonded fiber matrix (BFM). Mixture of wood fiber mulch and polyacrylamide binder shall be blended, with the appropriate amount of seed and fertilizer per Section32 9219, Seeding, according to manufacturer's recommendations.

B. BFM shall be hydraulically applied to the soil as a viscous mixture, crating a continuous, three-dimensional blanket that adheres to the soil surface. BFM shall be mixed and applied at the rate as specified in Article 2.06 unless otherwise indicated on the Plans.

C. The resulting coverage must be at least 1/8 inch (3 mm) thick over the entire surface area. BFM shall be applied in two applications from alternate directions to eliminate shadowing and shall be applied when no rain is expected for 12 hours.

3.08 Maintenance

A. Maintain temporary erosion and sedimentation control systems as dictated by site conditions, indicated in the construction documents, or as directed by governing authorities or OWNER to control sediment until final stabilization.

B. CONTRACTOR shall respond to maintenance or additional work ordered by OWNER or governing authorities immediately, but in no case, within not more than 48 hours if required at no additional cost to OWNER.

3.09 Inspection

A. General:

1. CONTRACTOR is responsible to obtain and/or serve as the Certified Operator.

2. Weekly inspections are to be conducted by CONTRACTOR as a minimum, and after every rainfall event. A copy of the inspection report shall be submitted to the agency having jurisdiction, as well as OWNER and ENGINEER.

3. Inspections shall be performed by a person familiar with the site, the nature of the major construction activities, and qualified to evaluate both overall system performance and individual component performance.

4. Inspector must either be someone empowered to implement BMPs in order to increase effectiveness to an acceptable level or someone with the authority to cause such things to happen.

5. Inspector must be certified as a "Storm Water Professional" through the MDEQ storm water training program. Additionally, the inspector shall be properly authorized in accordance with the applicable General Permit to conduct the certified site storm water inspections.

B. Inspection Frequency Reduction:

1. Inspection frequency may be reduced under the following conditions:

a. No active onsite construction activities.

b. Temporary cover has been provided across the entire site and no BMPs remain. Situation: waiting for grass to grow, but grass is dormant.

c. Ground is frozen and/or snow covered.

3.10 Project Completion

A. Remove temporary soil erosion and sedimentation control devices as soon as permanent measures have been established.

End of Section

Section 01 8900
Site Construction Performance Requirements

Part 1 General

1.01 Scope of Work

A. This Section includes general performance requirements for earthwork complete with, reimbursement for crop damage, removal and disposal of structures and obstructions, protection of existing sewers, tiles and mains; protection of existing building and improvements, protection of trees and other types of vegetation, protection of utility lines, requirements for pavement replacement, restoration of driveways and parking areas, restoration of sidewalks, restoration of lawns and disturbed areas, transportation, and disposal of excess excavation.

1.02 Related Work Specified Elsewhere

A. Section 01 5713: Temporary Erosion and Sediment Control
B. Section 31 2200: Grading
C. Section 31 2313: Subgrade Preparation
D. Section 31 2316: Structural Excavation and Backfill
E. Section 31 2333: Trenching and Backfilling
F. Section 32 1313: Concrete Paving
G. Section 32 9219: Seeding

1.03 Reference Standards

A. Unless otherwise specified, the Work for this Section shall conform to the applicable portions of the following Standard Specifications:

1. MDOT - Michigan Department of Transportation Standard Specifications for Construction, latest edition.

1.04 Requirements of Regulatory Agencies

A. CONTRACTOR shall comply with Section01 5713, Temporary Erosion and Sediment Control. CONTRACTOR, at his expense, shall secure all permits, and post all bonds or deposits required to comply with the "Soil Erosion and Sedimentation Control," requirements, being Part 91 of PA 451 of 1994 as amended.

B. CONTRACTOR shall comply with all requirements of the National Pollutant Discharge Elimination System (NPDES) Storm Water Program for Construction Activities, Part 31 of PA 451 of 1994 as amended.

C. CONTRACTOR shall provide, maintain and remove such temporary and/or permanent soil erosion and sedimentation control measures as specified on the Plans or as determined by ENGINEER.

1. Measures shall prevent surface runoff from carrying excavated materials into the waterways, to reduce erosion of the slopes, and to prevent silting in of waterways downstream of the Work.

2. Measures should include provisions to reduce erosion by the wind of all areas stripped of vegetation, including material stockpiles.

1.05 Submittals

A. Written permission for the use of all disposal and borrow sites shall be obtained and copies shall be furnished to ENGINEER.

1.06 Protection of Plant Life

A. Trees, shrubs, and other types of vegetation not within the limits of the Work or not designated on the Plans or by ENGINEER to be removed, shall be carefully protected from damage or injury during the various construction operations.

B. Any tree, shrub or other type of vegetation not designated to be removed but which is damaged by CONTRACTOR's operation shall be repaired or replaced by CONTRACTOR, at his expense, as determined by ENGINEER.

1.07 Protection of Existing Structures and Improvements

A. existing culverts, sewers, drainage structures, manholes, water gate wells, hydrants, water mains, utility poles, overhead lines, underground conduits, underground cables, pavement, or other types of improvements within the construction limits, not designated on the Plans to be removed, shall be carefully protected from damage during the construction operations.

B. Existing structure or improvement not designated to be removed, but which is damaged by CONTRACTOR's operations shall be repaired or replaced by the CONTRACTOR, to the satisfaction of the owner, at his expense.

C. Deposits of dirt or debris in sewers, culverts, tiles, drainage structures, manholes, gate wells, etc. caused by CONTRACTOR shall be cleaned out at the CONTRACTOR’s expense.

1.08 Maintaining Drainage

A. Existing open drains, field and roadway ditches, drainage tile, sewers, enclosed drains, natural and artificial watercourses, surface drainage or any other types of drainage within the limits of the Work shall be maintained and free to discharge during construction.

B. Drainage facility not designated to be abandoned, but which is damaged, or any drainage interrupted by the CONTRACTOR's operation shall be immediately repaired, replaced, or cleared by the CONTRACTOR.

C. Costs incurred shall be incidental to the excavating, backfilling and compacting or grading operations.

Part 2 Products

2.01 Granular Material

A. Bank run sand meeting the requirements of MDOT, Granular Material Class II.

2.02 Aggregate for Shoulders, Parking Areas, Driveways or Roads

A. Crushed Limestone, Natural Aggregate or Slag and meeting the requirements of MDOT Section 902.

Part 3 Execution

3.01 General

A. The various construction operations shall be restricted to the existing right-of-way or the areas indicated on the Plans. If CONTRACTOR requires additional area, CONTRACTOR shall furnish the ENGINEER with written permission obtained from the property owner for any part of the operations he conducts outside of the right-of-way or limits indicated.

3.02 Existing Improvements

A. CONTRACTOR shall expose existing sewers and structures to which the new Work is to be connected and notify ENGINEER of same. ENGINEER will verify the vertical and horizontal locations of the existing system and shall inform CONTRACTOR as to the necessary adjustments required to align the new Work with the existing system.

3.03 Existing Utilities

A. When existing utilities are shown on the Plans, their locations are approximate only, as secured in the field investigation and/or from available public records. CONTRACTOR, prior to the start of construction, shall contact Miss Dig and the public agency or utility having jurisdiction to request the verification of all utilities within the construction area.

B. When existing utility lines, structures or utility poles are encountered during the performance of the Work, CONTRACTOR, at his expense, shall perform his operations in such a manner that the service will be uninterrupted.

C. CONTRACTOR shall expose all existing utility lines prior to any excavation operation, to determine any conflict with the proposed improvement. CONTRACTOR shall be responsible for any relocation required as a result of any conflict of existing utilities shown on the plans, with the proposed improvement.

D. Should it become necessary to move any utility structure, line or pole shown on the Plans or otherwise found necessary to be moved, CONTRACTOR shall make all arrangements with OWNER of the utility for the moving. costs incurred for such moving shall be at CONTRACTOR's expense unless indicated otherwise. However, before disturbing a utility line, structure or pole, CONTRACTOR shall furnish ENGINEER with satisfactory evidence, in writing, that proper arrangements have been made with the owner of the utility.

3.04 Utility Poles

A. CONTRACTOR shall be responsible for any removal or relocation required as a result of any conflict of existing utility poles (including street light poles, guy poles, telephone poles, etc.) with proposed improvements.

B. CONTRACTOR shall make all arrangements for removing or relocating utility poles with the owner of the utility pole.

C. Prior to disturbing any utility pole, CONTRACTOR shall provide ENGINEER with written evidence that proper arrangements have been made with the owner of the utility pole.

D. When required by the Work, CONTRACTOR shall temporarily support poles in the vicinity of the Work at no additional cost to OWNER. Support shall be in accordance with and to the satisfaction of the utility company.

3.05 Existing Sewers, Tile, and Mains

A. Existing sanitary sewers, storm sewers, drain tile, septic tank bed tiles, water mains or building services or leads, that are encountered during the performance of the Work that require relocation or are damaged, shall be restored with new materials equal in quality and type to the materials encountered.

B. New material shall be installed as specified in the Contract Documents and per the requirements of the local agencies. Bedding and backfill material, unless otherwise specified, shall be an approved Class II granular material, compacted to 98% of its maximum unit weight.

C. Seepage bed tile and water mains shall be replaced in accordance with the requirement of the agency having jurisdiction.

D. Relocation or protection of existing sewers, tiles, tile field, water mains or building services and leads shall be at CONTRACTOR's expense, unless otherwise indicated in the Contract Documents.

3.06 Existing Structures

A. Existing surface and subsurface structures may be shown on the Plans, in locations considered most probable from information secured in the field investigation or from available public records.

B. Neither the correctness nor completeness of such information is guaranteed or implied.

C. Structures shall be protected, preserved or restored by CONTRACTOR, to the satisfaction of the structure owner, at no additional cost to the Project.

3.07 Existing Buildings

A. Existing buildings or structures may be encountered throughout the Project within limits of the presently established right-of-way or easement. Good construction methods and procedures shall be employed by CONTRACTOR, at his expense, to protect the structures.

B. When it becomes necessary for CONTRACTOR to move one of these buildings or structures in order to proceed with construction, CONTRACTOR, at his expense, shall exercise all due care in moving the building or structure to prevent undue damage .

C. Prior to moving an existing building or structure, CONTRACTOR shall furnish ENGINEER with satisfactory evidence, in writing, that proper arrangements have been made with the owner.

D. Unless otherwise specified in the Contract Documents, the length of the move shall be maintained to a minimum which will allow for construction of the improvement.

3.08 Removal of Structures

A. Removal of existing structures shall consist of removing and salvaging the existing frame and cover. The ends of the existing pipe shall be plugged and braced. The complete structure shall be removed entirely and disposed of. The excavation shall be backfilled with sand and compacted to 98% of its maximum unit weight. Maximum unit weight shall be determined by ASTM D698, Method B.

B. If a structure is to be removed from a system that is to remain in service, a bypass system, approved by ENGINEER, shall be installed and maintained by the CONTRACTOR, during the rebuilding period.

3.09 Salvaged Material

A. Salvaged materials shall become the property of CONTRACTOR unless otherwise specified in the Contract Documents, and shall be disposed of by CONTRACTOR, at his expense.

3.10 Holes

A. Earth removed during any phase of the excavation or removal operations, resulting in a hole or void, shall be replaced by backfilling to the proposed subgrade with a suitable granular material. Material shall be placed by the controlled density method or other effective means having the approval of ENGINEER and shall be compacted to 95% of maximum unit weight.

B. Furnishing, placing and compacting of the backfill material shall be at CONTRACTOR's expense.

3.11 Restoration of Aggregate Surfaces

A. Shoulders:

1. Shoulder shall be regarded as the area between the edge of pavement and the ditch, or the area within 10 feet of the pavement, whichever is the lesser.

2. Backfilling of trenches in the shoulder area shall be carried to within 5 inches of the existing surface as specified under Trench “A" or Trench "B." The remaining depth shall be backfilled with a minimum of 5 inches of compacted 22A or 23A aggregate with calcium chloride applied, at the rate of 6 pounds per Ton of aggregate .

3. CONTRACTOR, at his expense, shall furnish, place and compact all materials necessary to complete the backfilling and restoration operation within the shoulder area.

B. Driveways and Parking Areas:

1. Aggregate driveway areas shall be regarded as the area from the right-of-way line to the edge of the traveled roadway and shall include the shoulder area.

2. Backfilling of trenches crossing aggregate surfaced driveways and parking areas shall be carried to the bottom of the proposed base course as specified under Trench “B”. The remaining depth shall be backfilled with a minimum of 6 inches of compacted 22A or 23A aggregate, with calcium chloride applied at the rate of 6 pounds per Ton of aggregate.

3. Aggregate surfaced areas beyond the limits of the actual excavation which are disturbed, as determined by ENGINEER, by such operations as temporary storage of materials or passage of equipment, shall be resurfaced, at CONTRACTOR's expense.

    a. Upper 3 inches of disturbed areas shall be removed as necessary to allow the final elevation of the resurfacing course to be at the elevation of the drive or parking area which existed prior to excavation.

    b. Disturbed area shall be resurfaced with a minimum of 3 inches of compacted 22A or 23A aggregate, with calcium chloride applied at the rate of 6 pounds per Ton of aggregate

4. CONTRACTOR, at his expense, shall furnish, place, and compact all materials necessary to complete the backfilling and restoration operations within the driveway and parking area.

C. Roads and Streets:

1. Backfilling of trenches crossing aggregate surfaced roads or streets shall be carried to within 12 inches of the existing surface as specified under Trench "B." The remaining depth shall be backfilled with two 6-inch layers of compacted 22A or 23A aggregate, with calcium chloride applied at the rate of 6 pounds per Ton of aggregate.

2. CONTRACTOR, at his expense, shall furnish, place, and compact all materials necessary to complete the backfilling and restoration operations within the roadway or street area.

3. Also, any settlement of the aggregate surface shall be restored by placing additional aggregate, up to the original grade, and shall be done at the CONTRACTOR's expense.

D. Compaction:

1. Compaction of all aggregate shall be performed by a pneumatic-tired roller or a vibratory compactor until the material forms a stable surface.

3.12 Restoration of Paved Surfaces

A. CONTRACTOR, at his expense, shall provide the materials necessary to complete the backfilling and restoration operations, which shall include furnishing, compacting, forming, placing, rolling, floating, jointing, finishing, curing and providing protection against elements.

B. Restoration of any roadways that are partially damaged shall include a minimum replacement of one (1), full width lane of roadway. The length of replacement shall be at least equal to the width.

C. Concrete:

1. Backfilling of trenches crossing concrete driveways, sidewalks, roads, streets or parking areas shall be carried to the bottom of the proposed pavement as specified under Trench "B"

2. Unless otherwise specified on the Plans or as determined by ENGINEER, the concrete removed shall be replaced with 3,500 psi concrete of the thickness removed and shall include reinforcing equal to the existing, if the existing pavement was reinforced.

a. The construction of concrete pavements shall be in accordance with Section 32 1313, Concrete Paving.

3. Restoration of sidewalks shall also include the construction of sidewalk ramps at the intersection of the curb and shall conform to the current rules and regulations of Act 8, Michigan PA 1973, as amended and to Section 32 1315, Sidewalks and Driveways, and unless otherwise indicated in the Proposal, shall be considered incidental to the Project.

D. Bituminous:

1. Backfilling of trenches crossing bituminous driveways, sidewalks, roads, streets or parking areas shall be carried to the bottom of the base course as specified under Trench "B."

2. Bituminous pavement or bituminous surface course with an aggregate base shall be replaced in accordance with Section 32 1216, Bituminous Paving.

3. Bituminous surfaced areas beyond the limits of the actual excavation which are disturbed by such operations, as temporary storage of materials or passage of equipment, shall be resurfaced with an approved bituminous mixture the same thickness as removed, but in no case less than 2 inches in thickness. Replacement material shall extend to smooth-cut edges, shall be uniform in direction and shall be at an elevation which provides a uniform surface between the undisturbed abutting surfaces.

4. Restoration of any bituminous chip seal shoulders that are damaged or partially damaged, as determined by ENGINEER, shall include complete replacement full width and length (extending a minimum of 25 linear feet beyond the damaged area both ways). Existing bituminous chip seal shoulders shall be brought to proper grade with compacted 22A or 23A aggregate and resurfaced with a double chip seal per Section 32 1216, Bituminous Paving.

3.13 Soil Erosion and Sedimentation Control

A. CONTRACTOR shall comply with the requirements of Section 01 5713, Temporary Erosion and Sediment Control. Prior to commencing any type of earthwork, CONTRACTOR shall obtain a Soil Erosion and Sedimentation Control permit from the local enforcing Agency.

B. CONTRACTOR, at his expense, shall obtain all approvals, secure all permits and post all bonds and deposits required to comply with the Soil Erosion and Sedimentation Control Act, Part 91 of PA 451 of 1994, as amended, and those of the enforcing agency.

C. CONTRACTOR shall provide ENGINEER with a copy of the soil erosion permit issued by the local enforcing agency for the Project, prior to commencing any type of earthwork on the Project.

3.14 Excess Excavation

A. Excess excavation shall be defined as all surplus earth material realized from the construction that is free of brush, roots, stumps, broken concrete, pipe, debris, and other extraneous material.

B. CONTRACTOR, when requested by OWNER, shall transport all excess excavation to a site(s) designated by OWNER.

1. Excess excavation shall be graded by CONTRACTOR to provide positive surface drainage of the site(s).

2. Grading shall be done such that adjacent properties are not damaged or affected. The grading shall include removal of all surface irregularities to provide a smooth surface (± 0.25 foot).

C. When the excess excavation has not been requested by e OWNER, CONTRACTOR shall remove and properly dispose of the material at no additional cost to OWNER.

D. Proper disposal of all excess excavation, including transportation, grading, and protection of adjacent properties shall be considered as a final cleanup item. No additional payment will be made for this item.

E. Brush, roots, stumps, broken concrete, pipe, debris, and other extraneous material from the construction shall become the property of CONTRACTOR, and shall be disposed of per all applicable Laws, rules or regulations. Removal and disposal of this material shall be considered as part of final cleanup. No additional payment will be made for this item.

F. OWNER approval of the final site(s) condition in writing will be required prior to final payment authorization.

End of Section

Division 02
Existing Conditions

Section 02 4100
Selective Demolition

Part 1 General

1.01 Section Includes

A. This section includes the selective removal and subsequent disposal of utilities, pavement, portions of buildings, and other items indicated to be removed

1.02 Description of Work

A. Unless directed otherwise in the Contract Documents, CONTRACTOR shall:

1. Remove and properly dispose of all structures, trash, rubbish, basement walls, floors, foundations, sidewalks, steps and driveways from the specified parcel.

2. Remove fuel tanks, outdoor toilets and septic tanks, cisterns, meter pits, and plug or abandon wells.

3. Remove materials from the demolition site in accordance with federal, state and local regulations.

4. Remove and dispose of appliances and other items that may contain refrigerants in accordance with 40 CFR, Part 82. Appliances and other items that may contain refrigerants include, but are not limited to, refrigerators, freezers, dehumidifiers and portable or central air conditioners.

5. Remove and legally dispose of mercury-containing materials including fluorescent, high-pressure sodium, mercury vapor, metal halide light bulbs, and thermostats containing a liquid filled capsule. PCB-containing materials include capacitors, ballasts, and transformers where the component is contained within a metal jacket and does not have a specific, legible label stating no PCBs are present.

6. Disconnect utility services before demolition.

7. Perform site clearance, grading and restoration.

8. Complete the demolition work in accordance with the plans and these technical specifications and any special provisions included in the Contract Documents.

1.03 Protection of the Public and Properties

A. Littering Streets:

1. CONTRACTOR shall be responsible for removing any demolition debris or mud from any street, alley or right-of-way resulting from the execution of the demolition work. Any cost incurred by OWNER in cleaning up any litter or mud shall be charged to CONTRACTOR and be deducted from funds due for the work.

2. Littering of the site shall not be permitted.

3. Waste materials shall be promptly removed from the site.

B. Street Closure:

1. If it should become necessary to close any traffic lanes, it shall be CONTRACTOR's responsibility to acquire the necessary obstruction permits and to place adequate barricades and warning signs as required the agency having jurisdiction.

2. Street or lane closures shall be coordinated with the appropriate agency having jurisdiction.

C. Protection of the Public by CONTRACTOR:

1. Sidewalks: CONTRACTOR shall be responsible for any damage to public sidewalks abutting or adjacent to the demolition properties resulting from the execution of the demolition work.

a. Cost of repair or replacement shall be considered incidental to the work and CONTRACTOR shall obtain permits and pay fees.

2. Pedestrian Access: It shall be CONTRACTOR's responsibility to place and construct the necessary warning signs, barricades, fencing and temporary pedestrian sidewalks, as directed by ENGINEER; and to maintain alternate pedestrian access for sidewalks around the demolition site.

a. Cost of these items shall be considered incidental to the work.

3. Temporary Fence: Temporary fence shall be erected around areas of excavation, dangerous building(s) or structure(s) to prevent access to the public. Such fence shall be at least four feet high, consistently restrictive from top to grade, and without horizontal openings wider than two inches. Fence shall be erected before demolition and shall not be removed until the hazard is removed.

D. Demolition Hours:

1. CONTRACTOR shall comply with any restrictions to working hours as included in the Contract Documents.

2. CONTRACTOR shall comply with all applicable ordinances and restrictions of the agency having jurisdiction.

E. Noise Pollution:

1. Construction equipment used in conjunction with this project shall be in good repair and adequately muffled. CONTRACTOR shall comply with noise pollution requirements of the agency having jurisdiction.

F. Dust Control:

1. CONTRACTOR shall comply with applicable air pollution control requirements of the agency having jurisdiction.

2. CONTRACTOR shall take appropriate actions to minimize atmospheric pollution.

3. To minimize atmospheric pollution, ENGINEER shall have the authority to require that reasonable precautions be taken to prevent particulate matter from becoming airborne. Such reasonable precautions shall include, but not be limited to:

a. The use of water or chemicals for control of dusts in the demolition of existing buildings or structures, construction operations, the grading of roads, or the clearing of land.

b. Covering, when in motion, open-bodied trucks transporting materials likely to give rise to airborne dusts.

G. Requirements for the Reduction of Fire Hazards:

1. Removal of Material:

a. Before demolition of any part of any building, CONTRACTOR shall remove volatile or flammable materials, such as gasoline, kerosene, benzene, cleaning fluids, paints or thinners in containers, and similar substances.

2. Fire Extinguishing Equipment:

a. CONTRACTOR shall be responsible for having and maintaining the correct type and class of fire extinguisher on site.

b. When a cutting torch or other equipment that might cause a fire is being used, a fire extinguisher shall be placed close at hand for instant use.

3. Fires:

a. No fires of any kind will be permitted in the demolition work area.

4. Hydrants:

a. No material obstructions or debris shall be placed or allowed to accumulate within fifteen feet of any fire hydrant.

b. Fire hydrants shall be accessible at all times.

5. Debris:

a. Debris shall not be allowed to accumulate on roofs, floors, or in areas outside of and around any structure being demolished.

b. Excess debris and materials shall be removed from the site as the work progresses.

6. Telephone Service:

a. CONTRACTOR shall arrange for access to and use of, during working hours, one or more telephones in the vicinity of the work site for the purposes of making calls in case of fire or other emergencies, and shall keep all personnel on the job, and the local emergency response agency informed of the location of such telephones.

b. CONTRACTOR's foreman, or at least one regular member of each shift, shall be charged with the responsibility of promptly calling emergency services when necessary. The same person shall be required to inspect the building and the site frequently for possible fires or fire-producing conditions and to apply appropriate corrective action, particularly at the close of work each day.

H. Protection of Public Utilities:

1. CONTRACTOR shall not damage existing fire hydrants, street lights, traffic signals, power poles, telephone poles, fire alarm boxes, wire cables, pole guys, underground utilities or other appurtenances in the vicinity of the demolition sites.

2. CONTRACTOR shall pay for temporary relocation of utilities, which are relocated at CONTRACTOR's request for his convenience.

I. Protection of Adjacent Property:

1. CONTRACTOR shall not damage or cause to be damaged any public right-of-way, structures, parking lots, drives, streets, sidewalks, utilities, lawns or any other property adjacent to parcels released for demolition whether or not the property is scheduled for future demolition.

2. CONTRACTOR shall provide such sheeting and shoring, fencing, or other temporary barricades, as required, to protect adjacent property during demolition. Care must also be taken to prevent the spread of dust and flying particles toward adjacent properties.

3. CONTRACTOR shall restore existing agricultural drain tiles or roadway subdrains that are cut or removed, including drainable backfill, to original condition

a. Repairs shall be subject to approval by the property owner where applicable, and by ENGINEER.

1.04 Risk of Loss

A. CONTRACTOR shall accept the site in its present condition and shall inspect the site for its character and the type of structures to be demolished.

B. OWNER assumes no responsibility for the condition of existing buildings, structures, and other property within the demolition area, or the condition of the property before or after the solicitation for proposals.

C. No adjustment of proposal price or allowance for any change in conditions that occur after the acceptance of the lowest responsible, responsive proposal will be allowed.

1.05 Property Ownership

A. Title:

1. Property address, legal description, and ownership will be included in the Contract Documents.

2. Upon execution of the contract for the work of demolition and site clearance on all or any part of the demolition area, all rights, title, and interest of OWNER in and to buildings, structures and other property to be demolished and/or removed by CONTRACTOR on part or all of said project area as described in the Contract Documents and contract addenda thereto, shall be deemed to be vested in CONTRACTOR.

B. Land:

1. No property rights, title, or interest of any kind whatsoever, in or to the land or premises upon which such buildings or structures stand, is created, assigned, conveyed, granted, or transferred to CONTRACTOR, or any other person or persons, except only the license and right of entry to remove such buildings and structures in strict accordance with the Contract Documents.

2. CONTRACTOR shall not use the land or premises, or allow any other party to use the land or premises, for any purpose other than activities in direct support of the demolition of the building.

1.06 Vacating of Buildings

A. Structure(s) identified in the Contract Documents shall be vacated before a Notice to Proceed is issued and CONTRACTOR begins work.

B. In case CONTRACTOR finds that any structure is not vacated, CONTRACTOR shall immediately notify ENGINEER and shall not begin demolition or site clearance operations on such property until further directed by ENGINEER.

1. CONTRACTOR's responsibility for such buildings will not begin until ENGINEER issues a Notice to Proceed with the demolition.

2. No claim for extension of time or increase in price will be considered because of occupancy of any buildings.

3. In case such occupancy is prolonged, OWNER reserves the right to delete the structure from the work.

1.07 Release of Buildings

A. The demolition area shall be released to CONTRACTOR upon Award of Contract and Notice to Proceed. Said Notice to Proceed shall give any sequence of the demolition and the portion of work that is available to be released if all areas are not ready at the same time. ENGINEER shall approve any change in the sequence. CONTRACTOR shall have full control of the demolition progress and clearance of the site, subject to the provisions of the Contract Documents.

1.08 Permits and Fees

A. CONTRACTOR shall obtain all the necessary permits and pay all permit fees that are required as a direct result of the demolition work specified herein.

1.09 Submittals

A. The submittals shall be in accordance with Section 01 3300, Submittal Procedures, as well the requirements listed herein.

B. Submittals shall include, but not be limited to, the following:

1. Demolition Schedule:

a. Indicate overall schedule and interruptions required for utility and building services.

b. Indicate demolition and removal sequence.

c. Indicate location of items designated for reuse and OWNER's retention.

d. Indicate location and construction of temporary work.

1.10 Quality Assurance

A. Conform to applicable code for demolition work, dust control, products requiring electrical disconnection and re-connection.

B. Conform to applicable code for procedures when hazardous or contaminated materials are discovered.

C. Obtain required permits from authorities having jurisdiction.

Part 2 Products (Not Used)

Part 3 Execution

3.01 General

A. CONTRACTOR shall be responsible for providing ENGINEER with a minimum of 24 hours advance notification prior to beginning the execution of demolition of any structure.

3.02 Salvage of Demolition Materials

A. CONTRACTOR shall be allowed to salvage demolition materials only from property owned by OWNER. Property ownership will be shown in the Contract Documents.

B. No salvage will be permitted on privately owned property. Privately owned property included for demolition under this contract will be strictly to abate a public nuisance as authorized by the property owner or as directed by the Courts.

1. OWNER has the authority to abate the nuisance, however, OWNER does not have the right to salvage any materials.

2. CONTRACTOR may recycle demolition debris at a licensed or permitted recycling center, however, all other debris must be disposed of at a licensed or permitted disposal facility.

C. CONTRACTOR may salvage demolition materials on properties owned by OWNER as long as demolition is completed within the completion provisions included in the Contract Documents. Buildings, building materials, and equipment resulting from this work shall become the property of CONTRACTOR, and shall be removed from the premises at once. Salvaged material shall be removed immediately from the premises, right-of-way, streets or alleys.

D. OWNER reserves the right to remove salvage items for use by OWNER. These items shall be identified in the Contract Documents or shall be removed by OWNER prior to the issuance of the Notice to Proceed.

3.03 Examination

A. Examine existing equipment and structures indicated to be demolished before demolition.

B. Determine where removals may result in structural deficiency or unplanned building collapse during demolition. Coordinate demolition sequence and procedures to prevent structures from becoming unstable.

C. Determine where demolition may affect structural integrity or weather resistance of adjacent buildings or structures indicated to remain.

1. Identify measures required to protect adjacent buildings and structures from damage.

2. Identify remedial work including patching, repairing, bracing, and other work required to leave buildings and structures indicated to remain in structurally sound and weathertight and watertight condition.

D. Verify hazardous material abatement is complete before beginning demolition, where applicable.

3.04 Demolition and Removals

A. Structural Parts of Buildings:

1. No wall or part thereof shall be permitted to fall outwardly from any building except through chutes or by other controlled means or methods, which will ensure safety and minimize dust, noise and other nuisance.

2. Subject to site restrictions, outside chimneys or outside portions of chimneys shall be raised in advance of general demolition of each building. Any portion of a chimney inside a building shall be razed as soon as it becomes unsupported by reason of removal of other parts of the building.

3. Any part of a building, whether structural, collateral, or accessory, which has become unstable through removal of other parts, shall be removed as soon as practicable, and no such unstable part shall be left free-standing or inadequately braced against all reasonably possible causes of collapse at the end of any day's work.

B. Basements and Foundation Walls:

1. Basement floors, footings, and foundations shall be completely removed from the site unless specifically stated in the special provisions. The basement area is to be inspected and approved by ENGINEER before backfilling is started.

2. CONTRACTOR shall ensure that no basement excavation will remain open and exposed for more than 24 hours.

3. CONTRACTOR shall contact ENGINEER when removal is complete to schedule this basement inspection. Failure to do so may result in re-excavation of the basement area at CONTRACTOR's expense.

C. Concrete Slabs:

1. CONTRACTOR shall remove all concrete slabs, asphalt, surface obstructions, masonry slabs and appurtenances.

D. Retaining Walls:

1. Retaining walls or curbs near the perimeter of parcels shall be removed unless otherwise indicated in the Contract Documents.

2. CONTRACTOR shall employ hand labor or other suitable tools and equipment necessary to complete the work without damage to adjacent public or private property.

3. Where such retaining walls or curbs are removed, the embankment shall be graded to a slope of not greater than 3:1 horizontal: vertical or as directed by ENGINEER.

4. Cost of tree or brush removal due to the removal and grading out of the retaining wall shall be considered incidental and shall be included in pay item for demolition.

E. Fences:

1. Fences, guardrails, bumpers, signs, clotheslines, and similar facilities shall be completely removed from the site, except fences on the apparent boundary between a contract parcel and an improved non-contract parcel shall not be removed unless specifically stated in the special provisions.

2. Posts for support shall be pulled out or dug up so as to be entirely removed.

F. Partially Buried Objects:

1. Piping, posts, reinforcing bars, anchor bolts, railings and other partly buried objects protruding from the ground shall be removed. Remaining void shall be filled with soil and compacted in accordance with these specifications.

G. Vegetation:

1. CONTRACTOR shall remove all dead trees, trees identified for removal, stumps, trees which are not an asset to the property, bushes, vegetation, brush and weeds, whether standing or fallen, unless specifically stated otherwise by ENGINEER.

2. CONTRACTOR shall protect trees not removed from damage by the demolition operation. In the event that CONTRACTOR damages a tree, it shall be repaired or removed by CONTRACTOR as directed by ENGINEER.

H. Fuel Tanks:

1. Fuel tanks, above or below ground, shall be carefully removed and disposed of in a safe manner in accordance with local, state and federal regulations.

a. Fuel tanks, above or below the ground, or tanks which have been used for storage of gasoline, kerosene, benzene, oils or similar volatile materials shall be carefully removed and disposed of in a safe manner.

The time, place and manner of disposal will be as set forth in the Contract Documents.

b. Other tanks or receptacles shall be pumped out or emptied in a safe manner, and then shall be flushed out immediately with water, carbon dioxide or nitrogen gas until they are gas-free when checked with a "Explosimeter" or another equally efficient instrument, before the work of removal is begun. Checking with the "Explosimeter" shall be done in the presence of ENGINEER by competent personnel.

I. Outdoor Toilets and Septic Tanks:

1. Outdoor toilets and septic tanks shall be pumped out by a licensed company.

2. Toilet building or septic tank shall be demolished and removed from the site.

a. Excavation or pit shall be backfilled and compacted in accordance with these specifications.

b. Septic tanks shall be broken up and removed from the site and the excavation filled in accordance with local, state, and federal regulations.

J. Cisterns and Meter Pits:

1. Cisterns and meter pits shall be demolished and removed. Excavations shall be backfilled and compacted in accordance with these specifications.

3.05 Well Plugging and Abandonment

A. Wells shall be plugged and abandoned in accordance with local, state and federal regulations.

3.06 Disposal of Demolition Debris and Solid Waste

A. Debris:

1. Materials, rubbish, and trash shall be removed from the demolition area leaving the basements and demolition area free of debris.

2. Cost incurred by the OWNER in cleaning up such materials and debris left behind shall be deducted from funds due CONTRACTOR under this contract.

B. Tires:

1. CONTRACTOR shall visit the site to determine the number of tires that have been abandoned on site.

2. If any additional tires are found on site prior to commencing demolition activity, CONTRACTOR shall immediately notify ENGINEER of the quantity of additional tires found on site so a change order can be prepared for additional removal.

C. Disposal of Demolition Debris and Solid Waste:

1. Debris and solid waste shall be delivered by CONTRACTOR to designated disposal facilities, or to an approved disposal facility licensed in accordance with state and/or local regulations, laws, and zoning.

2. CONTRACTOR shall be responsible to pay all fees for waste disposal.

3. CONTRACTOR shall submit to ENGINEER copies of all disposal tickets for each structure demolished, where available, which identify the specific address of the origin of the debris associated with each ticket.

4. Cost of disposal fees shall be considered incidental to the demolition.

D. Asbestos Abatement:

1. Handling of asbestos material is subject to all applicable state and federal mandates.

2. Asbestos removal is not required on privately owned property that may be included in this work as part of a public nuisance abatement court order; however, CONTRACTOR shall comply with applicable regulations regarding its handling and disposal.

3. Asbestos will be removed by a licensed abatement contractor by a separate contract or in accordance with special provisions on properties owned by OWNER.

4. In the event that asbestos is discovered on a property owned by the OWNER during demolition, CONTRACTOR shall notify ENGINEER and the asbestos shall be removed by a licensed abatement contractor by contract or in accordance with the special provisions.

E. Demolition of Structures with Transite Siding:

1. Privately owned properties containing transite siding shall be listed in the Contract Documents, and all demolition debris from these structures shall be disposed of at an approved landfill.

2. CONTRACTOR shall be responsible for notifying said landfill prior to commencing demolition on these structures to allow for authorization to dispose of material at the landfill.

3. CONTRACTOR shall assume responsibility for the landfill fees for disposing of the demolition debris.

4. Structures with transite siding shall be thoroughly sprayed with water during the execution of the demolition to contain airborne particles.

5. Debris shall be thoroughly wetted prior to transporting to the landfill.

F. Freon Removal and Disposal:

1. Handling of Freon containing appliances is subject to applicable state and federal mandates and regulations.

2. CONTRACTOR shall be responsible for the identification and removal and disposal of the material in accordance with applicable regulations.

3. Costs associated with said removal and disposal shall be considered incidental and shall be included in the lump sum bid for demolition.

G. PCB and Mercury Removal and Disposal:

1. Handling of any fluorescent lighting fixtures and ballasts containing PCB or mercury is subject to applicable state and federal mandates and regulations.

2. CONTRACTOR shall be responsible for the removal and disposal of the material in accordance with applicable regulations.

3. Costs associated with said removal and disposal shall be considered incidental and shall be included in the lump sum bid for demolition.

3.07 Sanitary Sewer and Water Service Disconnections

A. Sanitary Sewer Service Disconnection: Sanitary sewer services shall be disconnected and plugged in conformance with the requirements of the local jurisdiction.

B. Water Service Disconnection: Water services and stubs for the buildings or properties within the demolition work shall be disconnected in conformance with the requirements of the local jurisdiction.

3.08 Backfill, Grading, and Clean Up

A. Backfill:

1. When site conditions permit, as determined by ENGINEER, on-site soil shall be used as backfill material. The top 9 to 12 inches of topsoil shall be stripped and stockpiled on site for use as final topsoil and grading material. If adequate topsoil is not available on site, CONTRACTOR shall bring in enough topsoil from off-site to place a minimum 8-inch cover on the entire site. Excess excavation materials shall be removed from the site.

2. Topsoil material shall not be permitted as deep fill material. Any borrow or fill material shall be approved by ENGINEER before and during the placing of the material.

3. Depressions on the property shall be filled, compacted, and graded to a uniform slope with adequate drainage.

B. Compaction:

1. Excavations shall be backfilled with acceptable material and compacted in accordance with Article 3.06 of Section 31 2316, Structural Excavation and Backfilling.

2. CONTRACTOR shall notify ENGINEER 24 hours in advance of placing any backfill or original backfill material so a soil sample can be obtained.

3. It shall be the responsibility of CONTRACTOR to run a density test during and after the placement of the backfill material.

C. Additional Fill Material:

1. Additional fill material shall be of equal quality to the soil adjacent to the excavation, and free of rubble or organic matter.

2. CONTRACTOR shall provide for a minimum depth of 8 inches of topsoil over the excavated area.

3. There shall be no payment for additional fill material, which shall be considered incidental to the demolition bid price. Additional fill material shall be acceptable fill material that meets the requirements of Section 2010.

D. Hand Labor:

1. CONTRACTOR shall employ hand labor where the use of power machinery is unsafe or unable to produce a finished job. Hand labor shall also be used to clean the site of any debris.

E. Grading:

1. The site shall be graded to conform to all surrounding areas and shall be finished to have a uniform surface that shall not permit ponding of water.

2. CONTRACTOR shall grade and shape the site to drain, complete fine grading and final clean up as part of the lump sum price for demolition.

F. Final Cleaning Up:

1. Before acceptance of the demolition work, CONTRACTOR shall remove all unused material and rubbish from the site of the work, remedy any objectionable conditions CONTRACTOR may have created on private property, and leave the right-of-way in a neat and presentable condition.

2. CONTRACTOR shall not make agreements that allow salvaged or unused material to remain on private property.

3. Ground occupied by CONTRACTOR in connection with the work shall be restored. Restoration shall include appropriate smoothing to its original condition and seeding of the area.

4. On demolition sites where seeding will be delayed because of the allowable seeding dates, CONTRACTOR shall complete fine grading and shaping of the site to leave the site in a neat and presentable condition subject to the approval of ENGINEER.

5. Final cleaning up shall be subject to approval of ENGINEER and in accordance with applicable regulations.

3.09 Safety and Fencing

A. Safety:

1. CONTRACTOR shall comply with all applicable current federal, state and local safety and health regulations.

B. Safety Fencing:

1. CONTRACTOR shall furnish and place a safety fence around the site of the work adequate to secure the demolition site, including any resulting debris or excavation, and to prevent pedestrian access. Fencing shall be considered incidental to the demolition.

2. Safety fence shall remain in place until the demolished materials are removed from the site and all holes or excavated areas are backfilled. The fencing material shall remain the property of CONTRACTOR.

3.10 Authorized Workers

A. Only CONTRACTOR and its employees are allowed to demolish, dismantle, detach or dispose of any part of the demolition structure or its contents.

3.11 Daily Clean Up of Right-Of-Way And Private Property

A. At the end of each workday, CONTRACTOR shall clean sidewalks, streets, and private property of any debris caused by the demolition operation.

End of Section

Division 03
Concrete

Section 03 1100
Concrete Forming

Part 1 General

1.01 Scope of Work

A. This Section includes formwork for cast-in-place concrete, complete with furnishing, preparation, installation, coating, protection, adjustment, removal and accessories.

1.02 Related Work Specified Elsewhere

A. Section 03 1500: Concrete Accessories
B. Section 03 2000: Concrete Reinforcing
C. Section 03 3000: Cast-In-Place Concrete
D. Section 31 2316: Structural Excavation and Backfill

1.03 Design Standards

A. Formwork shall be designed for the loads, lateral pressure, and allowable stresses outlined in "Recommended Practice for Concrete Formwork" ACI 347 and for design considerations, wind loads, allowable stresses and other applicable requirements of the local building code. Design and construction of the formwork shall be the responsibility of CONTRACTOR.

B. Formwork shall be true in every respect to produce hardened concrete to the required shape, size, grade and alignment as indicated on the Plan, and of sufficient strength, bracing and rigidity to maintain their position and shape under the loads and operations incidental to placing and curing the concrete, as well as other forces resulting from the movement of the forms.

C. Forms shall be mortar-tight at the time concrete is placed in them and shall be so constructed that the surfaces of the finished concrete will be reasonably free from ridges, fins, offsets, or similar defects. A

D. Adequate and suitable means for removing the forms without injury to the surfaces or edges of the finished concrete shall be provided.

1.04 Allowable Tolerances

A. Formwork shall be constructed such that the hardened surfaces shall conform to the tolerance limits of ACI 347, except as modified below:

1. Variation from plumb in lines and surfaces of piers, walls, or columns:

   a. In any ten (10) feet (3 m) of length: 1/4 inch (5 mm)
   b. Maximum for entire length: 1-inch (25 mm)

2. Variation from the level or from the grades:

   a. In any ten (10) feet (3 m) of length: 1/4 inch (5 mm)
   b. Maximum for entire length: 3/4 inch (20 mm)

3. Variation of distance between walls, columns and beams:

   a. In any ten (10) feet (3 m) of distance: 1/4 inch (5 mm)
   b. Maximum for entire distance: 1-inch (25 mm)

4. Variation of the linear lines from established position as indicated on the Plans:

   a. In any 20 feet (6 m) of length: 1/2 inch (10 mm)
   b. Maximum for entire length: 1-inch (25 mm)

5. Variation in sizes and locations of sleeves, floor openings, and wall openings:

   a. Minus: 1/4 inch (5 mm)
   b. Plus: 1/2 inch (10 mm)

6. Variation in cross-sectional dimensions of columns and beams and thickness of slabs and walls:

   a. Minus: 1/4 inch (5 mm)
   b. Plus: 1/2 inch (10 mm)

7. Variations of footing dimensions from plan dimensions:

   a. Minus: 1/2 inch (10 mm)
   b. Plus: 2 inches (50 mm)

8. Thickness ± 5%, up to maximum of 1 inch (25 mm)

1.05 Reference Standards

A. ACI - American Concrete Institute
B. ASTM - ASTM International

1.06 Submittals

A. Submit manufacturer's literature for form coating.

B. Submit formwork layout plans, design data and procedures if requested by ENGINEER.

1.07 Storage and Handling

A. Store and handle form coating to prevent contamination of coating in accordance with manufacturer's recommendations.

1.08 Sequencing

A. Sequence installation of formwork with the Work of Section 03 2000, Concrete Reinforcing; Section 03 1500, Concrete Accessories; and Section 03 3000, Cast-In-Place Concrete.

Part 2 Products

2.01 Form Materials

A. Use lumber that is straight, uniform width and thickness, free from knots, offsets, holes, dents, warpage and other surface defects.

B. Use plywood product of standard psi, waterproof, resin-bonded, exterior-type Douglas Fir, face adjacent to concrete shall be Grade B or better.

C. Metal forms to be smooth metal plate free of surface irregularities.

D. Chamfer Strips: Use clear white pine, surface against concrete planed, 1-inch (25 mm) bevel width or cant strip.

2.02 Form Coating

A. Use nonstaining form oil or other mineral oil which will neither discolor nor otherwise injuriously affect the concrete.

2.03 Form Ties

A. Use permanently embedded body type with removable end cones on outer ends, permanently embedded portion 1-inch (25 mm) back from concrete face.

2.04 Forms - General

A. Use forms that conform to ACI 347. Fabricate with facing materials that produce the specified tolerance requirements of Article 1.04 of this Section; produce true surfaces, sharp corners and true lines; and are free of offsets, ridges, bulging, waves and concave or convex areas.

2.05 Layout

A. Use regular and uniform pattern; long dimension of panels vertical; joints horizontal, vertical and aligned; form ties uniformly spaced and aligned in horizontal and vertical rows.

Part 3 Execution

3.01 Preparation

A. Forms shall not be reused if there is any evidence of surface wear and tear or defects which would impair the quality of the surface. Surfaces of forms and embedded materials shall be cleaned of any mortar from previous concreting and of all other foreign material or water before coating is placed in them.

B. Forms shall be coated in accordance with manufacturer's recommendations before the form or reinforcement is placed in final position. Surplus coating on form surfaces, or any coating on reinforcing steel and construction joints shall be removed before placing concrete.

3.02 Installation of Forms

A. Forms shall be sufficiently tight to prevent loss of mortar from the concrete, set true to the lines and elevations indicated on the Plans, tied and braced to remain true during and after concrete placement within tolerances of Article 1.04 of this Section. ENGINEER may at any time condemn any section or sections of forms found deficient in any respect, and such form shall be promptly removed and replaced.

B. No wooden spreaders shall be allowed to remain in the concrete. No metal shall be within 1-inch (25 mm) of any surface.

C. Place chamfer strips in forms to bevel all corners, edges, joints and other structural elements exposed to view, including use of dummy chamfer and false joints to provide neat and uniform appearance. Exposed corners and edges shall have 3/4" x 3/4" - 45° chamfers (20 mm x 20 mm x 45 degree), unless otherwise indicated on the Plan.

D. Provide temporary openings at the base of wall forms and at the other points when necessary to facilitate cleaning and inspection immediately before depositing concrete.

E. Secure in position wedges used for final alignment and items to be embedded in concrete.

F. Forms for keyways shall be prepared in advance of pouring concrete. Keyway forms in slab edges and vertical wall joints shall be rigidly secured in place before the concrete is poured. Forms for keyways for horizontal joints in walls may be placed at the conclusion of the pour, but proper provision shall be made for obtaining and holding the full depth and form of the keyway.

3.03 Adjustment of Forms

A. Positive means of adjustment should be provided to permit realignment or readjustment of shores if excessive settlement occurs.

B. A pair of wedges may be used at the top or bottom of shores, but not at both ends, to facilitate vertical adjustment, to correct uneven settlements, or to facilitate dismantling of the formwork.

C. Screw jacks for pipe shores or scaffold-type shoring may be used at both top and bottom so long as they are secured by the shore or scaffold leg against loosening or falling out, to avoid lateral deflections.

D. During and after concreting, but before initial set of the concrete, the elevations, camber, and plumbness of formwork systems shall be checked, using telltale devices. Appropriate adjustments shall be promptly made where necessary. If, during construction, any weakness develops and the formwork shows any undue settlement or distortion, the Work shall be stopped, the affected construction removed if permanently damaged, and the formwork strengthened.

3.04 Removal of Forms

A. Forms, wedges or shoring shall not be removed or disturbed until the concrete has attained sufficient strength to safely support superimposed dead, temporary construction, and live loads.

B. When forms or shoring are removed, there shall be no excessive deflection or distortion of the concrete.

C. Forms shall be removed in an orderly fashion; with care to avoid surface gouging, corner or edge breakage, or other damage or injury to the concrete surface or physical property; and without impact or shock, to permit the concrete to carry its share of the loads gradually and uniformly.

D. Form removal shall not impair the safety and serviceability of the structure or concrete members.

E. Forms and shoring in the formwork used to support the weight of concrete in beams, slabs, and other structural members shall remain in place a minimum of 14 days or until the concrete has reached a minimum of 75% of the design compressive strength. Cylinder strength shall be based on test specimens cured in the field, as described in ASTM C31, under conditions which are not more favorable than the most unfavorable conditions for the portions of the concrete which the test specimens represent and shall be determined in accordance with Section 03 3000, Cast In Place Concrete.

F. Formwork for columns, walls and other vertical members shall remain in place a minimum of five (5) days or until the concrete has attained a minimum of 75% of its design strength. Where such formwork also supports the formwork of beams and slabs, the removal times of the latter shall govern. Face and edge forms shall be removed as soon as practicable and

permitted by ENGINEER in order to facilitate effective repair of voids or broken corners before the surface has dried.

G. Forms and shoring in the formwork shall not be removed without the approval of ENGINEER. Minimum in-place times are for ordinary conditions and represent cumulative number of days, not necessarily consecutive, after the concrete was placed, during which the temperature of the air surrounding the concrete is above 50°F (10°C). The times may be increased or decreased as directed by ENGINEER, dependent on air temperatures, cement type, concrete additives or other conditions of the Work in accordance with ACI 347.

3.05 Reshoring

A. When removing forms before structural members are strong enough to carry dead load and/or construction loads, reshores shall be installed to assure safe distribution of loading. Reshoring operations shall be planned in advance and shall be subject to ENGINEER's review.

B. During reshoring, no construction loads shall be permitted on the new construction.

C. Reshores shall be placed as soon as practicable after form removal, but in no case later than the end of the working day on which form removal occurs, and shall remain in place until the concrete has acquired the required strength.

End of Section

Section 03 1500
Concrete Accessories

Part 1 General

1.01 Scope of Work

A. This Section includes joint fillers, joint sealants, waterstops, and miscellaneous embedded items in concrete.

1.02 Related Work Specified Elsewhere

A. Section 03 1100: Concrete Forming
B. Section 03 2000: Concrete Reinforcing
C. Section 03 3000: Cast-In-Place Concrete

1.03 Reference Standards

A. ASTM - American Society for Testing Materials
B. CRD - U.S. Army Corps of Engineers Handbook for Concrete and Cement Specifications

1.04 Submittals

A. Submit certified manufacturer's affidavits for expansion joint filler, joint sealant and waterstops to verify compliance with the applicable Specifications.

B. Submit a schedule of concrete pouring and indicate locations of proposed construction and expansion joints. This schedule is subject to approval of ENGINEER.

1.05 Environmental Requirements

A. Environmental requirements relative to temperature for placing joint sealants are specified in article 3.04 of this Section.

1.06 Sequencing

A. CONTRACTOR shall sequence installation of miscellaneous embedded items with the Work of Section 03 1100 Concrete Forming; Section 03 2000, Concrete Reinforcing; and Section 03 3000 Cast-In-Place Concrete.

Part 2 Products

2.01 Joint Filler

A. Preformed Expansion Joint Filler for Concrete (Bituminous Type) ASTM D994.

B. Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types) ASTM D1751.

C. Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Concrete ASTM D1752.

2.02 Joint Sealer

A. Joint Sealants, Hot-Poured, For Concrete and Asphalt Pavements ASTM D6690 Type II.

B. Joint Sealants, Hot-Poured, Elastomeric Type, for Portland Cement Concrete Pavements ASTM D3406.

2.03 Waterstops

A. PVC waterstops shall conform to CRD-C572 polyvinyl chloride (PVC) or CRD-C513 styrene-butadiene rubber (SBR). Flat ribbed type shall be used in joints in walls and slabs where shown on the plans. Center bulb type shall be used in expansion joints.

B. Bentonite waterstops shall be a compound of 75% high swelling sodium bentonite and 25% butyl rubber. Bentonite waterstops require an adhesive as recommended by the manufacturer to adhere the waterstop to the substrate.

C. Hydrophilic rubber waterstop shall be a combination of chloroprene rubber and chloroprene rubber modified to impart hydrophilic properties. The waterstop shall have a delay coating to inhibit initial expansion due to moisture present in fresh concrete. Hydrophilic rubber waterstops require an adhesive as recommended by the manufacturer to adhere the waterstop to the substrate.

2.04 Concrete Anchors

A. General:

1. Select type and size to achieve required loading capacity using information provided by manufacturer. If required type is not indicated, select type appropriate to conditions and item being fastened.

2. Maintain critical edge distance and spacing per manufacturer's recommendations for all anchors. Provide tamper proof hardware when called for on the plans.

B. Adhesive Anchors:

1. Combination capsule adhesive and insert system; chisel pointed threaded rod with hex nut/washer, reinforcing bar, or internally threaded insert, installed into pre-drilled anchor hole using rotary hammer drill, crushing glass capsule containing two part epoxy acrylate resin (vinyl ester) with quartz aggregate and hardening agent, forming adhesive mortar.

2. Threaded rod: ASTM A 193 Grade B7, ASTM A 194 Grade 2H or ASTM A 563 Grade DH nuts, and ASTM F 436 washers; plated in accordance with ASTM B 633, SC1, with Type II yellow chromate treatment or Type 304 stainless steel when specified on the plans.

3. Threaded Insert: Carbon steel tubular insert, internally threaded, plated in accordance with ASTM B 633, SC1.

C. Wedge Type Anchors:

1. One piece body with expansion mechanism installed in pre-drilled hole using matching tolerance bit.

2. Carbon steel anchor body, washers, nuts and wedges, plated in accordance with ASTM B 633, SC1, Type III or Type 304 stainless steel anchor body, washers, nuts and wedges when so indicated on plans.

Part 3 Execution

3.01 Contractor's Verification

A. Inspect the locations and surfaces to receive joint filler, joint sealer, waterstops, or miscellaneous embedded items and correct defects or conflicts which will affect the proper performance of the item to be placed.

3.02 Preparation

A. Accessories to be embedded into concrete shall have contact surfaces free of dirt, curing compound, protrusions of hardened concrete or any other foreign material which would affect bond with concrete.

B. Prime surfaces in accordance with manufacturer's recommendations.

3.03 Installation of Joint Fillers

A. Details, including materials and methods of installation of joint fillers shall be as indicated on the Plans and as approved by ENGINEER.

3.04 Installation of Joint Sealants

A. Joints shall not be sealed when the sealant, air or concrete temperature is less than 40°Fahrenheit (4°Celsius). Bond breaker and backup material shall be installed where required as indicated on the Plans or manufacturer's recommendations.

3.05 Installation of Waterstops

A. Waterstops shall be of maximum practicable length to minimize joints.

B. Waterstops shall be positioned as indicated on the Plans in a manner to permanently retain flexibility.

C. Splice in length or at intersections shall be performed by heat sealing and in accordance with manufacturer's recommendations.

D. Reform splices with a remolding iron with ribs or corrugations to match the pattern of the waterstop. When cooled and bent by hand in as sharp as an angle as possible, the splice shall show no sign of separation.

E. Provide support and protection of the waterstops during the progress of the work. Any waterstop punctured or damaged shall be replaced or repaired at CONTRACTOR's expense. Concrete shall be thoroughly consolidated in the vicinity of the waterstop. Suitable guards shall be provided to protect exposed projecting edges and ends of partially embedded waterstops from damage when concrete placement has been discontinued.

3.06 Concrete Anchors

A. Do not begin installation until substrates have been properly prepared. Do not proceed with installation if substrate preparation is unsatisfactory.

B. Clean surfaces thoroughly prior to installation. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

C. Install in accordance with manufacturer's instructions and recommendations and as required by applicable code. Anchor applied items neatly, with item mounted plumb and level unless otherwise indicated.

D. ENGINEER reserves the right to require the anchor manufacturer's representative to demonstrate proper installation procedures for post-installed anchors and to observe CONTRACTOR's installation procedures, at no extra cost to OWNER. ENGINEER reserves the right to require pullout or shear tests to determine adequacy of anchors, at no extra cost to OWNER.

3.07 Miscellaneous Embedded Items

A. All sleeves, inserts, anchor bolts, and other embedded items required for adjoining Work or for its support shall be placed prior to concreting.

B. Embedded items shall be positioned accurately and supported against displacement. Voids in sleeves, inserts, and anchor slots shall be filled temporarily with readily removable material to prevent the entry of concrete into the voids.

End of Section

Section 03 2000
Concrete Reinforcing

Part 1 General

1.01 Scope of Work

A. This Section includes the furnishing, fabrication, placement and care of material used as concrete reinforcement.

1.02 Related Work Specified Elsewhere

A. Section 03 1100: Concrete Forming:
B. Section 03 1500: Concrete Accessories
C. Section 03 3000: Cast-In-Place Concrete

1.03 Reference Specifications

A. Latest or current ACI Standards and Code Requirements for "Concrete and Reinforced Concrete" shall govern all concrete Work except where otherwise specified herein. Copies of standards can be obtained from the American Concrete Institute.

1.04 Testing Agency

A. Testing agencies shall meet the requirements of Recommended Practice for Inspection and Testing Agencies for Concrete, Steel and Bituminous Materials as Used in Construction, ASTM E329.

1.05 Allowable Tolerances

A. Fabrication:

1. Sheared length: ± 1-inch (25 mm).
2. Depth of truss bars: +0, -1/2 inch (+0, -10 mm).
3. Stirrups, ties, and spirals: ± 1/2 inch (±10 mm)
4. All other bends: ± 1-inch (±25 mm).

B. Placement:

1. Concrete cover to form surfaces: ± 1/4 inch (±5 mm).
2. Minimum spacing between bars: -1/4 inch (-5 mm).
3. Top bars in slabs and beams:

    a. Members eight (8) inches (200 mm) deep or less: ± 1/4 inch (5 mm).

    b. Members more than eight (8) inches (200 mm) but not over two (2) feet (600 mm) deep: ± 1/2 inch (±10 mm).

    c. Members more than two (2) feet (600 mm) deep: ± 1-inch (±25 mm).

4. Crosswise of members: Spaced evenly within two (2) inches (50 mm) of stated separation.

5. Lengthwise of members: ± 2 inches (±50 mm).

6. Maximum bar movement to avoid interference with other reinforcing steel, conduits, or embedded items: 1-bar diameter, with approval from ENGINEER.

1.06 Source Quality Control

A. Reinforcing steel shall be subject to inspection at the source of supply, fabricator, or after delivery to the Project Site at the discretion of ENGINEER.

B. CONTRACTOR may be required to furnish additional test of reinforcing steel for each 100 tons (90 metric ton) or fraction thereof. Testing for bend, pull, elongation and weight to assure compliance with Specifications shall be in accordance with ASTM A370.

1.07 Reference Standards

A. ACI - American Concrete Institute
B. ASTM - ASTM International
C. CRSI - Concrete Reinforcing Steel Institute

1.08 Submittals

A. CONTRACTOR shall submit Shop Drawings indicating the size and dimensions for fabrication and placing of reinforcing steel, including bar schedules, stirrup spacing, and diameter of bend bars. Bar supports type and grade shall be indicated.

B. CONTRACTOR shall submit test certificates of the manufacturer's laboratory, identifying chemical and physical analysis of each load of reinforcing steel delivered.

C. CONTRACTOR shall submit test certificates of a qualified independent testing agency evaluation of the mechanical splice devices to assure compliance with ACI 318.

1.09 Delivery, Storage, and Handling

A. Deliver reinforcement to Project site in bundles tagged and marked in accordance with "Manual of Standard Practice" of the CRSI.

B. Reinforcing steel shall be stored above ground on platforms or other supports, in an orderly manner to facilitate inspection and checking, and be protected from physical injuries or contamination.

1.10 Sequencing

A. CONTRACTOR shall coordinate placement of the reinforcing in a manner which will not prevent the proper and timely completion of dependent construction phases.

Part 2 Products

2.01 Reinforcing Bars

A. Reinforcement shall be of the grade and type as specified herein unless otherwise indicated on the Plans or Shop Drawing.

B. Bars:

1. Deformed and Plain Billet-Steel Bars: ASTM A615, Grade 60.
2. Rail-Steel Deformed and Plain Bars: ASTM A616-96a, Grade 60.

3. Axle-Steel Deformed and Plain Bars: ASTM A617-96a, Grade 60.
4. Low Alloy Steel Deformed Bars: ASTM A706.

C. Mats:

1. Fabricated steel bar or rod mats of the clipped type shall conform to ASTM A184.

2.02 Welded Wire Fabric

A. Welded wire fabric shall be in flat mats only.

B. Plain:

1. Conform to ASTM A185, 6 x 6 – w2.9 x w2.9 unless otherwise indicated on the Plans.

C. Deformed:

1. Conform to ASTM A496, 6 x 6 – w2.9 x w2.9 unless otherwise indicated on the Plans.

2.03 Tie Wire

A. Plain:

1. Conform to Cold Drawn Steel Wire for Concrete Reinforcement, ASTM A82, 16-gage minimum size.

B. Deformed:

1. Conform to Deformed Steel Wire for Concrete Reinforcement, ASTM A496, size D-4 minimum.

2.04 Bar Supports

A. Metal bar supports shall be fabricated from cold-drawn steel wire in accordance with current CRSI Standards.

B. Stainless steel supports shall be of Type 1, with stainless steel wire conforming to ASTM A493 attached to the tips of the support so the nonstainless wire will lie no closer than 1/4 inch (5 mm) from the form surface.

C. Plastic coated supports shall be of Type 1, with plastic coating of polyethylene conforming to ASTM D1248 on the legs and tips.

D. Precast concrete brick supports shall conform to ASTM C55, Type 1, Grade N.

2.05 Fabrication

A. Bars shall be bent cold to the shapes and dimensions as indicated on the Plans, or as required by the current "Manual of Standard Practice" of the CRSI.

B. Steel shall not be bent or straightened in a manner that will injure the material. Bars with kinks or improper bends shall not be used.

C. The diameter of bend measured on the inside of the bar for standard hooks, other than stirrups and tie hooks, shall not be less than the values of the following table.

Minimum Diameters of Bend	
Bar Size	**Minimum Diameter**
#3 through #8 (#10M - #25M)	6 bar diameters
#9, #10, and #11 (#29M - #36M)	8 bar diameters
#14 and #18 (#43M - #57M)	10 bar diameters

D. Bends for stirrups and ties with number 5 (#16M) bar and smaller shall not be less than four bar diameters. For bars larger than No. 5 (#16M), shall be according to the "Minimum Diameter of Bend" table above.

E. Bends for stirrups and ties for welded wire fabric shall not be less than 4-bar diameters for deformed wire larger than D-6 and 2-bar diameters for all other wires. Bends with inside diameter of less than 8-bar diameters shall not be less than 4-bar diameters from nearest welded intersection.

Part 3 Execution

3.01 Contractor's Verification

A. CONTRACTOR shall examine the areas in which the reinforcing steel is to be placed to assure proper lines and levels.

3.02 Preparation

A. Remove dirt, grease, oil, loose mill scale, excessive rust, and foreign matter that will reduce bond with concrete or splicing method.

B. The ends of bars to be butt spliced shall be cut square and smooth.

3.03 Installation - General

A. Reinforcing shall be placed as indicated on the approved Shop Drawings, within allowable tolerances. Bar supports, as indicated on approved Shop Drawings, or in Specifications, shall be used for proper separation and support of reinforcing steel.

3.04 Minimum Spacing

A. Unless otherwise indicated on the Plans, the minimum spacing of bars shall be the following:

B. Footings and other principal structural members in which the concrete is deposited against the ground shall have 3 inches (75 mm) of concrete between the bar and the ground contact surface.

C. Concrete surfaces which, after removal of the forms, are to be exposed to the weather or in contact with the ground or liquids, shall be protected with 2 inches (50 mm) of concrete.

D. The concrete protective covering for any reinforcement at surfaces not exposed directly to the ground, liquids or weather shall be 3/4 inch (20 mm) for slabs and walls and 1-1/2 inches (40 mm) for beams and girders.

E. Column spirals or ties shall be protected everywhere by a covering of concrete cast monolithically with the core and shall be at least 1-1/2 inches (40 mm).

F. Concrete protection for reinforcement shall in all cases be at least equal to the diameter of bars, except for concrete slabs as noted above.

G. The minimum center to center distance between parallel bars shall be 2-1/2 times the diameter of the bars. In no case shall the clear spacing between bars be less than one inch (25 mm) nor less than 1-1/3 times the maximum size of the coarse aggregate. The maximum center to center distance in parallel bars shall be 18 inches (450 mm). Where reinforcement in beams and girders is placed in two (2) or more layers, the clear distance between layers shall be not less than 1-inch (25 mm), and the bars in the upper layers shall be placed directly above those in the bottom layer.

H. Welded wire fabric designated as load-carrying reinforcement shall be overlapped wherever successive mats are continuous in such a way that the overlap measured between outermost cross wires of each fabric sheet is not less than the spacing of the cross wires plus 2 inches (50 mm). It shall be supported as required for reinforcing bars.

3.05 Splicing

A. Splices shall be avoided at points of maximum stress. Splicing of bars shall be in accordance with ACI 318.

B. Splicing of bars shall be done by overlapping in accordance with ACI Detailing Manual SP-66, and securely laced with wire unless indicated otherwise on the Plans or approved Shop Drawing.

C. Lap adjoining wire mesh by no less than one (1) full mesh and lace securely with wire. Offset end laps in adjacent widths to prevent continuous splice.

D. Welded wire fabric reinforcement shall be overlapped wherever successive mats are continuous in such a way that the overlap measured between outermost cross wires of each fabric sheet is not less than one full mesh spacing plus 2 inches (50 mm). The fabric shall extend across supporting beams and walls and to within 4 inches (100 mm) of concrete edges. It may extend through contraction joints where alternate wires are field cut. It shall be adequately supported during placing of concrete to insure its proper position in the slab either by the methods of Article 3.06 of this Section or by laying the fabric on a layer of the fresh concrete of the correct depth before placing the upper layer of the slab.

E. Vertical bars in columns shall be offset at least 1-bar diameter at lapped splices. To insure proper placement, templates shall be furnished for all column dowels.

F. Bars of size 14, 18 or larger (#43M #57M or larger), where size 11 (#36M) bars are butt spliced to larger sizes and/or when approved by the ENGINEER shall be welded in accordance with ACI 301 by full penetration butt welds. Adequate jigs and clamps or other devices shall be provided by the CONTRACTOR to support, align and hold the longitudinal centerline of the bars in a straight line.

G. Bars larger than size eleven (#36M) may be butt spliced by mechanical devices approved by ENGINEER, in accordance with ACI 318. Splices shall be made using manufacturer's standard jigs, clamps, ignition devices and other required accessories to support, align and hold the longitudinal centerline of the bars in a straight line.

3.06 Securing Reinforcement

A. Reinforcement shall be securely laced with wire to supports or reinforcing to prevent displacement during the concrete placement, as required by the current "Manual of Standard Practice" of the CRSI.

3.07 Field Quality Control

A. ENGINEER shall inspect the reinforcing steel after it has been installed, and the reinforcing steel placement shall be approved by ENGINEER prior to placement of concrete.

B. CONTRACTOR shall avoid displacement of the reinforcing steel during concrete placement.

End of Section

Section 03 3000
Cast-in-Place Concrete

Part 1 General

1.01 Scope of Work

A. This Section includes all monolithic cast-in-place concrete work complete with materials, mixes, installation and testing.

1.02 Related Work Specified Elsewhere

A. Section 01 2200: Unit Prices
B. Section 03 1100: Concrete Forming
C. Section 03 1500: Concrete Accessories
D. Section 03 2000: Concrete Reinforcing
E. Section 04 0511; Mortaring and Grouting

1.03 Reference Standards

A. Unless otherwise specified, the Work of this Section shall conform to the applicable portions of the following Standard Specifications:

1. ACI - American Concrete Institute

2. ASTM - ASTM International

3. MDOT - Michigan Department of Transportation, Standard Specifications for Construction, latest edition

1.04 Reference Specifications

A. The latest or current ACI Standards and Code Requirements for "Concrete and Reinforced Concrete" shall govern all concrete Work except where otherwise specified herein.

1.05 Testing Agency

A. Inspections and tests required by this Section shall be performed by organizations acceptable to ENGINEER.

1.06 Allowable Tolerances

A. See Section 03 1100, Concrete Forming, for the allowable tolerances for concrete surfaces.

1.07 Design Criteria

A. Mixes shall be designed and tested for each size and gradation of aggregates and for each consistency intended for use. Design quantities and test results of each mix shall be submitted for review.

B. Necessary construction joints are shown on the Plans. Modification of location or placement of construction joints not indicated on the Plans shall be subject to approval of ENGINEER. In general, they shall be located within the middle one-third of the span of slabs, beams, and girders unless a beam intersects a girder at this point, in which case the joint in the girder shall be offset a distance equal to twice the width of the beam.

C. Joints in walls and columns shall be at the underside of floors, slabs, beams, or girders and at the tops of footings or floor slabs. Beams, girders, brackets, column capitals, haunches, and drop panels shall be placed at the same time as slabs. Joints shall be perpendicular to the main reinforcement.

D. Expansion joint locations and details shall be as shown on the Plans. In no case shall any fixed metal be continuous through an expansion joint.

E. Keyways shall be provided in all joints where required to provide for either shear or watertightness. Unless otherwise required, the width of keys shall be at least one-third the thickness of the section at that point and their depth at least one-third their width.

1.08 Source Quality Control

A. Furnish tests of cement and aggregates. Material sampling shall conform to the following ASTM Standards:

1. Cement C183
2. Aggregates D75

B. Testing shall be in accordance with applicable ASTM Standards to assure compliance with Specifications.

C. Make tests for the following quantities, or fraction thereof:

1. Cement ..... 550 tons (500 metric ton)
2. Fine Aggregate ..... 2,000 Tons (1800 metric ton)
3. Coarse Aggregate ..... 2,000 Tons (1800 metric ton)

D. Use same brand cement for any given structure produced by a single mill unless otherwise provided by authorization of ENGINEER.

1.09 Submittals

A. Submit Shop Drawings showing the location of joints. Included shall be a schedule of the concrete pouring. The location of joints and pouring schedule shall be subject to approval by ENGINEER.

B. CONTRACTOR shall submit test reports for cement and aggregates to assure compliance with the Specifications.

C. Concrete mixture designs and test data shall be submitted for review by ENGINEER with a written request for approval. No concrete shall be placed until CONTRACTOR has received such approval in writing. Each mixture report shall include:

1. Slump on which design is based.
2. Total gallons of water per cubic yard (l/m^3).
3. Brand, type, composition, and quantity of cement.
4. Brand, type, composition, and quantity of pozzolan or other mineral admixtures.

5. Brand, type, composition, and quantity of ground granulated blast furnace slag.
6. Specific gravity and gradation of each aggregate.
7. Ratio of fine to total aggregates.
8. Weight (surface dry) of each aggregate, lbs./c.y. (kg/m^3).
9. Brand, type, ASTM, active chemical ingredients, and quantity of each admixture.
10. Air content.
11. Compressive strength based on 7-day and 28-day compression tests.
12. Time of initial set.

D. Submit manufacturer's literature of abrasive wear resistant floor finish and of chemical curing compound for review by ENGINEER.

E. Submit a sample concrete delivery ticket for review by ENGINEER.

F. Submit tickets collected at the site of concrete placement accompanying each load of concrete. A printout system for producing these tickets in connection with automatic batching will be permitted.

1. Each ticket shall be serially numbered, show the charging time, quantity and grade of concrete, location of delivery and the signatures of inspectors at the plant and site. Transit mixed concrete tickets shall also include revolution counter reading at charging and mixing completion.

G. Submit reports of the sampling and testing of slump, air content and strength performed.

H. Submit reports of nondestructive, core and/or liquid retention testing required for acceptance of concrete in place.

1.10 Material Storage and Handling

A. Materials shall be stored and handled in accordance with ACI 304 and as specified below.

B. When permission is given to store cement in the open, a floor at least six (6) inches (150 mm) above the ground and a waterproof covering shall be provided and so placed as to insure runoff in case of rain.

C. Cement sacks shall be thoroughly shaken when emptying sacks into the batch. Cement salvaged by CONTRACTOR by cleaning sacks mechanically or otherwise, or from discarded sacks of cement, shall not be used in the Work. The use of a fractional sack of cement will not be permitted unless the fractional part is measured by weight. At the time of its use in the Work, the cement shall be free from lumps.

D. No aggregates which have become intermixed prior to proportioning shall be used. Sufficient aggregate shall be available at the site to preclude the possibility of damaging delays while placing the concrete.

E. Cars used for shipping aggregates shall be clean and in good repair. The use of straw, marsh, hay or other similar materials for closing cracks or holes in cars will not be tolerated.

F. Pozzolans and other cementitious materials shall be stored and handled in the manner of cement.

G. Store and handle curing compound in a manner to prevent contamination.

1.11 Environmental Requirements

A. Environmental requirements shall be in accordance with ACI 305 for hot weather concreting, and ACI 306 for cold weather concreting. Specific temperature requirements are contained in Article 2.10 of this Section for mixing and Article 3.13 of this Section for placing.

Part 2 Products

2.01 Materials - General

A. Materials shall meet the requirements of ACI 301, ACI 318, and MDOT Specification, Division 9.

B. Concrete materials shall be tested and inspected as the Work progresses. The review and/or check-test of the proposed materials, securing of production samples of materials at plant stockpiles and/or review of the manufacturer's reports for compliance will be performed at no cost to CONTRACTOR.

C. Testing and inspection required due to substitution or change of materials requested by CONTRACTOR shall be at CONTRACTOR's expense.

2.02 Cement

A. Cement shall be the type as indicated on the Plans or as specified.

B. Type I and IA, conforming to ASTM C150, air-entraining Portland cement when special properties are not specified.

C. Type III and IIIA, conforming to ASTM C150, air-entraining Portland cement for use when high-early strength is specified.

D. Type IS and IS-A, conforming to ASTM C595, air-entraining Portland blast-furnace slag cement for use in general concrete construction.

E. Type IP and IP-A, conforming to ASTM C595, air-entraining Portland-Pozzolan cement for use in general construction. The addition of suffix (MS) signifies that moderate sulfate resistance is specified. The addition of suffix (MH) signifies that moderate heat of hydration is specified.

2.03 Aggregates

A. Washing will be required to eliminate the dust, clay, or silt coating. Aggregates which have been washed shall not be used sooner than 24 hours after washing, unless approved by the ENGINEER.

B. Coarse aggregate shall be gravel or crushed rock, conforming to MDOT Section 902.03. Class 17A for members eight (8) inches (200 mm) or less in thickness and Class 6AA for other construction.

C. Gravel shall consist of hard, clean, durable particles of rock or pebbles and shall be free from lumps of clay.

D. Crushed rock shall consist of angular fragments of crushed hard heads or boulders or crushed igneous rock free from weathered rock and of uniform quality.

E. Sieve and screen analyses determination of clay, silt, and dust content and percentages of objectionable particles will be based on dry weights and conform to MDOT Section 902.03, Table 902-1, "Grading Requirements for Coarse Aggregates, Dense-Graded Aggregates, and Open Graded Aggregates" and Table 902-2, "Physical Requirements for Coarse Aggregate, Dense Graded Aggregates and Open Graded Aggregates."

F. Fine aggregate shall be sand size 2NS, MDOT, Section 902.09.

G. Fine aggregates shall consist of sharp sand which shall be composed of clean, hard, durable grains and shall be free from lumps of clay and organic deleterious substances.

H. Fine aggregates shall conform to MDOT Section 902.09 and Table 902-4, "Grading Requirements for Fine Aggregates."

2.04 Admixtures

A. Admixtures shall be used to achieve concrete as indicated on the Plans or specified herein. Calcium chloride shall not be used.

1. Air-entraining, conforming to ASTM C260.
2. Pozzolan and Fly Ash, conforming to ASTM C618, Class C or F.
3. Water reducing, conforming to ASTM C494.
4. Retarder, conforming to ASTM C494.
5. Plasticizer, conforming to ASTM C494.
6. Ground granulated blast furnace slag conforming to ASTM C989, grade 100.

B. Abrasive wear resistant floor finish shall be packaged, dry combination of Portland cement, graded Quartz aggregate and dispersing agents formulated to produce an abrasive and wear resistant monolithic surface.

2.05 Joint Filler

A. See Section 03 1500, Concrete Accessories.

2.06 Water

A. Water shall be free from oil, acid, alkali, organic matter, and any other deleterious substances. Water approved by the Local Board of Health may be used without testing. Water from other sources shall be tested before using.

2.07 Curing Compound

A. Shall be adequate to prevent checking, cracking and loss of moisture, conforming to ASTM C309.

2.08 Mixes

A. Concrete shall consist of a mixture of air-entraining Portland cement, coarse and fine aggregate, and water with admixtures if required. Admixtures shall not be used without ENGINEER's review. The mixture, combined in proportions, shall meet the requirements of MDOT, Specification Section 701, and ACI 211.1.

B. Concrete shall be classified and proportioned on the basis of minimum compressive strength at 28 days when cured in a moist room at a temperature within the range of 65° to 75°F (18° to 24°C). The desired strength of the concrete shall be shown on either the Plans or in the Specifications.

C. Table 1 shows for each grade of concrete the minimum compressive strength, cement content, and the modulus of rupture. Concrete shall be 3,500 psi, Grade 3.5, unless otherwise shown on the plans.

Table 1 - Concrete Mixtures

Concrete Grade	Coarse Aggregate	Min Cement Content				Min. Comprehensive Strength at 28 Days (PSI/MPa)	Min. Modulus of Rupture at 28 Days (PSI/MPa)	% Air
		Type of Cement	lbs/yd^3	Sacks/yd^3	kg/m^3			
4.5	6AA	I, IA, IS, IS-A	658	7.0	390	4,500 / 31.0	725 / 5.0	4 - 6
4.0	6AA or 17A	I, IA, IS, IS-A	611	6.5	362	4,000 / 28.0	700 / 4.8	4 - 6
3.5	6AA or 17A	IS, IS-A, IP, IP-A	564	6.0	335	3,500 / 24.0	650 / 4.5	4 - 6

Notes:

1. Maximum water cement ration shall be 0.45
2. Structural concrete for walls and slabs shall be placed with a slump of four (4) inches (100 mm) maximum.
3. Ground granulated blast furnace slag (GGBFS) may be substituted for cement on a pound for pound basis from a minimum of 25% up to a maximum of 40% GGBFS and 60% cement
4. Fly ash may be substituted for cement on a pound for pound basis up to a maximum of 15% fly ash and 85% cement

D. Aggregates shall be proportioned by weight, except for small structures and for incidental Work requiring less than 10 cubic yards (7 m^3) of concrete, in which case they may be proportioned by volume when approved by ENGINEER.

E. Cement in bulk, when permitted, shall be proportioned by weight.

F. When proportioned by volume, the amount of each aggregate required for a single batch shall be measured separately and accurately. Shovel methods of measuring will not be permitted. The unit of volumetric measurement shall be 1 cubic foot or 1 cubic meter.

G. When proportioned by weight, the amount of each aggregate required for a single batch shall be weighed in a separate container. The equipment for weighing shall be of an approved type, and of such accuracy that there shall not be an error of more than 1 percent in any one batch.

2.09 Batching Admixtures

A. The batching of admixtures to achieve and maintain production of the mix design of concrete shall be in accordance with ACI 212.

B. If the air content is found to be less or greater than the specified amount, CONTRACTOR shall immediately discontinue Work and correct the air content.

C. Decreasing the air content may be accomplished by blending air-entraining Portland cement with Portland cement, manufactured at the same mill, in a ratio which will reduce the air content to a value within the specified limits, this blending shall be reviewed by ENGINEER.

D. Increasing the air content may be accomplished by adding to each batch a sufficient amount of air-entraining admixture to bring the air content up to the designed amount.

E. Pozzolan and ground granulated blast furnace slag shall be proportioned based on the mix design approved by ENGINEER per Article 1.09 of this Section to produce watertight concrete.

F. Water Reducer can be used to reduce the water requirement of concrete to obtain consistency of slump, modify workability, increase strength or any other approved use.

2.10 Temperature Limits of Mixture

A. The temperature of the cement, at the time of delivery to the mixer, shall not exceed 165 degrees F (74°C). It may be required that it be stored at CONTRACTOR's expense until cooled to that temperature.

B. The temperature limits of aggregates and water entering the mixer shall be as follows:

Limits of Temperature		
Component	**Minimum**	**Maximum**
Water	75°F (24°C)	140°F (60°C)
Fine Aggregate	65°F (18°C)	140°F (60°C)
Coarse Aggregate	65°F (18°C)	110°F (43°C)
Concrete (resulting)	60°F (15°C)	90°F (32°C)

2.11 Mixers and Mixing

A. General:

1. Concrete mixing operations shall be in accordance with ACI 304 and MDOT, Section 701, and shall be subject to random inspection during the progress of the Work at no charge to CONTRACTOR.

B. Central Mixed Concrete:

1. Mixers shall be capable of quickly and completely discharging without segregation or loss.

2. Efficiency of the mixers shall be maintained at all times through repair or replacement of worn parts when necessary.

3. Mixers shall be provided with readily adjustable, automatic devices which will measure the cement and water within one (1) percent and admixtures within three (3) percent.

4. Drum of the mixer shall be kept free from hardened concrete and shall be completely emptied before recharging.

5. Retempering or remixing concrete that has partially set will not be permitted.

6. Mixer shall be cleaned thoroughly each time when out of operation for more than 1/2 hour.

7. Recommended mixing time is a minimum time of one (1) minute for one (1) cubic yard (or cubic meter), with an additional 15 seconds for each additional cubic yard (or cubic meter).

8. Concrete shall be delivered to the site in clean, tight truck bodies designed for this purpose and painted with paraffin if necessary for easy dumping. Concrete at the point of delivery shall have the proper consistency and shall be free from segregation. Mechanical agitators in the truck bodies will be required if the period of time from the mixing plant to the point of dumping exceeds 30 minutes.

9. No concrete shall be dumped if the elapsed time from the mixing plant to the point of dumping exceeds 60 minutes.

C. Transit Mixed Concrete:

1. Transit-mix concrete shall be in accordance with ASTM C94. If transit-mix concrete is used, it shall meet all the foregoing requirements specified for central mixed concrete and, in addition, the following:

a. Batched materials shall be properly proportioned and in a dry state. The proper amount of water shall be added to the mixer on the trucks, and no additional water shall be added. No admixtures or accelerators shall be added except as herein noted, without the approval of ENGINEER.

b. Trucks shall not be loaded beyond their rated capacity and shall have mixing drums cleaned of all set-up materials at frequent intervals while in use. Trucks with leaking water valves shall not be used.

c. Recommended mixing speed should be no less than 12 revolutions per minute, with a minimum of 90 revolutions or until the mix is satisfactory.

d. Mixing shall be continuous after water is added to the mix in the drum, but no concrete shall be placed in the forms more than 90 minutes after water is added to the mix.

e. Truck-mixed concrete shall be delivered to the site of the Work and discharged from the mixer within the maximum period of 1-1/2 hours from the first introduction of water to the mix. Concrete which remains in the mixer after this period and any concrete which appears too stiff to be properly workable or which appears to have begun to take its initial set shall be rejected and removed from the site of the Work.

D. OWNER may employ an independent testing laboratory to provide a qualified inspector to be present at the plant where batching of concrete occurs. The inspector shall verify the compliance of the mix with the Specifications and shall sign a form indicating the quantity of concrete and the concrete mixture of each load.

2.12 Change of Mixture

A. If CONTRACTOR requests a change or substitution of approved batch proportioning, mixing, or delivery operations additional testing and/or inspection shall be at CONTRACTOR's expense.

2.13 Acceptable Manufacturers

A. Acceptable manufacturers of abrasive wear resistant floor finish include: Master Builders Company "Mastercon Aggregate," Sonneborn Building Products "Harcol," or equal.

Part 3 Execution

3.01 Verification of Formwork, Reinforcing, and Subgrades

A. CONTRACTOR shall inspect formwork, reinforcement and subgrades to confirm compliance with the related Work specified elsewhere.

3.02 Embedded Items

A. CONTRACTOR shall verify the location, from certified vendor or applicable engineering drawings, of all embedded items including anchor bolts, wall sleeves, wall casting, railing post sleeves and miscellaneous pipes and conduits and shall install the items accurately at the locations determined.

3.03 Building in Other Work

A. CONTRACTOR shall make all necessary provisions in concrete Work for other Work installed by this or other contractors, and build in all required steel beams, frames, curbs, expansion joints, inserts, hangers, pipes, floor drains, pipe trench covers and frames, anchors, sleeves, floor ducts, fiber and steel conduit, pipe hanger sockets, and all other Work furnished by either this or other contractors.

B. CONTRACTOR shall build in all anchors, ties, etc., specified under brick and other Work, in faces of concrete Work which are to be faced with masonry, and any other Work shown or noted to be built into concrete. In addition, CONTRACTOR shall provide all openings and holes in concrete Work as shown or as needed to accommodate other Work.

3.04 Special Concrete

A. CONTRACTOR shall verify the use and/or locations of watertight concrete and/or high-early strength concrete.

3.05 Preparation

A. CONTRACTOR shall notify ENGINEER two (2) working days prior to placement of concrete.

B. Before depositing new concrete on or against existing concrete the existing concrete shall be roughened, thoroughly cleaned of foreign matter and laitance and saturated with water. The cleaned and saturated surface of the hardened concrete, including vertical and inclined surfaces, shall be coated with a bonding agent or slushed with a minimum 2-inch (50 mm) thick coating of concrete without coarse aggregate grout against which the new concrete shall be placed before the mixture has attained its initial set.

C. Before concrete is placed in any unit, the forms and the placing and fixing of all steel and incidental items shall be complete, and the forms, steel and adjacent concrete shall be thoroughly cleaned and wetted down.

D. Where indicated on the Plans, CONTRACTOR shall bridge the subgrade with at least 2,000 psi (13.8 MPa), 3-inch (75 mm) thick lean concrete before placing the reinforcement. This shall be at no extra cost.

E. No concrete shall be deposited in any unit until the area has been completely dewatered in accordance with Section 31 2319, Dewatering, and not until after CONTRACTOR has made satisfactory provisions to eliminate all possibility of water entering or flowing through the concrete while it is being poured or is taking its set. No concrete shall be placed under or on water.

3.06 Conveying

A. Concrete handling equipment shall be of such a nature and shall be so located that the concrete after leaving the mixer will reach its destination with a minimum lapse of time, with no segregation, and loss of slump. Use of drop chutes, except at or in the forms, is prohibited.

B. Interior hopper slope of concrete buckets shall be not less than 60 degrees from the horizontal, the minimum dimension of the clear gate opening shall be at least 5 times the nominal maximum size aggregate and the area of the gate opening shall be not less than 2 square feet (0.2 m^2).

1. Maximum dimension shall not be greater than twice the minimum dimension.

2. Bucket gates shall be essentially grout tight when closed and may be manually, pneumatically or hydraulically operated except for buckets larger than 2 cubic yards (1.5 m^3) shall not be manually operated.

3. Design of the bucket shall provide means for positive regulation of the amount and rate of deposit of concrete in each dumping position.

C. Belt conveyors shall be designed and operated to assure a uniform flow of concrete from mixer to final place of deposit without segregation of ingredients or loss of mortar and shall be provided with positive means for preventing segregation of the concrete at the transfer points and the point of placing.

D. Concrete may be conveyed by positive displacement pump when authorized by ENGINEER. Pumping equipment shall be piston or squeeze pressure type. Pipeline shall be rigid steel pipe or heavy duty flexible rubber hose. Inside diameter of the pipe shall be at least 3 times the nominal maximum size coarse aggregate in the concrete mixture to be pumped. Maximum size coarse aggregate shall not be reduced to accommodate the pumps.

E. Distance to be pumped shall not exceed limits recommended by the pump manufacturer. Concrete shall be supplied to the pump continuously. When pumping is completed, concrete remaining in the pipeline shall be ejected without contamination of concrete in place. After each operation, equipment shall be thoroughly cleaned, and flushing water shall be wasted outside of the forms.

3.07 Placing

A. Concrete shall be so deposited as to maintain the top surface level, unless otherwise shown on the Plans, and also as to avoid any appreciable flow in the mass.

B. Where placing operations involve dropping the concrete more than 3feet (1 m) in the forms, it shall be deposited through sheet metal or other approved spouts or pipes. These spouts or pipes shall have suitable receiving hoppers at the upper ends, and the lower ends shall be kept within 6 inches (150 mm) of the newly placed concrete so as to prevent segregation and avoid spattering the reinforcing steel with mortar. Under no circumstances shall concrete that has partly hardened be deposited in the Work.

C. Each layer of concrete shall be plastic when covered with the following layer and the forms shall be filled at a rate of vertical rise of not less than 2 feet (600 mm) per hour. Concrete vibrators shall penetrate the initial layer when placing the following layer. Vertical construction joints shall be provided as necessary to comply with these requirements.

D. Concrete shall be placed and compacted in wall or column forms before any reinforcing steel is placed in the system to be supported by such walls or columns. The portion of any wall or column placed monolithically with a floor or roof slab shall not exceed 6 feet (1.8 m) of vertical height. Concrete in walls or columns shall set at least 2 hours before concrete is placed in the structural systems to be supported by such walls or columns.

E. Concrete shall be set when top finished. Laitance, debris, and surplus water shall be removed from concrete surfaces at tops of forms by screeding, scraping, or other effective means. Wherever the top of a wall will be exposed to weathering, the forms shall be overfilled and after the concrete has settled, the excess shall be screeded off.

F. No concrete shall be placed in contact with frozen ground. Time between charging and placement of concrete shall not exceed 1-1/2 hours.

G. Concrete shall be compacted by continuous vibrating, tamping, spading or slicing. Care shall be taken to eliminate all voids and to provide full bond on reinforcing steel and embedded fixtures. Mechanical vibration shall be employed. Concrete shall be compacted and thoroughly worked with suitable tools combined with the use of vibrators applied internally and providing a frequency not less than 7,000 revolutions per minute. All such vibrating, including the methods and equipment, shall be subject to the review of ENGINEER.

H. The time of vibrating in any area shall only be sufficient to get efficient compaction, but shall in no case be carried to the point where there is segregation of the fine and coarse materials of the mix. There shall be an absolute minimum of direct vibration of the steel or forms during the process of vibrating. Vibrators shall be inserted and withdrawn from the concrete at numerous locations, from 18 to 30 inches (450 to 750 mm) apart, but shall not be used to transport concrete within the forms. CONTRACTOR shall have a standby vibrator on the job site during all concrete pouring operations.

3.08 Finishing Unformed Surfaces

A. The unformed surfaces of all concrete shall be screeded and given an initial float finish followed by steel troweling.

B. Screeding shall provide a concrete surface conforming to the proper elevation and contour with all aggregates completely embedded in mortar. All screeded surfaces shall be free of surface irregularities with a height or depth in excess of 1/4 inch (5 mm) as measured from a 10-foot (3 m) straightedge.

C. Screeded surfaces shall be given an initial float finish as soon as the concrete has stiffened sufficiently for proper working. Any piece of coarse aggregate which is disturbed by the float or which causes a surface irregularity shall be removed and replaced with mortar. Initial floating shall produce a surface of uniform texture and appearance with no unnecessary working of the surface. Floating shall be performed with hand floats or suitable mechanical compactor floats.

D. Troweling shall be performed after the second floating when the surface has hardened sufficiently to prevent an excess of fines being drawn to the surface. Troweling shall produce a dense, smooth, uniform surface free from blemishes and trowel marks. The top surface of driveways, and sidewalks shall be given a broomed finish after troweling.

E. Unless specified to be beveled, exposed edges of floated or troweled surfaces shall be edged with a tool having 1/4 inch (5 mm) corner radius.

3.09 Finishing Formed Surfaces

A. After removal of forms, the finishing of all concrete surfaces shall be started as soon as its condition will permit.

B. Grind all seams, fins or projections flush with the concrete surface.

C. Fill and point all honeycomb, tie holes and voids.

D. Dampen the surface with water and apply a cement and silica sand slurry to the entire surface to fill small defects and air voids.

E. Remove excess slurry from concrete. Surfaces to be finished shall receive an application of dry Portland cement which shall be rubbed into the slightly dampened surface with a suitable cloth.

F. After pointing and removal of projections as specified herein, exposed surfaces of concrete, including walls, columns, beams, pilasters and the undersides of slabs, shall be given a rubbed surface finish.

3.10 Floors

A. Concrete floor finish shall be applied to all building floors not receiving further floor finish. At these locations, the concrete shall be brought to the proper elevation and screeded. The surface shall be given two (2) steel trowelings when the concrete has set sufficiently to finish smoothly. Floors shall be sloped uniformly toward floor drains at a slope of 1/8 inch per foot (10 mm per meter).

B. Concrete finish on steps and loading platforms shall be wood troweled to true and uniform surface and then steel troweled. The surface shall then be slightly roughened with a broom or by dragging burlap across the surface.

C. Concrete floors shall be finished with an abrasive resistant floor finish in the areas noted on the finish schedule on the Plans. Premixed floor hardener shall be applied to the surface of the freshly floated concrete floor, in strict accordance with the manufacturer's directions. Color to be selected by OWNER.

3.11 Expansion Joints

A. Comply with the requirements of Section 03 1500, Concrete Accessories. Expansion joints shall have removable polystyrene joint caps secured to the top thereof and shall be accurately positioned and secured against displacement to clean, smooth concrete surfaces.

B. Joint caps shall be of the size required to install filler strips at the desired level below the finished concrete surface and to form the groove for the joint sealant to the size shown on the Plans.

C. Joint caps shall not be removed until after the concrete curing period.

3.12 Concrete Curing

A. Concrete shall be cured for a period not less than 7 consecutive days. CONTRACTOR shall have adequate equipment and curing material on the job site before concrete placement begins, and it shall be adequate to prevent checking and cracking and loss of moisture from all the surfaces of the concrete. Concrete shall be protected from rain, flowing water, wind and the direct rays of the sun. Openings in concrete shall be sealed to prevent drying of the concrete during the curing period.

B. Curing compounds shall not be used on surfaces to which additional concrete or other material are to be bonded.

C. Curing compounds when used shall be applied in strict accordance with the manufacturer's recommendations.

D. Concrete cured with water shall be kept wet by covering with ponded water or fog spraying to keep all surfaces continuously wet.

E. Horizontal construction joints and finished surfaces cured with sand shall be covered a minimum thickness of 1-inch (25 mm), uniformly, and kept saturated during the curing period.

F. Burlap used for curing shall be treated to resist rot and fire and free of sizing or any substances that are injurious to Portland cement or cause discoloration. Strips shall be lapped by half widths. The burlap shall be saturated with water after placement and during the curing period.

G. Straw or hay shall be in a layer no less than 6 inches (150 mm) thick and held in place by screens, wire or other means to prevent dispersion by the wind. Care shall be observed to avoid discoloration of the concrete surface from the vegetable fibers and for the flammability of the material. The straw shall be saturated with water after placement and during the curing period.

3.13 Environmental Conditions

A. General:

1. CONTRACTOR shall provide cold or hot weather protection in accordance with ACI and as specified herein. There shall be no additional cost for hot or cold weather protection of the concrete.

B. Cold Weather Protection:

1. When placing concrete in cold weather, CONTRACTOR shall plan and prosecute his Work in a manner which shall assure results free from damage through freezing, contraction, and loss of concrete strength.

2. No concrete shall be poured when the surrounding temperature is below 40°Fahrenheit (4°Celsius), unless the aggregates and water are properly heated. Concrete which has been poured at higher temperatures but has not attained a strength equal to 75% of the required strength of the class of concrete involved, shall be housed and protected in accordance with the provisions of this Section whenever the surrounding temperature falls below 40° Fahrenheit (4°Celsius).

3. Application of heat to the materials shall be made in a manner which will keep these materials clean and free from injurious substances.

4. Aggregates may be heated only by steam coils or steam jets, except in the case of small quantities of concrete when other methods may be approved by the ENGINEER. A sufficient quantity of properly heated aggregates shall be on hand prior to starting the pouring of any unit.

5. Concrete shall be properly housed with canvas, burlap, or other windproof material in such a manner that any necessary removal of the forms or finishing of the concrete can proceed without undue damage to the concrete from the elements.

6. Heating of the housing shall be done in a manner which will maintain a temperature between 50° and 70° Fahrenheit (10° and 20°Celsius), at all times for at least 5 days after the pour is complete and 12 hours before the pour begins.

7. Supplemental heating units shall have exhaust vented to the exterior and shall not cause deleterious reactions or deposits to occur to concrete.

C. Hot Weather Protection:

1. Concrete deposited in hot weather shall not have a placing temperature that will cause difficulty from loss of slump, flash set, or cold joints. Concrete temperature shall be less than 90°Fahrenheit (32°Celsius).

2. In hot weather, suitable precautions shall be taken to avoid drying of the concrete prior to finishing operations. Use of windbreaks, sunshades, fog sprays, or other devices shall be provided.

3.14 Addition of Water

A. To increase workability, adding water to the mix shall be limited to a one time addition of 1 gallon of water per cubic yard of concrete (5 liters per cubic meter) and mixed with a minimum of 30 revolutions at a rate of 12 to 15 revolutions per minute. Addition of water shall be within the slump requirements.

3.15 Concrete Delivery Ticket

A. A ticket system shall be used for recording the transportation of concrete from the batching plant to point of delivery. This ticket shall be issued to the truck operator at the point of loading and given to ENGINEER upon delivery. Ticket shall as a minimum indicate the time of mixer charging, quantity of concrete, type of mixture including amount of cement, and the plant where the concrete was batched.

3.16 Concrete Delivery Rejection

A. Concrete not permitted for inclusion in the Work by ENGINEER shall be removed from the site. Rejection of concrete will be determined through concrete testing and elapsed time from mixer charging to delivery.

3.17 Concrete Testing at Placement

A. General:

1. Tests shall be made of fresh concrete for each 50 cubic yards (40 m^3), or whenever consistency appears to vary. Sampling and testing of slump, air content and strength will be performed at no cost to CONTRACTOR.

2. Composite samples shall be secured in accordance with the Method of Sampling Fresh Concrete, ASTM C172.

B. Slump Test:

1. Slump Test shall be in accordance with ASTM C143. CONTRACTOR shall use the least slump possible consistent with workability for proper placing of the various classifications of concrete.

2. A tolerance of up to 1-inch (25 mm) above the indicated maximum slump shall be allowed for individual batches provided the average for all batches or the most recent 10 batches tested, whichever is fewer, does not exceed the maximum limit.

C. Air Content:

1. Air content of normal weight concrete will be determined in accordance with Method of Test for Air Content of Freshly Mixed Concrete by the Pressure Method, ASTM C231.

D. Compressive Strength:

1. A set of cylinders for compressive strength tests will consist of four cylinders per each set.

2. Molding and curing specimens from each set shall be in accordance with Method of Making and Curing Concrete Test Specimens in the Field, ASTM C31. Any deviations from the requirements of this Standard shall be recorded in the test report.

3. Testing specimens will be in accordance with Method of Test for Compressive Strength of Cylindrical Concrete Specimens, ASTM C39. One (1) specimen shall be tested at 7 days for information and 2 shall be tested at 28 days for acceptance.

a. The acceptance test results shall be the average of the strengths of the 2 specimens tested at 28 days. If 1 specimen in a test manifests evidence of improper sampling, molding or testing, it shall be discarded and the strength of the remaining cylinder shall be considered the test result.

4. The strength level of the concrete will be considered satisfactory so long as the averages of all 28 day strength test results equal or exceed the specified 28-day strength and no individual strength test result falls below the specified 28-day strength by more than 500 psi (3.4 MPa).

5. If the strength test is not acceptable, further testing shall be performed to qualify the concrete.

3.18 Testing of Concrete in Place

A. Additional testing of materials or concrete occasioned by their failure by test or inspection to meet specification requirements shall be at the expense of CONTRACTOR.

B. Testing by impact hammer, sonoscope, or other nondestructive device may be permitted by ENGINEER to determine relative strengths at various locations in the structure as an aid in evaluating concrete strength in place or for selecting areas to be cored. Such tests, unless properly calibrated and correlated with other test data, shall not be used as a basis for acceptance or rejection.

C. When required by ENGINEER, cores at least two (2) inches (50 mm) in diameter shall be obtained and tested in accordance with Methods of Obtaining and Testing Drilled Cores and Sawed Beams of Concrete, ASTM C42.

D. If the concrete in the structure will be dry under service conditions, the cores shall be air dried (temperature 60° to 80°Fahrenheit (15°-25°Celsius), relative humidity less than 60%) for 7 days before test and shall be tested dry.

E. If the concrete in the structure will be more than superficially wet under service conditions, the cores shall be tested after moisture conditioning in accordance with ASTM C42.

F. At least 3 representative cores shall be taken from each member or area of concrete in place that is considered potentially deficient. The location of cores shall be determined by ENGINEER so as to least impair the strength of the structure. If, before testing, one or more of the cores shows evidence of having been damaged subsequent to or during removal from the structure, it shall be replaced.

G. Concrete in the area represented by a core test will be considered adequate if the average strength of the cores is equal to at least 85% of and if no single core is less than 75% of the specified 28-day strength.

H. Core holes shall be filled by low slump concrete or mortar.

3.19 Retention Testing

A. Tanks or structures designed to hold or retain water, wastewater or other liquids shall be retention tested.

B. To test a tank or structure for leakage, CONTRACTOR shall clean, disinfect (if required) and fill the tank or structure with water to its maximum level.

C. The water shall be allowed to remain 24 hours with all associated valves and appurtenances tightly closed.

D. During this 24-hour period, the water level as measured by a hook gage shall show no measurable loss.

E. If this test fails, CONTRACTOR shall dewater the tank or structure, make such repairs as necessary to achieve a watertight tank or structure, clean, disinfect (if required), and retest.

F. Tests and repairs shall be repeated until the tank or structure is accepted by ENGINEER.

3.20 Defective Concrete

A. If, in the opinion of ENGINEER, the defects in the concrete are of such a nature as to warrant condemnation, that portion of the pour may be ordered replaced in its entirety and CONTRACTOR shall promptly replace same without additional compensation.

B. Defective concrete shall be repaired by cutting out the defective area and placing new concrete which shall be formed with keys, dovetails or anchors to attach it securely in place.

End of Section

Division 04
Masonry

Section 04 0511
Mortaring and Grouting

Part 1 General

1.01 Scope of Work

A. This Section includes the preparation and installation of mortar and grout used for bond or primer coats, laying and grouting masonry units, filling the inside annular space of pipe joints, general patching, grout for riprap and flagstone slope protection, joints in precast structural members, spaces under leveling plates and equipment bases, supporting structures, grouting dowels and anchor bolts.

1.02 Definitions

A. Mortar is a plastic mixture of cementitious materials, admixtures where specified, fine aggregate and water. Grout is a mixture of sand, water, and fine aggregate mixed to a fluid consistency.

1.03 Reference Standards

A. ACI - American Concrete Institute

B. ANSI - American National Standards Institute

C. ASTM - American Society for Testing and Materials

D. MDOT - Michigan Department of Transportation, Standard Specifications for Construction, latest edition

1.04 Reference Specifications

A. Latest or current ACI Standards, and the “Specifications for Masonry Structures," ACI-530.1, shall govern mortar and grout work except where otherwise specified herein.

1.05 Submittals

A. Manufacturer's literature shall be submitted for premixed materials.

1.06 Product Delivery, Storage, and Handling

A. Materials shall be stored and handled as recommended in ACI 304.

B. When cement is stored in the open, a floor at least six (6) inches (150 mm) above the ground and a waterproof covering shall be provided and so placed as to insure runoff in case of rain. At the time of its use the cement shall be free from lumps. Cement sacks shall be thoroughly shaken when emptying sacks into the batch. Cement salvaged by CONTRACTOR by cleaning sacks mechanically or otherwise, or from discarded sacks of cement shall not be used.

C. Aggregates are to be furnished, stocked and handled so that uniformity of grading will be obtained at the time of batching. The area on which stockpiles are to be built shall be thoroughly cleaned of all foreign materials and shall be firm, reasonably level, and well drained. No aggregates which have become intermixed prior to proportioning shall be used.

D. The premixed mortar or grout shall be stored and handled in strict accordance with the manufacturer's recommendations.

1.07 Job Conditions

A. Environmental requirements relative to temperature for mixing and placing mortar or grout shall be in accordance with Articles 2.08 and 3.08 of this Section.

Part 2 Products

2.01 Premixed Mortar or Grout

A. Premixed mortar or grout shall be a complete packaged mixture to which water is to be added at the job site. Mortar and grout shall be nonshrink, nonstaining.

2.02 Cement

A. The type of cement to be used shall be as indicated on the Plans or as specified below:

1. Portland cement: Types I, IA or III: ASTM C150.
2. Masonry cement: Type N, S, or M: ASTM C91.
3. Mortar: Type M or S: ASTM C270.
4. Hydrated lime: Type S: ASTM C207.

2.03 Aggregate

A. Fine aggregate: Type 2MS, per MDOT Section 902.08.

2.04 Admixtures

A. Integral waterproofing compounds, accelerators, retarders or other admixtures not definitely mentioned in the Specifications shall not be used in mortar or grout without the approval of the ENGINEER. Use no admixtures containing calcium chloride.

2.05 Water

A. Water shall be free from oil, acid, alkali, organic matter, and any other deleterious substances. Water approved by the State Board of Health may be used without testing. Water from other sources shall be tested before using.

2.06 Mixes

A. General:

1. Water shall be added to premixed mortar or grout in strict accordance with manufacturer's recommendations to prepare a stiff or plastic mix, depending on workability needed for application.

2. For job mixed mortar or grout, a mixture of cement, aggregate, water and admixtures, if required, shall be combined in proportions meeting the requirements of MDOT Section 702 to produce mortar or grout for the use indicated on the Plans and as specified herein.

3. For job mixed mortar and grout the cement and aggregate shall be proportioned by weight for cubic yard (or cubic meter) batches or by volume for small batches. Shovel method of volume measuring will not be permitted. When materials are measured by volume, water shall be added in amounts necessary for the consistency required for the Work.

B. Standard Mortar and Grout:

MDOT Designation	General Use
R-1 (Grout)	Bond or Primer Coat
R-2 (Mortar)	Laying masonry units, caulking pipe joints, general patching
R-3 (Mortar)	Filler between slope protection and riprap

C. Nonshrinking Mortar and Grout:

1. Unless otherwise indicated on the Plans or Specifications, the cement shall be Portland Type I. The materials shall be proportioned by weight, with water added in amounts to obtain necessary consistency required for the Work.

MDOT Designation	General Use
Type H-1	Joints in precast structural members
Type H-2	Spaces under leveling plates, supporting structures, grouting dowels, anchor bolts

2.07 Mixing

A. Minimum mixing time shall be five (5) minutes. Consistency of mortar shall be adjusted to provide the best workability. If the mortar begins to stiffen from evaporation or absorption of a part of the mixing water, the mortar shall be retempered by adding water and remixing. Consistency of the grout shall be such that at the time of placement, it will completely fill all spaces intended to receive grout.

2.08 Mix Temperature

A. The temperature of the mix shall be between 40 degrees and 120 degrees Fahrenheit (4 degrees to 49 degrees Celsius).

2.09 Acceptable Manufacturers

A. Acceptable manufacturers of premixed, nonshrink, nonmetallic grout include: Sonneborn "Sonogrout"; L and M Construction Chemicals "Duragrout"; Master Builders "Masterflow 713"; Five Star Products “Five Star Grout”, or equal.

Part 3 Execution

3.01 Contractor's Verification

A. CONTRACTOR shall verify the elevation of structural member or equipment bases to be grouted, and/or location of anchoring devices as indicated on the Plans or approved Shop Drawings.

3.02 Preparation

A. Surfaces to receive mortar or grout shall be prepared as follows, unless otherwise specified:

1. Remove laitance down to sound concrete.

2. Surface shall be properly wet cured, being free of chemical curing compound, oil, grease, dirt and loose particles.

3. Clean bolt and/or tie holes, anchor bolts and underside of bearing plates.

4. Saturate concrete including holes prior to grouting.

B. When a premixed mortar or grout is used, preparation of surfaces shall be in strict accordance with manufacturer's recommendations.

3.03 Installation - General

A. All mortar and grout shall be used within 2-1/2 hours of initial mixing. No mortar or grout shall be used after it has begun to set.

B. Premixed mortar or grout shall be used in strict accordance with the manufacturer's recommendations.

3.04 Installation of Masonry Units

A. Mortar joints to bond brick or block shall be no less than 3/8 inch (9 mm) and no greater than 1/2 inch (10 mm) thick. Surface of the joint shall be struck to be flush with the masonry units.

3.05 Surface Finishing Applications

A. Nonshrink mortar shall be thoroughly compacted into all voids, holes, honeycombs, or other defects in the finish surface of concrete. Mortar shall be flush with the surrounding concrete and matching in color and texture.

3.06 Grouting Anchoring Devices

A. Nonshrink, nonstaining mortar or grout shall be placed in the hole provided, then the anchoring device or dowel shall be set into the grout filled hole. Surface shall be flush with the surrounding concrete. No pressures or loads shall be applied to the anchoring device until the mortar or grout has attained its ultimate strength.

3.07 Grouting Plates and Structural Members

A. Thoroughly fill the area between the foundation and plate or member with nonshrink, nonmetallic grout. If required, immediately set shims and align plate or member as required. After the grout has set hard remove forms or shims and finish with a capping mortar.

3.08 Cold Weather Work

A. General:

1. No masonry units, mortar or grout Work shall be placed in contact with frozen surfaces. No mortar or grout Work shall be performed when the mean air temperature is below 40 degrees Fahrenheit (4 degrees Celsius) unless the materials are heated and/or CONTRACTOR provides adequate protection of the Work. Work shall be protected against freezing for no less than 48 hours after placement.

2. Application of heat to the materials shall be made in a manner which will keep these materials clean and free from injurious substances.

B. Air Temperature 40 degrees to 32 degrees Fahrenheit (4 to 0 degrees Celsius):

1. Sand or mixing water shall be heated to produce mortar temperatures between 40 degrees and 120 degrees Fahrenheit (4 to 49 degrees Celsius). Heating of either of the ingredients shall be to a minimum 70 degrees and maximum 160 degrees Fahrenheit (21 to 71 degrees Celsius). Ideal mortar temperature should be 70 degrees to 80 degrees Fahrenheit (21 to 27 degrees Celsius).

C. Air Temperature 32 degrees to 25 degrees Fahrenheit (0 to -4 degrees Celsius):

1. Sand and mixing water shall be heated to produce mortar temperatures between 40 degrees and 120 degrees Fahrenheit (4 to 49 degrees Celsius). Maintain temperatures of mortar on boards above freezing. Heat sand and water to a minimum 70 degrees and maximum 160 degrees Fahrenheit (21 to 71 degrees Celsius).

D. Air Temperature 25 degrees to 20 degrees Fahrenheit (-4 to -7 degrees Celsius):

1. Sand and mixing water shall be heated to produce mortar temperatures between 40 degrees and 120 degrees Fahrenheit (4 to 49 degrees Celsius). Maintain mortar temperatures on boards above freezing. Salamanders or other sources of heat shall be used on both sides of interior bearing walls under construction and on the inside of all exterior walls. Windbreaks shall be employed when wind is in excess of 15 mph (24 kph).

E. Air Temperature 20 degrees Fahrenheit (-7 degrees Celsius) and Below:

1. Sand and mixing water shall be heated to provide mortar temperatures between 40 degrees and 120 degrees Fahrenheit (4 to 49 degrees Celsius). Enclosure and auxiliary heat shall be provided to maintain air temperature above 32 degrees Fahrenheit (0 degrees Celsius). Temperature of units when laid shall be not less than 20 degrees Fahrenheit (-7 degrees Celsius).

End of Section

Section 04 0513
Masonry Mortaring

Part 1 General

1.01 Scope of Work

A. CONTRACTOR shall furnish tools, equipment, materials, and supplies and shall perform labor required to complete the mortar for unit masonry construction and masonry repointing work as indicated on the Contract Drawings and specified herein.

1.02 Related Work Specified Elsewhere

A. Section 04 2000: Unit Masonry

1.03 References

A. American Society for Testing and Materials (ASTM):

1. ASTM C109, Test Method for Compressive Strength of Hydraulic Cement Mortars
2. ASTM C144, Specification for Aggregate for Masonry Mortar
3. ASTM C150, Specification for Portland Cement
4. ASTM C207, Specification for Hydrated Lime for Masonry Purposes
5. ASTM C270, Specification for Mortar for Unit Masonry
6. ASTM C780, Test Method for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry
7. ASTM C1148, Standard Test Method for Measuring the Drying Shrinkage of Masonry Mortar

1.04 Submittals

A. Submit the following in accordance with Section 01300, Submittals:

1. Product Data:
    a. Submit manufacturer's instructions, product data and MSDS.
    b. Submit mortar mix design as well as data indicating proportion or property specifications used for each type of mortar including Portland cement, lime sand and coloring admixtures, if any.
2. Samples: Submit cured samples of colored mortar to Architect for initial review.
3. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
4. Test Reports: Submit test reports for mortar indicating conformance with ASTM C270 property specifications.

1.05 Quality Assurance

A. Cementitious materials, aggregates and color admixtures are to be blended and packaged under factory controlled conditions, requiring only the addition of water on site.

B. Use approved mix designs and single-source all aggregates, cement, lime and color admixtures to assure maximum consistency.

1.06 Delivery, Storage And Handling

A. Deliver prepackaged, dry-blended mortar mix to project site in clearly labeled plastic-lined bags each bearing the name and address of the manufacturer, Production Codes or Batch Numbers, and color or formula numbers. Individual bag weight is approximately 50 pounds.

B. Store mortar off the ground and in accordance with manufacturer's instructions to prevent contamination by foreign materials. Maintain packaged materials in a clean, dry state protected against weather, traffic and foreign materials.

1.07 Environmental Requirements

A. Cold Weather Requirements:

1. When ambient air temperature is below 40 degrees Fahrenheit, heat mixing water to maintain mortar temperature between 40 and 120 degrees Fahrenheit until placed. If necessary, store materials in a heated area to allow mortar temperatures to remain above 40 degrees Fahrenheit throughout the placement and finishing cycle.

2. Subject to written approval of the mortar manufacturer, and in accordance with their written dosage instructions, add the recommended quantity and type of non-chloride accelerating admixture when temperatures are below 32 degrees Fahrenheit.

B. Hot Weather Requirements:

1. Under hot, dry and windy conditions use proper predampening, protection and moist curing procedures as required to keep mortar moist for 72 hours following final tooling.

Part 2 Products

2.01 Materials

A. Portland cement: ASTM C150 Type I, grey or white as required to match original mortar. Fly ash, slag and pozzolans are not permitted as substitutes for Portland cement.

B. Hydrated Lime: ASTM C207 Type S, incorporated as a finely divided powder in uniform particle size, free of lumps, flakes or other inconsistencies.

C. Mortar Aggregate: ASTM C144 Natural sand blend, rounded to sub-angular in shape, washed, screened and dried, with zero or near zero -270 crystalline silica content. Aggregate to be selected to match the color and texture of the original mortar aggregates as closely as possible while remaining in compliance with ASTM C144 grading and soundness requirements.

D. Mortar Colors: Inorganic mineral oxides meeting the requirements of ASTM C797, at levels not to exceed 10% on cement weight, except for carbon black, which may not exceed 2% on cement weight.

E. Admixtures: NO admixtures shall be used without the express written consent of the Architect and the mortar manufacturer. Calcium chloride is not permitted in any mortar. Admixtures containing more than 0.1% chloride ions are NOT permitted.

F. Water: Potable, free of deleterious quantities of materials which may affect mortar performance or appearance.

2.02 Mixing Mortar

A. Mortar shall be preblended, pre-colored and prepackaged under controlled factory conditions. Ingredients are to be batched within plus or minus 1% accuracy, except pigments which shall be weighed to a precision of 0.01%.

1. Mortar shall conform to the minimum property requirements given in Table II of ASTM C270, based on 28 day laboratory testing ONLY. Mortar type shall be as selected, based on the following criteria:

a. Type M: 2500 psi min.; for pavements and walls in contact with earth or below grade.

b. Type S: 1800 psi min.; for chimneys, parapets and load-bearing masonry constructions.

c. Type N: 750 psi min.; for general repointing of walls

d. Type O: 350 psi min.; for repointing of softer masonry or masonry where original mortar design mix was Type O.

e. Type K: High lime mortar; for repointing of historic masonry or structures constructed with low strength brick or sandstone.

f. Straight lime Mortar "L": No Portland cement in mix; for masonry buildings constructed prior to 1900 and incorporating lime mortars without Portland cement.

B. Thoroughly mix mortar in quantities needed for immediate use, using mechanical mortar mixer or paddle mixer. Add approximately half the required water and mix mortar for a minimum of 5 minutes, and then slowly add water as needed to reach the desired working consistency. Do not exceed mix time of 10 minutes.

C. Add only clean, potable water at the project site. Do not add cement, lime, bonding agents, coloring admixtures, set accelerators, plasticizers, air entraining admixtures or other materials unless specifically authorized in writing.

D. Use a batch type mixer in accordance with ASTM C270.

E. Use of ready mix mortar (ASTM C1142) is not acceptable.

F. Use mortar within 1-1/2 hours of mixing, after which unused mortar is to be discarded. This period shall be reduced to 30 minutes in hot weather.

1. Retempering is allowed in accordance with ASTM C270 if it is demonstrated that retempering does not negatively affect color consistency.

2. Retempering is to be used to replace water lost to evaporation only.

3. Do not retemper mortars which have begun to set.

Part 3 Execution

3.01 Installation

A. General:

1. Pre-dampen masonry surfaces to receive repointing mortar for a minimum of 20 minutes prior to mortar placement.

2. Masonry surfaces should be saturated but free of excess or standing water at time of mortar placement.

B. Fill mortar into joints in 1/4 inch "lifts". Start by filling deeper sections, compacting each layer, packing it into the rear and corners of the joint.

C. As soon as the mortar reaches "thumbprint" hardness, apply the next layer at 1/4 inch thickness. A minimum of 2 layers are required.

D. When final layer is thumbprint hard, tool to specified profile. Match to adjacent, existing profile or to original profile as instructed.

E. To avoid changing the appearance of the building, it may be necessary to slightly recess the mortar from the masonry surface. Do not flush fill joints in worn masonry if this results in a visually wider joint than the original.

F. Remove excess mortar and smears using a stiff natural bristle brush and clean water before it has set.

G. Wet cure tooled joints as required by lightly misting with clean water periodically for up to 3 days following installation.

1. Type K and straight Lime mortars always require 3 days wet cure.

2. Types O and N may require shorter wet cure periods, depending on temperature, humidity, wind and suction of the masonry.

a. Misting should be performed every hour or two on the first day, as required to maintain the mortar in a wet condition, and this may be reduced to every three or four hours on subsequent days.

H. Final Cleaning:

1. Allow mortar to fully cure for a minimum of 28 days before final cleaning. Only low pressure should be used to avoid damaging newly repointed joints.

End of Section

Section 04 2000
Unit Masonry

Part 1 General

1.01 Scope of Work

A. CONTRACTOR shall furnish tools, equipment, materials, and supplies and shall perform labor required to complete the unit masonry work as indicated on the Contract Drawings and specified herein.

B. CONTRACTOR alone shall be fully responsible for the design, strength, safety and adequacy of shoring, bracing and methods of construction, and for the strength, consistency, finish and general quality of masonry.

1.02 Related Work Specified Elsewhere

A. Section 04 0513: Masonry Mortar
B. Section 06 1000: Rough Carpentry
C. Section 07 6000: Flashing and Sheet Metal
D. Section 08 1100: Hollow Metal Doors and Frames

1.03 Quality Assurance

A. Unit Masonry Standard: Comply with ACI 530.1/ASCE 6, *Specifications for Masonry Structures*, except as otherwise indicated herein.

B. Single-Source Responsibility for Masonry Units: Obtain exposed masonry units of uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, from one manufacturer for each different product required for each continuous surface or visually related surfaces.

C. Single-Source Responsibility for Mortar Materials: Obtain mortar ingredients of uniform quality, including color for exposed masonry, from one manufacturer for each cementitious component and from one source and producer for each aggregate.

D. Preinstallation Conference: Conduct conference at Project site to comply with requirements of Division 1.

1.04 Submittals

A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.

B. Product Data:

1. Product data for each different masonry unit, accessory, and other manufactured product indicated.

C. Shop Drawings:

1. Shop drawings for stone trim in form of cutting and setting drawings showing sizes, profiles, and locations of each stone trim unit required.

2. Shop drawings for reinforcing detailing fabrication, bending, and placement of unit masonry reinforcing bars. Comply with ACI 315, *Details and Detailing of Concrete Reinforcing*, showing bar schedules, stirrup spacing, diagrams of bent bars, and arrangement of masonry reinforcement.

D. Test Reports:

1. Material test reports from a qualified independent testing laboratory employed and paid by CONTRACTOR indicating and interpreting test results relative to compliance of the following proposed masonry materials with requirements indicated:

a. Mortar complying with property requirements of ASTM C 270.

b. Grout mixes. Include description of type and proportions of grout ingredients.

c. Masonry units.

1.05 System Performance Requirements

A. Provide unit masonry that develops the following installed compressive strengths (f'_m):

1. For concrete unit masonry: f'_m = 1500 psi

1.06 Project Conditions

A. Protection of Masonry: During erection, cover tops of walls, projections, and sill with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.

1. Extend cover a minimum of 24 inches down both sides and hold cover securely in place.

2. Where one wythe of multi-wythe masonry walls is completed in advance of other wythes, secure cover a minimum of 24 inches down face next to unconstructed wythe and hold cover in place.

B. Do not apply uniform floor or roof loads for at least 12 hours and concentrated loads for at least 3 days after building masonry walls or columns.

C. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Remove immediately any grout, mortar, and soil that comes in contact with such masonry.

1. Protect base of walls from rain-splashed mud and mortar splatter by means of coverings spread on ground and over wall surface.

2. Protect sills, ledges, and projections from mortar droppings.

3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes from mortar droppings.

D. Cold-Weather Construction: Comply with referenced unit masonry standard for cold-weather construction and the following:

1. Do not lay masonry units that are wet or frozen.
2. Remove masonry damaged by freezing conditions.

E. Hot-Weather Construction: Comply with referenced unit masonry standard.

1.07 Delivery, Storage, And Handling

A. Deliver masonry materials to project in undamaged condition.

B. Store and handle masonry units off the ground, under cover, and in a dry location to prevent their deterioration or damage due to moisture, temperature changes, contaminants, corrosion, and other causes. If units become wet, do not place until units are in an air-dried condition.

C. Store cementitious materials off the ground, under cover, and in dry location.

D. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.

E. Store masonry accessories including metal items to prevent corrosion and accumulation of dirt and oil.

Part 2 Products

2.01 General

A. Comply with referenced unit masonry standard and other requirements specified in this Section applicable to each material indicated.

2.02 Concrete Masonry Units

A. General: Comply with requirements indicated below applicable to each form of concrete masonry unit required.

1. Provide special shapes where indicated and as follows:

   a. For lintels, corners, jambs, sash, control joints, headers, bonding, and other special conditions.

   b. Square-edged units for outside corners, except where indicated as bullnose.

2. Size: Provide concrete masonry units complying with requirements indicated below for size that are manufactured to specified face dimensions within tolerances specified in the applicable referenced ASTM specification for concrete masonry units.

   a. Concrete Masonry Units shall be manufactured to specified dimensions of 3/8 inch less than nominal widths by nominal heights by nominal lengths indicated on drawings.

3. Provide Type II, non-moisture-controlled units.

4. Exposed Faces: Manufacturer's standard color and texture, unless otherwise indicated.

B. Hollow Load-Bearing Concrete Masonry Units:

1. Standard: ASTM C 90.

2. Unit Compressive Strength: Provide units with minimum average net area compressive strength not less than the unit compressive strengths required to produce concrete unit masonry construction of compressive strength indicated.

3. Weight Classification: Lightweight.

C. Solid Load-Bearing Concrete Masonry Units:

1. Standard: ASTM C 145.

2. Unit Compressive Strength: Provide units with minimum average net area compressive strength not less than the unit compressive strengths required to produce concrete unit masonry construction of compressive strength indicated.

3. Weight Classification: Lightweight.

2.03 Mortar And Grout Materials

A. Portland Cement: Comply with ASTM C 150. Type I or II; Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce required mortar color.

B. Masonry Cement: Comply with ASTM C 91. For colored aggregate mortars use masonry cement of natural color or white as required to produce mortar color indicated.

C. Ready-Mixed Mortar: Cementitious materials, water, and aggregate complying with requirements specified in this article, combined with set-controlling admixtures to produce a ready-mixed mortar complying with ASTM C 1142.

D. Hydrated Lime: Comply with ASTM C 207, Type S.

E. Aggregate for Mortar: Comply with ASTM C 144, except for joints less than 1/4 inch use aggregate graded with 100 percent passing the No. 16 sieve.

F. Aggregate for Grout: Comply with ASTM C 404.

G. Water: Clean and potable.

H. Available Products: Subject to compliance with requirements.

2.04 Reinforcing Steel

A. General: Provide reinforcing steel complying with requirements of referenced unit masonry standard and this article.

B. Steel Reinforcing Bars:

1. Billet steel complying with ASTM A 615.
2. Epoxy-coated billet steel complying with ASTM A 615 and ASTM A 775.

C. Deformed Reinforcing Wire: Comply with ASTM A 496.

D. Plain Welded Wire Fabric: Comply with ASTM A 185.

E. Deformed Welded Wire Fabric: Comply with ASTM A 497.

2.05 Joint Reinforcement

A. General: Provide joint reinforcement complying with requirements of referenced unit masonry standard and this Section, formed from the following:

1. Stainless steel wire, Type 304 complying with ASTM A 580, for exterior walls; and galvanized carbon steel wire, coating class as required by referenced unit masonry standard, for interior walls.

B. Description: Welded-wire units prefabricated with deformed continuous side rods and plain cross rods into straight lengths of not less than 10 feet, with prefabricated corner and tee units, and complying with requirements indicated below:

1. Wire Diameter for Side Rods: 0.1875 inch.
2. Wire Diameter for Cross Rods: 0.1875 inch.

C. Subject to compliance with requirements, provide joint reinforcement by one of the following manufacturers::

1. AA Wire Products Co.
2. Dur-O-Wal, Inc.
3. Heckman Building Products, Inc.
4. Hohmann & Barnard, Inc.
5. Masonry Reinforcing Corp. of America.
6. National Wire Products Industries.
7. Southern Construction Products, Inc.

2.06 Ties And Anchors, General

A. General: Provide ties and anchors specified in subsequent articles that comply with requirements for metal and size of referenced unit masonry standard and of this article.

B. Galvanized Carbon Steel Wire: ASTM A 82, coating class as required by referenced unit masonry standard for application indicated.

C. Galvanized Carbon Steel Wire: Coating class shall be as required by referenced unit masonry standard for wire ties and anchors in interior walls and shall comply with ASTM A 82, unless otherwise indicated.

D. Stainless Steel Wire: Type 304, for wire ties and anchors in exterior walls complying with ASTM A 580,

E. Stainless Steel Wire: Type 304 with a diameter of 0.1875 inch and in compliance with ASTM A 580,

F. Steel Plates and Bars: Hot-dip galvanized to comply with ASTM A 123 or ASTM A 153, Class B3, as applicable to size and form indicated.

G. Subject to compliance with requirements, provide products by one of the following manufacturers:

1. AA Wire Products Co.
2. Dur-O-Wal, Inc.
3. Heckman Building Products, Inc.
4. Hohmann & Barnard, Inc.
5. Masonry Reinforcing Corp. of America.
6. National Wire Products Industries.
7. Southern Construction Products, Inc.

2.07 Bent Wire Ties

A. CONTRACTOR shall furnish and install individual units prefabricated from bent wire to comply with requirements indicated below:

1. Tie Shape for Hollow Masonry Units Laid with Cells Vertical: Rectangular with closed ends and not less than 4 inches wide.

2. Tie Shape for Solid Masonry Unit Construction: Z-shaped ties with ends bent 90 degrees to provide hooks not less than 2 inches long.

3. Type for Masonry Where Coursing Between Wythes Align: Unit ties bent from one piece of wire.

4. Type for Masonry Where Coursing Between Wythes Does Not Align: Adjustable ties composed of two parts, one with pintles, the other with eyes, maximum misalignment 1-1/4 inches.

2.08 Miscellaneous Anchors

A. Unit Type Masonry Inserts in Concrete: Cast iron or malleable iron inserts of type and size indicated or required.

B. Dovetail Slots: Furnish dovetail slots, with filler strips, of slot size indicated, fabricated from 0.0336-inch (22-gage) sheet metal.

2.09 Post-Installed Anchors

A. Anchors shall be capable of sustaining, without failure, load imposed within factors of safety indicated, as determined by testing per ASTM E 488, conducted by a qualified independent testing laboratory.

1. For cast-in-place and postinstalled anchors in concrete, anchors shall be capable of sustaining, without failure, a load equal to 4 times loads imposed by masonry.

2. For post-installed anchors in grouted concrete masonry units, anchors shall be capable of sustaining, without failure, a load equal to 6 times loads imposed by masonry.

B. Corrosion Protection:

1. Carbon steel components zinc-plated to comply with ASTM B 633, Class Fe/Zn 5 (5 microns) for Class SC 1 service condition (mild).

2. Stainless steel components complying with ASTM F 593 and ASTM F 594, Group 1 alloy 304 or 316 for bolts and nuts; alloy 304 or 316 for anchor.

2.10 Embedded Flashing Materials

A. Sheet metal flashing shall be fabricated in accordance with the requirements specified in 07 6000, Flashing and Sheet Metal, and the following:

1. Stainless Steel: 0.0156 inch (28 gage) thick.

B. Vinyl sheet flashing shall be flexible sheet flashings especially formulated from virgin polyvinyl chloride with plasticizers and other modifiers to remain flexible and waterproof in concealed masonry applications, black in color and of thickness indicated below:

1. Thickness: 30 mils.
2. Application: Use where flashing is fully concealed in masonry.

2.11 Miscellaneous Masonry Accessories

A. Nonmetallic Expansion Joint Strips: Premolded filler strips complying with ASTM D 1056, Type 2 (closed cell), Class A (cellular rubber and rubber-like materials with specific resistance to petroleum base oils), Grade 1 (compression-deflection range of 2-5 psi), compressible up to 35 percent, of width and thickness indicated, formulated from the following material:

1. Neoprene.
2. Urethane.
3. Polyvinyl chloride.

B. Preformed Control Joint Gaskets: Material as indicated below, designed to fit standard sash block and to maintain lateral stability in masonry wall:

1. Styrene-Butadiene Rubber Compound: ASTM D 2000, Designation 2AA-805.
2. Polyvinyl Chloride: ASTM D 2287, General Purpose Grade, Type PVC-65406.

C. Bond Breaker Strips: Asphalt-saturated organic roofing felt complying with ASTM D 226, Type I (No. 15 asphalt felt).

D. Plastic Weep Hole/Vent: One-piece flexible extrusion manufactured from ultraviolet-resistant polypropylene co-polymer, designed to weep moisture in masonry cavity to exterior, sized to fill head joints with outside face held back 1/8 inch from exterior face of masonry, in color selected from manufacturer's standard.

Part 3 Execution

3.01 Examination

A. Examine conditions for compliance with requirements for installation tolerances and other specific conditions, and other conditions affecting performance of unit masonry. For the record, prepare a written report listing conditions detrimental to performance of unit masonry.

B. Examine rough-in and built-in construction to verify actual locations of piping connections prior to installation.

3.02 Installation

A. Thickness: Build cavity and composite walls and other masonry construction to the full thickness shown. Build single-wythe walls to the actual thickness of the masonry units, using units of nominal thickness indicated.

B. Build chases and recesses as shown or required to accommodate items specified in this and other Sections of the Specifications. Provide not less than 8 inches of masonry between chase or recess and jamb of openings and between adjacent chases and recesses.

C. Leave openings for equipment to be installed before completion of masonry. After installation of equipment, complete masonry to match construction immediately adjacent to the opening.

D. 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.

E. Match coursing, bonding, color, and texture of new masonry with existing masonry where indicated

3.03 Mortar Bedding And Jointing

A. Lay hollow concrete masonry units as follows:

1. With full mortar coverage on horizontal and vertical face shells.

2. Bed webs in mortar in starting course on footings and in all courses of piers, columns, and pilasters, and where adjacent to cells or cavities to be filled with grout.

3. For starting course on footings where cells are not grouted, spread out full mortar bed including areas under cells.

B. Cut joints flush for masonry walls to be concealed or to be covered by other materials, unless otherwise indicated.

3.04 Horizontal Joint Reinforcement

A. General: Provide continuous horizontal joint reinforcement as indicated. Install longitudinal side rods in mortar for their entire length with a minimum cover of 5/8 inch on exterior side of walls, 1/2 inch elsewhere. Lap reinforcing a minimum of 6 inches.

B. Cut or interrupt joint reinforcement at control and expansion joints, unless otherwise indicated.

C. Provide continuity at corners and wall intersections by use of prefabricated "L" and "T" sections. Cut and bend reinforcement units as directed by manufacturer for continuity at returns, offsets, pipe enclosures, and other special conditions.

3.05 Anchoring Masonry To Structural Members

A. General: Anchor masonry to structural members where masonry abuts or faces structural members to comply with the following:

B. Provide an open space not less than 1 inch in width between masonry and structural member, unless otherwise indicated. Keep open space free of mortar or other rigid materials.

C. Anchor masonry to structural members with flexible anchors embedded in masonry joints and attached to structure.

D. Space anchors as indicated, but not more than 24 inches o.c. vertically and 36 inches o.c. horizontally.

3.06 Movement (Control And Expansion) Joints

A. General: Install control and expansion joints in unit masonry where indicated. Build in related items as the masonry progresses. Do not form a continuous span through movement joints unless provisions are made to prevent in-plane restraint of wall or partition movement.

B. Form control joints in concrete masonry as follows:

1. Fit bond breaker strips into hollow contour in ends of block units on one side of control joint. Fill the resultant core with grout and rake joints in exposed faces.

2. Install preformed control joint gaskets designed to fit standard sash block.

3. Install special shapes designed for control joints. Install bond breaker strips at joint. Keep head joints free and clear of mortar or rake joint.

C. Form expansion joints in brick made from clay or shale as follows:

1. Build flanges of metal expansion strips into masonry. Lap each joint 4 inches in direction of water flow. Seal joints below grade and at junctures with horizontal expansion joints, if any.

2. Build flanges of factory-fabricated expansion joint units into masonry.

3. Build in joint fillers where indicated.

4. Form open joint of width indicated but not less than 3/8 inch for installation of sealant and backer rod specified in Division 7 Section "Joint Sealers." Maintain joint free and clear of mortar.

D. Build in horizontal pressure-relieving joints where indicated; construct joints by either leaving an air space or inserting nonmetallic 50 percent compressible joint filler of width required to permit installation of sealant and backer rod specified in Division 7 Section "Joint Sealers." Locate horizontal pressure-relieving joints beneath shelf angles supporting masonry veneer and attached to structure behind masonry veneer.

3.07 Lintels

A. Install steel lintels where indicated.

B. Provide masonry lintels where shown and wherever openings of more than 1'-0" for brick size units and 2'-0" for block size units are shown without structural steel or other supporting lintels.

C. Provide minimum bearing of 8 inches at each jamb, unless otherwise indicated.

3.08 Flashing/Weep Holes

A. General:

1. Install embedded flashing in masonry at shelf angles, lintels, ledges, other obstructions to the downward flow of water in the wall, in accordance with Section 07 6000.

a. Prepare masonry surfaces so that they are smooth and free from projections that could puncture flashing.

b. Place through-wall flashing on sloping bed of mortar and cover with mortar.

c. Seal penetrations in flashing with adhesive/sealant/tape as recommended by flashing manufacturer before covering with mortar.

d. Install reglets and nailers for flashing and other related construction where shown to be built into masonry.

2. Install weep holes in the head joints in exterior wythes of the first course of masonry immediately above embedded flashings and as follows:

a. Form weep holes with by keeping head joints free and clear of mortar; spacing holes 24 inches on center.

b. In insulated cavities/air spaces cover cavity/air space side of open weep holes with copper or plastic insect screening before placing insulation in cavity.

3.09 Installation of Reinforced Unit Masonry

A. General: Install reinforced unit masonry to comply with requirements of referenced unit masonry standard.

B. Temporary Formwork: Construct formwork and shores to support reinforced masonry elements during construction. Construct formwork to conform to shape, line, and dimensions shown. Make sufficiently tight to prevent leakage of mortar and grout. Brace, tie, and support forms to maintain position and shape during construction and curing of reinforced masonry.

C. Do not place grout until entire height of masonry to be grouted has attained sufficient strength to resist grout pressure.

D. 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.

3.10 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 and in fresh mortar or grout, pointed to eliminate evidence of replacement.

B. Pointing:

1. During the tooling of joints, enlarge any voids or holes, except weep holes, and completely fill with mortar.

2. Point-up all joints including corners, openings, and adjacent construction to provide a neat, uniform appearance, prepared for application of sealants.

C. 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 1/2 panel uncleaned for comparison purposes. Obtain Architect'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 means of bucket and brush hand-cleaning method using the following masonry cleaner:

a. Job-mixed detergent solution.

b. Job-mixed acidic solution.

c. Proprietary acidic cleaner; apply in compliance with directions of acidic cleaner manufacturer.

D. Protection: Provide final protection and maintain conditions that ensure unit masonry is without damage and deterioration at time of Substantial Completion.

End of Section

Division 06
Wood, Plastic, and Composites

Section 06 1000
Rough Carpentry

Part 1 General

1.01 Scope of Work

A. This Section includes all rough carpentry work including framing, nailers, blocking, wood grounds, furring and sheathing necessary for the completion of the project as indicated on the Plans. Rough carpentry includes carpentry work not specified as part of other sections and which is generally not exposed, except as otherwise indicated.

1.02 Standard References

A. American Forest and Paper Association (AFPA):

1. Manual for Wood Frame Construction

B. American National Standards Institute (ANSI):

1. A208.1 Mat-Formed Manufactured Panels

C. Engineered Wood Association American Plywood Association (APA):

1. Form E30 - Engineered Wood Design/Construction Guide: Residential and Commercial

D. American Society of Mechanical Engineers (ASME):

1. B18.2.1 - Square and Hex Bolts and Screws - Inch Series

2. B18.6.1 - Wood Screws (Inch Series)

E. American Society for Testing and Materials (ASTM):

1. A153 - Specification for Zinc -Coating (Hot-Dip of Iron and Steel Hardware)

2. A307 - Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength

3. A563 - Specification for Carbon and Alloy Steel Nuts

4. A653 - Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process

5. D245 - Practice for Establishing Structural Grades and Related Allowable Properties for Visually Graded Lumber

6. D2555 - Test Method for Establishing Clear Wood Strength Values

F. American Wood Preservers Association (AWPA):

1. C2 - Lumber, Pressure Treatment
2. C9 - Plywood, Pressure Treatment
3. C20 - Structural Lumber, Fire-Retardant Pressure Treatment

4. C27 - Plywood, Fire-Retardant Pressure Treatment

5. M4 - Standard for the Care of Preservative-Treated Wood Products

1.03 Submittals

A. General: Submit the following in accordance with the conditions of Contract and Section 01 3300, Submittal Procedures.

B. Product Data: Submit manufacturer's product data for each distinct product specified.

C. Wood treatment data as follows, including chemical treatment manufacturer's warranty and instructions for handling, storing, installing, and finishing treated materials:

1. For each type of preservative-treated wood product, include certification by treating plant stating type of preservative solution and pressure process used, net amount of preservative retained, and compliance with applicable standards.

2. For waterborne-treated products, include statement that moisture content of treated materials was reduced to levels indicated before shipment to Project site.

3. For fire-retardant-treated wood products, include certification by treating plant that treated materials comply with specified standard and other requirements as well as data relative to bending strength, stiffness, and fastener-holding capacities of treated materials.

D. Material Certificates: Where dimensional lumber is provided to comply with minimum allowable unit stresses, submit listing of species and grade selected for each use, and submit evidence of compliance with specified requirements. Compliance may be in form of a signed copy of applicable portion of lumber producer's grading rules showing design values for selected species and grade. Design values shall be as approved by the Board of Review of American Lumber Standards Committee.

1.04 Quality Assurance

A. Single-Source Responsibility for Fire-Retardant-Treated Wood: Obtain each type of fire-retardant-treated wood product from one source and by single producer.

1.05 Delivery, Storage, and Handling

A. Deliver wood products bundled or crated to provide adequate protection during transit and job storage, with required grade marks clearly identifiable. Inspect wood products for damage upon delivery. Remove and replace damaged materials.

B. Keep materials under cover and dry. Protect from weather and contact with damp or wet surfaces. Stack lumber, plywood, and other panels. Provide for air circulation within and around stacks, and under temporary coverings.

1. For lumber and plywood pressure treated with waterborne chemicals, place spacers between each bundle to provide air circulation.

C. Protect sheet materials during handling to prevent breaking of corners and damage to surfaces.

1.06 Project Conditions

A. Coordination: Fit carpentry work to other work; scribe and cope as required for accurate fit. Correlate location of furring, nailers, blocking, grounds and similar supports to allow attachment of other work.

Part 2 Products

2.01 Lumber - General

A. Lumber Standards: Comply with PS 20-99, "American Softwood Lumber Standard," and with applicable grading rules of inspection agencies certified by ALSC's Board of Review. Lumber design values are to comply with ASTM D245 and ASTM D2555.

B. Inspection Agencies: Inspection agencies, and their grading rules include the following:

1. Northeastern Lumber Manufactures Association (NELMA):

a. Standard Grading Rules

2. Redwood Inspection Service (RIS):

a. Standard Specifications for Grades of California Redwood Lumber

3. Southern Pine Inspection Bureau (SPIB):

a. Standard Grading Rules for Southern Pine Lumber

4. West Coast Lumber Inspection Bureau (WCLIB):

a. No. 17 Standard Grading Rules for West Coast Lumber

5. Western Wood Products Association (WWPA):

a. Western Lumber Grading Rules.

C. Grade Stamps: Provide lumber with each piece factory marked with grade stamp of inspection agency evidencing compliance with grading rule requirements and identifying grading agency, grade, species, moisture content at time of surfacing, and mill.

1. For exposed lumber apply grade stamps to ends or back of each piece, or omit grade stamps entirely and issue certificate of grade compliance from inspection agency in lieu of grade stamp.

D. Where nominal sizes are indicated, provide actual sizes required by PS 20-99 for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry lumber.

1. Provide dressed lumber, S4S, unless otherwise indicated.

2. Provide lumber with 19 percent maximum moisture content at time of dressing and shipment for sizes 2" or less in nominal thickness, unless otherwise indicated.

2.02 Wood-Preservative-Treated Materials

A. General: Where lumber or plywood is indicated as preservative treated or is specified to be treated, comply with applicable requirements of AWPA C2 (lumber) and AWPA C9 (plywood).

1. For exposed items indicated to receive stained finish, use chemical formulations that do not bleed through, contain colorants, or otherwise adversely affect finishes.

B. Pressure-treat aboveground items with waterborne preservatives to minimum retention of 0.25 lb/cu. ft. (4.0 kg/cu. m.). After treatment, kiln-dry lumber and plywood to maximum moisture content of 19 and 15%, respectively. Treat indicated items and the following:

1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.

2. Wood sills, sleepers, blocking, furring, stripping, and similar concealed members in contact with masonry or concrete.

3. Wood framing members less than 18 inches (460 mm) above grade.

4. Wood floor plates installed over concrete slabs directly in contact with earth.

C. Pressure-treat wood members in contact with ground or freshwater with waterborne preservatives to minimum retention of 0.40 lb/cu. ft. (6.4 kg/cu. m.).

D. Complete fabrication of treated items before treatment, where possible. If cut after treatment, apply field treatment complying with AWPA M4 to cut surfaces. Inspect each piece of lumber or plywood after drying and discard damaged or defective pieces.

2.03 Fire-Retardant-Treated Materials

A. General: Where fire-retardant-treated wood is indicated, comply with applicable requirements of AWPA C20 (lumber) and AWPA C27 (plywood). Identify fire-retardant-treated wood with appropriate classification marking of Underwriter Laboratory (UL), U.S. Testing, or Timber Products Inspection, Inc.

B. Interior Type A: For interior locations, use chemical formulation that produces treated lumber and plywood with the following properties under conditions present after installation:

1. Bending strength, stiffness, and fastener-holding capacities are not reduced below values published by manufacturer of chemical formulation under elevated temperature and humidity conditions simulating installed conditions when tested.

2. No form of degradation occurs due to acid hydrolysis or other causes related to treatment.

3. Contact with treated wood does not promote corrosion of metal fasteners.

C. Exterior Type: Use for exterior locations, and where indicated.

D. Inspect each piece of treated lumber of plywood after drying, and discard damaged or defective pieces.

2.04 Dimension Lumber

A. General: If not indicated on Contract documents, provide dimension lumber of any species and grades indicated for applicable use category listed in table below. Lumber shall comply with ALSC National Grading Rule (NGR) provisions of inspection agency applicable to species.

Product (Nominal Dimension)	Grade	Use
Structural Light Framing 2 to 4 inches thick 2 to 4 inches wide	Select Structural No. 1 No. 2 No. 3	Structural applications where highest design values are needed in light framing sizes.
Light Framing 2 to 4 inches thick 2 to 4 inches wide	Construction Standard Utility	Where high-strength values are not required, such as wall framing, plates, sills, cripples, and blocking.
Stud 2 to 4 inches thick 2 inches and wider	Stud	Optional all-purpose grade designed primarily for stud uses, including bearing walls.
Structural Joists and Planks 2 to 4 inches thick 5 inches and wider	Select Structural No. 1 No. 2 No. 3	Intended to fit engineering applications for lumber nominal 5 inches and wider, such as joists, rafters, headers, beams, trusses, and general framing.

B. Species and grades must meet or exceed the following values, unless indicated otherwise on Contract documents.

1. Fb (extreme fiber stress in bending): Minimum 850 psi (5.9 MPa).
2. E (modulus of elasticity): Minimum 1,300,000 psi (8950 MPa).

C. Exposed Framing: Refers to dimension lumber which is not concealed by other work, and is indicated to receive stained, painted, or natural finish.

1. Provide material hand-selected from lumber of species and grade indicated for type of use, for uniformity of appearance, and freedom from characteristics that would impair finish appearance.

2.05 Miscellaneous Lumber

A. General: Provide lumber for support or attachment of other construction, including rooftop equipment curbs and support bases, cant strips, bucks, nailers, blocking, furring, grounds, stripping, and similar members.

B. Fabricate miscellaneous lumber from dimension lumber of sizes indicated, and into shapes shown on Contract documents.

C. Moisture Content: 19 percent maximum for lumber items not specified to receive wood preservative treatment.

D. Grade and Species: For dimension lumber sizes, provide No. 3 or Standard grade lumber per ALSC's NGRs of any species. For board-size lumber, provide No. 3 Common or Standard

grade per WWPA of any species.

2.06 Structural-Use Panels for Underlayment

A. General: Over smooth subfloors, provide underlayment not less than 1/4 inch (6.4 mm) thick. Over board or uneven subfloors, provide underlayment not less than 11/32 inch (8.7 mm) thick.

B. Plywood Underlayment for Resilient Flooring: For underlayment under 19/32 inch (15.1 mm) thick, provide plywood panels with fully sanded face, APA Underlayment grade, Exposure 1.

C. Structural-Use Panel Underlayment for Resilient Flooring: For underlayment 19/32 inch (15.1 mm) thick or more, provide fully sanded, veneer-faced, APA-rated, Sturd-I-Floor panels, Exposure 1.

D. Plywood Underlayment for Ceramic Tile: Provide APA-rated, Underlayment grade, exterior plywood, 5/8 inch (15.9 mm) thick, for ceramic tile set in epoxy mortar.

E. Plywood Underlayment for Carpet: For underlayment under 19/32 inch (15.1 mm) thick, provide plywood panels with fully sanded face, APA Underlayment grade, Exposure 1.

F. Structural-Use Panel Underlayment for Carpet: For underlayment 19/32 inch (15.1 mm) thick or more, provide APA-rated Sturd-I-Floor panels with touch-sanded face, Exposure 1.

2.07 Particleboard

A. General: Comply with and factory mark each panel according to ANSI A208.1. Provide thickness indicated on Contract documents.

B. Particleboard Underlayment: Grade PBU.

C. Particleboard Subflooring: Grade M-3-Exterior Glue.

D. Particleboard Wall Sheathing: Grade M-1-Exterior Glue.

2.08 Fasteners

A. General: Provide fasteners of size and type indicated, that comply with requirements specified.

1. Where rough carpentry work is exposed to weather, in ground contact, or in areas of high relative humidity, provide fasteners with hot-dip, zinc-coating per ASTM A153

B. Nails, Wire, Brads, and Staples: ASTM F1667FS FF-N-105B.

C. Wood Screws: ASME B18.6.1.

D. Lag Bolts: ASME B18.2.1.

E. Bolts: Steel bolts complying with ASTM A307, Grade A with ASTM A563 hex nuts and, where indicated, flat washers.

2.09 Metal Framing Anchors

A. General: Provide galvanized steel framing anchors of structural capacity, type, and size indicated, with allowable design loads as published by manufacturer, that meet or exceed those indicated.

B. Galvanized Steel Sheet: Hot-dip, zinc-coated steel sheet complying with ASTM A653, G60 coating designation; structural, commercial, or lock-forming quality, as standard with manufacturer for type of anchor indicated.

Part 3 Execution

3.01 Installation, General

A. Discard units of material with defects which might impair quality of work, and units which are too small to use in fabricating work with minimum joints or optimum joint arrangement.

B. Set carpentry work to required levels and lines, with members plumb and true and cut and fitted.

C. Securely attach carpentry work to substrate by anchoring and fastening as shown and as required by recognized standards.

D. Countersink nail heads on exposed carpentry work and fill holes.

E. Use common wire nails, except as otherwise indicated. Use finishing nails for finish work. Select fasteners of size that will not penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting of wood; predrill as required.

3.02 Wood Grounds, Nailers, Blocking and Sleepers

A. Provide wherever shown and where required for screeding or attachment of other work. Form to shapes as shown and cut as required for true line and level of work to be attached. Coordinate location with other work involved.

B. Attach to substrates as required to support applied loading. Countersink bolts and nuts flush with surfaces, unless otherwise indicated. Build into masonry during installation of masonry work. Where possible, anchor to formwork before concrete placement.

C. Install permanent grounds of dressed, preservative treated, key-beveled lumber not less than 1-1/2" wide and of thickness required to bring face of ground to exact thickness of finish material involved. Remove temporary grounds when no longer required.

3.03 Wood Furring

A. Install plumb and level with closure strips at edges and openings. Shim with wood as required tolerance of finished work.

B. Firestop furred spaces on walls at each floor level and at ceiling line of top story, with wood blocking or noncombustible materials, accurately fitted to close furred spaces.

3.04 Wood Framing, General

A. Provide framing members of sizes and on spacings shown, and frame openings as shown, or if not shown, comply with recommendations of "Manual for House Framing" of National Forest Products Association (N.F.P.A).

B. Do not splice structural members between supports.

C. Anchor and nail as shown, and to comply with "Recommended Nailing Schedule" of "Manual for House Framing" and "National Design Specifications for Wood Construction" published by N.F.P.A.

D. Firestop concealed spaces of wood framed walls and partitions at each floor level and at the ceiling line of the top story. Where firestops are by the framing system used, use closely fitted wood blocks of nominal 2" thick lumber of the same width as framing members.

E. Arrange studs so that wide face of stud is perpendicular to direction of wall or partition and narrow face is parallel.

1. Provide single bottom plate and double top plates using members of 2-inch nominal (38 mm actual) thickness whose widths equal that of studs; except single top plate may be used for non-load-bearing partitions. Nail or anchor plates to supporting construction, unless otherwise indicated.

2. For exterior walls, provide 2 by 6-inch nominal (38 by 140 mm actual) size wood studs spaced 24 inches (610 mm) o.c., except where otherwise indicated or required.

3. For interior partitions and walls, provide 2 by 4-inch nominal (38 by 89 mm actual) size wood studs spaced 16 inches (406 mm) o.c., except where otherwise indicated or required.

F. Construct corners and intersections with three (3) or more studs. Provide miscellaneous blocking and framing as shown, and as required to support facing materials, fixtures, specialty items, and trim.

1. Provide continuous horizontal blocking at mid-height of single-story partitions over 96 inches (2.4 m) high and multistory partitions, using members of 2-inch nominal (38 mm actual) thickness and of same width as wall or partitions.

G. Frame openings with multiple studs and headers. Provide nailed header members of thickness equal to width of studs. Set headers on edge and support on jamb studs.

1. For non-load-bearing partitions, provide double-jamb studs with headers not less than 4-inch nominal (89 mm actual) depth for openings 36 inches (914 mm) and less in width, and not less than 6-inch nominal (140 mm actual) depth for wider openings.

2. For load-bearing walls, provide double-jamb studs for openings 72 inches (1.8 m) and less in width, and triple-jamb studs for wider openings. Provide headers of depth shown as indicated on Contract documents.

H. Provide bracing in exterior walls and at interior load-bearing walls (that are not more than 25 feet (7.6 m) from other parallel braced walls) at each end and at not more than 25 feet (7.6 m) apart, to comply with IUBC Section 2308.9.326.11.3 “Bracing” and IUBC Table 2308.9.3(I).23-I-W “Braced Wall Panels” as required for Seismic Zone 2B.

3.05 Stud Framing

A. General: Provide stud framing of size and spacing indicated or, if not otherwise indicated, of the following sizes and spacings. Arrange studs so that wide face of stud is perpendicular to

direction of wall or partition and narrow face is parallel. Provide single bottom plate and double top plates using 2" thick members with widths equaling that of studs; except single top plate may be used for non-load-bearing partitions. Nail or anchor plates to supporting construction.

B. Provide 1” x 4” corner let-in corner braces unless diagonal or plywood type sheathing is used.

C. For interior partitions and walls provide 2" x 4" wood studs spaced 16" o.c.

D. Construct corners and intersections with not less than 3 studs. Provide miscellaneous blocking and framing as shown and as required for support of facing materials, fixtures, specialty items and trim.

E. Frame openings with multiple studs and headers. Provide nailed header members of thickness equal to width of studs. Set headers on edge and support on jamb studs.

F. For non-bearing partitions, provide double-jamb studs and headers not less than 6" deep for openings 3' and less in width, and not less than 10" deep for wider openings.

G. For load-bearing partitions, provide double-jamb studs for openings 4' and less in width, and triple-jamb studs with osb spacers for openings 4' to 6' in width. Provide headers of depth not less than 12" deep.

3.06 Floor Joist Framing

A. General: Install floor joists with crown edge up and support ends of each member with not less than 1-1/2 inches (38.1 mm) of bearing on wood or metal, or 3 inches (76 mm) on masonry. Attach floor joists as follows:

1. Where supported on wood members, by toe nailing or by using metal framing anchors.

2. Where framed into wood supporting members, by using wood ledgers as shown or, if not shown, by using metal joist hangers.

B. Frame openings with headers and trimmers supported by metal joist hangers; double headers and trimmers where span of header exceeds 48 inches (1.2 m).

C. Do not notch in middle third of joists; limit notches to 1/6 depth of joist, 1/3 at ends. Do not bore holes larger than 1/3 depth of joist; do not locate closer than 2 inches (51 mm) from top or bottom.

D. Provide solid blocking of 2-inch nominal (38 mm actual) thickness by depth of joist at ends of joists unless nailed to header or band.

E. Lap members framing from opposite sides of beams, girders, or partitions not less than 4 inches (102 mm) or securely tie opposing members together. Provide solid blocking of 2-inch nominal (38 mm actual) thickness by depth of joist over supports.

F. Under jamb studs at openings, provide solid blocking between joists.

G. Under non-load-bearing partitions, provide double joists separated by solid blocking equal to depth of studs above.

1. Provide triple joists separated as above, under partitions receiving ceramic tile and similar heavy finishes or fixtures.

H. Provide bridging of type indicated below, at intervals of 96 inches (2.4 m) o.c., between joists.

1. Form diagonal wood bridging from bevel cut 1 by 3-inch nominal (19 by 64 mm actual) size lumber, double-crossed and nailed both ends to joists.

2. Install steel bridging to comply with manufacturer's written instructions.

3.07 Rafter and Ceiling Joist Framing

A. Ceiling Joists: Install ceiling joists with crown edge up and complying with requirements specified above for floor joists. Face nail to ends of parallel rafters.

B. Rafters: Notch to fit exterior wall plates and toe nail or use metal framing anchors. Double rafters to form headers and trimmers at openings in roof framing, if any, and support with metal hangers. Where rafters abut at ridge, place directly opposite each other and nail to ridge member or use metal ridge hangers.

C. Provide collar beams (ties) as shown or, if not shown, provide 1 by 6-inch nominal (19 by 140 mm actual) size boards between every third pair of rafters, but not more than 48 inches (1219 mm) on center. Locate below ridge member, at third point of rafter span. Cut ends to fit roof slope and nail to rafters.

D. Rafter Ties: Tie straps shall be provided from each roof framing member to exterior studs, posts or other supporting members below the roof. Opposing rafters at ridges shall be aligned and connected with straps.

3.08 Stair Framing

A. Provide stair framing members of size, space, and configuration indicated or, if not otherwise indicated, to comply with the following requirements:

1. Stringer Size: 2 by 12-inch nominal (38 by 286 mm actual) size minimum.

2. Notching: Notch stringers to receive treads, risers, and supports; leave at least 3-1/2 inches (89 mm) of effective depth.

3. Stringer Spacing: At least three (3) stringers for each 36-inch (914 mm) clear width of stair.

B. Provide stair framing that does not exceed the following variations between treads and risers within each flight:

1. Adjacent Treads and Risers: 3/16 inch (4.76 mm).

2. Between Largest and Smallest Treads and Risers: 3/8 inch (9.53 mm).

3.09 Installation of Structural-Use Panels

A. General: Comply with applicable recommendations contained in APA Form No. E30, for types of structural-use panels and applications indicated.

B. Fastening Methods: Fasten panels as indicated below:

1. Combination Subflooring-Underlayment: Glue subflooring and underlayment to floor joists, and screw to joists. Space panels 1/8 inch (3.18 mm) at edges and ends.

2. Subflooring: Glue subflooring to floor joists, and screw to joists. Space panels 1/8 inch (3.18 m) at edge and ends.

3. Sheathing: Nail to framing. Space panels 1/8 inch (3.18 mm) at edges and ends.

4. Underlayment: Nail to subflooring. Space panels 1/32 inch (0.8 mm) at edges and ends.

5. Plywood Backing Panels: Nail or screw to supports.

3.10 Particleboard Underlayment

A. Install to comply with the recommendations of the National Particleboard Association (NPA) for type of subfloor indicated.

1. Fill and sand gouges, gaps, and chipped edges. Sand uneven joints flush.

2. Glue and nail underlayment to subflooring throughout.

End of Section

Division 07
Thermal and Moisture Protection

Section 07 3113
Asphalt Shingles

Part 1 General

1.01 Scope of Work

A. This Section includes asphalt shingles, felt underlayment, drip edge, and perimeter underlayment.

1.02 Related Work Specified Elsewhere

A. Section 06 1000: Rough Carpentry

1.03 Submittals

A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.

B. Samples for initial selection purposes in form of manufacturer's sample finishes showing full range of colors and profiles available.

1.04 Quality Assurance

A. Fire Performance Characteristics: Provide products that are identical to those tested for the specified fire performance characteristics by UL or other testing and inspecting organizations acceptable to authorities having jurisdiction. Identify products with appropriate markings of applicable testing and inspecting organization.

1. Fire Resistance Ratings: As indicated by reference to design designations in UL "Fire Resistance Directory."

1.05 Delivery, Storage, and Handling

A. Deliver materials to Project site in manufacturer's unopened bundles or containers with labels intact.

B. Handle and store materials at Project site to prevent water damage, staining, or other physical damage. Store rolled goods on end. Comply with manufacturer's recommendations for job site storage, handling, and protection.

1.06 Project Conditions

A. Weather Conditions: Proceed with Work only when existing and forecasted weather conditions will permit Work to be installed in compliance with manufacturer's recommendations and when substrate is completely dry.

1.07 Extra Materials

A. Deliver extra materials to OWNER. Furnish extra materials matching products installed as described below, packaged with protective covering for storage and identified with labels clearly describing contents.

1. Furnish quantity of full-size asphalt shingles equal to 2 percent of amount installed.

1.08 Warranty

A. Special Project Warranty: Submit a written warranty, executed by manufacturer, agreeing to repair or replace asphalt shingles that fail in materials or workmanship within the specified warranty period. Failures include, but are not limited to, deformation or deterioration of shingles beyond normal weathering. This warranty shall be in addition to, and not a limitation of, other rights OWNER may have against CONTRACTOR under the Contract Documents.

1. Warranty period is 20 years after date of Substantial Completion.

Part 2 Products

2.01 Manufacturers

A. Manufacturer: Subject to compliance with requirements, provide asphalt shingles that match the type and color of existing building shingles.

2.02 Asphalt Shingles

A. Square-Tab Strip Shingles, UL Class "A," Heavy Weight: Mineral-surfaced, self-sealing, three-tab asphalt fiberglass strip shingles complying with ASTM D 3018, Type 1 and ASTM D 3462. Provide shingles bearing UL Class "A" external fire exposure label and UL "Wind Resistant" label.

B. Ridge Shingles: Manufacturer's standard factory precut units to match shingles.

C. Colors, Blends and Patterns: Where manufacturer's standard products are indicated, provide asphalt shingles with the following requirements:

1. Provide selections made by ENGINEER from manufacturer's full range of standard colors, textures, and patterns for asphalt shingles of type indicated.

2.03 Accessories

A. Felt Underlayment: No. 15; unperforated organic felt complying with ASTM D 226, Type I; 36 inches wide.

B. Perimeter Underlayment (ice and water shield): Polyethylene-sheet-backed rubberized asphalt membrane, 40 mils thick. Provide primer when recommended by underlayment manufacturer.

1. Available Products: Subject to compliance with requirements, products that may be incorporated in the Work include, but are not limited to, the following:

a. "Bituthene Ice & Water Shield," W.R. Grace & Co.
b. "Polyken 640 Underlayment Membrane," Polyken Technologies.
c. "Polyguard Deck Guard," Polyguard Products, Inc.
d. "Ice Guard Membrane No. 108-AG," Royston Laboratories, Inc.
e. "Jiffy Seal Ice and Water Guard," Protecto Wrap Co.

C. Asphalt Plastic Cement: Non-asbestos fibrated asphalt cement complying with ASTM D 4586, designed for trowel application.

D. Nails: Aluminum or hot-dip galvanized steel, 11- or 12-gage, sharp-pointed, conventional roofing nails with barbed shanks, minimum 3/8-inch-diameter head, and of sufficient length to penetrate through plywood sheathing. Material of nails in contact with flashing shall match materials selected for flashing to prevent galvanic action.

E. Staples: Minimum 16-gage, zinc-coated steel roofing staples with minimum crown width of 15/16 inch, and of sufficient length to penetrate through plywood deck. Pneumatically apply staples without damaging shingle.

F. Metal Drip Edge: Minimum 0.024-inch mill finish aluminum sheet, brake-formed to provide 3-inch roof deck flange and 1-1/2-inch fascia flange with 3/8-inch drip at lower edge. Furnish in lengths of 8 or 10 feet.

Part 3 Execution

3.01 Examination

A. Examine substrate for compliance with requirements for substrates, installation tolerances, and other conditions affecting performance of Work of this Section. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.02 Preparation

A. Clean substrates of projections and substances detrimental to application. Cover knotholes or other minor voids in substrate with sheet metal flashing secured with noncorrosive roofing nails.

B. Coordinate installation with flashings and other adjoining work to ensure proper sequencing. Do not install roofing materials until all vent stacks and other penetrations through roof sheathing have been installed and are securely fastened against movement.

3.03 Installation

A. Comply with manufacturer's installation instructions and recommendations, but not less than recommended by "The NRCA Steep Roofing Manual."

B. Felt Underlayment: Apply one layer of felt underlayment horizontally over entire surface to receive asphalt shingles, lapping succeeding courses a minimum of 2 inches, end laps a minimum of 4 inches, and hips and valleys a minimum of 6 inches. Fasten felt with sufficient number of roofing nails or noncorrosive staples to hold underlayment in place until asphalt shingle application.

1. Provide additional layer of felt underlayment for roofs with slope of 3 inches per foot or more.

2. Omit felt underlayment at areas of perimeter underlayment. Lap felt underlayment over perimeter underlayment as recommended by manufacturer but not less than 2 inches.

C. Perimeter Underlayment: Apply minimum 24-inch-wide layer of perimeter underlayment at eaves.

D. Install asphalt shingles beginning at lower end with a starter strip of roll roofing or inverted shingles with tabs removed.

1. Fasten shingles in pattern, with weather exposure, and using number of fasteners per shingle as recommended by manufacturer.

2. Use vertical and horizontal chalk lines or premarked underlayment to ensure straight coursing.

3. Cut and fit asphalt shingles at ridges and edges to provide maximum weather protection. Provide same weather exposure at ridges as specified for roof. Lap shingles at ridges to shed water away from direction of prevailing wind. Fasteners at ridges shall be of sufficient length to penetrate sheathing as specified.

4. Pattern: 1/3 spacing offset at succeeding courses.

E. Flashing: Install metal flashing as indicated and in accordance with details and recommendations of the "Asphalt Roofing" section of "The NRCA Steep Roofing Manual."

3.04 Adjusting

A. Replace any damaged materials installed under this Section with new materials meeting specified requirements.

End of Section

Section 07 6000
Flashing and Sheet Metal

Part 1 General

1.01 Scope of Work

A. This section includes furnishing and installing fascia, soffits, drip edge, and miscellaneous sheet metal accessories.

1.02 Related Work Specified Elsewhere

A. Section 06 1000: Rough Carpentry

1.03 Standard References

A. American National Standards Institute (ANSI):

1. ANSI/SPRI RD-1 - Standard for Retrofit Roof Drains

B. American Welding Society (AWS):

1. AWS D1.2/D1.2M - Structural Welding Code - Aluminum

C. ASTM International (ASTM):

1. ASTM A167 - Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip

2. ASTM A038 - Standard Specification for Steel Sheet, Terne (Lead-Tin Alloy) Coated by the Hot Dip Process

3. ASTM A653 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process

4. ASTM B101 - Standard Specification for Lead-Coated Copper Sheet and Strip for Building Construction

5. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate

6. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes

7. ASTM B32 - Standard Specification for Solder Metal

8. ASTM B370 - Standard Specification for Copper Sheet and Strip for Building Construction

9. ASTM B69 - Standard Specification for Rolled Zinc

10. ASTM D1784 - Standard Specification for Rigid Polyvinyl Chloride (PVC) Compounds and Chlorinated Polyvinyl Chloride (CPVC) Compounds

11. ASTM D226 - Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing

12. ASTM D41 - Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing

13. ASTM D4586 - Asphalt Roof Cement, Asbestos-Free

1.04 Submittals

A. Product Data:

1. Flashing, Sheet Metal, and Accessories: Manufacturer's technical product data, installation instructions and general recommendations for each specified sheet material and fabricated product.

B. Samples of the following flashing, sheet metal, and accessory items:

1. 8-inch square samples of specified sheet materials to be exposed as finished surfaces.

2. 12-inch long samples of factory-fabricated products exposed as finished work. Provide complete with specified factory finish.

C. Shop Drawings:

1. Shop drawings showing layout, profiles, methods of joining, and anchorages details, including major counter-flashings, trim/fascia units, and expansion joint systems. Provide layouts at 1/4 inch scale and details at 3-inch scale.

1.05 Delivery, Handling, and Storage

A. Package and protect materials during shipment. Uncrate and inspect materials for damage, dampness, and wet-storage stains upon delivery to the job site. Remove from the site and replace damaged materials that cannot be restored to like-new condition. Handle sheet metal items to avoid damage to surfaces, edges, and ends. Store materials in dry, weather-tight, ventilated areas until immediately before installation.

1.06 Warranty

A. Products shall be warranted to be free of defects in material and workmanship for a period of five (5) years from date of shipment.

B. Product liability is limited to the repair or replacement of furnished materials, provided printed installation instructions have been followed. Manufacturer shall provide, at no additional charge to OWNER, a 20 year finish warranty against peeling, chalking, fading, checking and crazing, commencing upon the date of substantial completion. No other warranties either expressed or implied are acceptable unless so stated in writing.

1.07 Project Conditions

A. Coordinate work of this section with interfacing and adjoining work for proper sequencing of each installation. Ensure best possible weather resistance and durability of work and protection of materials and finishes.

Part 2 Products

2.01 Materials

A. Sheet Metal Flashing and Trim Materials

1. Stainless Steel: Any necessary flashing shall be AISI Type 302/304, complying with ASTM C167, 2D annealed finished, soft, except where harder temper required for forming or performance; 0.0156 inch thick (28 gage) except as otherwise indicated.

2. Extruded Aluminum: Fascia and soffit shall be manufacturer's standard extrusions of sizes and profiles indicated, 60064-T52, AA-C22A41 mill finish; with baked on enamel finish, 0.080 inch minimum thickness for primary legs of extrusions.

B. Miscellaneous Materials and Accessories:

1. Solder: For use with stainless steel, provide 60 - 40 tin/lead solder (ASTM B 32), with acid-chloride type flux, except use rosin flux over tinned surfaces.

2. Fasteners: Same metal as flashing/sheet metal or, other noncorrosive metal as recommended by sheet manufacturer. Match finish of exposed heads with material being fastened.

3. Bituminous Coating: SSPC - Paint 12, solvent type bituminous mastic, nominally free of sulfur, compounded for 15-mil dry film thickness per coat.

4. Mastic Sealant: Polyisobutylene; nonhardening, nonskinning, nondrying, nonmigrating sealant.

5. Elastomeric Sealant: Generic type recommended by manufacturer of metal and fabricator of components being sealed and complying with requirements for joint sealants as specified in Division 7 Section "Joint Sealers."

6. Metal Accessories: Provide sheet metal clips, straps, anchoring devices and similar accessory units as required for installation of work, matching or compatible with material being installed, noncorrosive, size and gage required for performance.

C. Fabricated Units:

1. General Metal Fabrication: Shop fabricate work to greatest extent possible. Comply with details shown, and with applicable requirements of SMACNA "Architectural Sheet Metal Manual" and other recognized industry practices.

2. Fabricate for water proof and weather resistant performance; with expansion provisions for running work, sufficient to permanently prevent leakage, damage or deterioration of the work. Form work to fit substrates.

3. Comply with material manufacturer instructions and recommendations for forming material.

4. Form exposed sheet metal work without excessive oil-canning, buckling and tool marks, true to line and levels indicated, with exposed edges folded back for form hems.

5. Seams: Fabricate nonmoving seams in sheet metal with flat-lock seams. For metal other than aluminum, tin edges to be seamed, form seams, and solder. Form aluminum seams with epoxy seam sealer; rivet joints for additional strength where required.

6. Expansion Provisions: Where lapped or bayonet-type expansion provisions in work cannot be used, or would not be sufficiently water/weatherproof, form expansion joints of intermeshing hooked flanges, not less than 1-inch deep, filled with mastic sealant (concealed within joints).

7. Sealant Joints: Where movable, nonexpansion type joints are indicated or required for proper performance of work, form metal to provide for proper installation of elastomeric sealant, in compliance with SMACNA standards.

8. Aluminum Extrusion Units: Fabricate extruded aluminum running units with formed or extruded aluminum joint covers, for installation behind main members where possible. Fabricate mitered and welded corner units.

Part 3 Execution

3.01 Installation

A. Installation Standards: Install flashing and sheet metalwork as indicated and in accordance with the approved Shop Drawings and SMACNA Architectural Sheet Metal Manual.

B. Flashing and Metal Trim: Provide flashing, counterflashing, cap flashing, metal trim, and any other fabricated items and miscellaneous sheet metalwork indicated or required to provide a complete and watertight installation.

C. Gutters and Downspouts: Install gutters and downspouts as indicated and in accordance with the approved Shop Drawings and pertinent provisions of SMACNA Architectural Sheet Metal Manual.

D. Work Quality:

1. Sheet metalwork shall be finished straight and true, with miters and joints accurately fitted. Exposed work shall be free of dents and other defects. Corners shall be reinforced and seams made waterproof. Edges of sheet metal shall be hemmed.

2. Provide for expansion and contraction in sheet metal assembly by means of expansion joints or other appropriate methods of SMACNA Architectural Sheet Metal Manual. Provide reinforcement as required.

3. Isolate and protect dissimilar metals from contact with each other by applying specified isolation material to contact surfaces. Protect surfaces of sheet metal in contact with concrete, treated wood, or aluminum with a heavy coating of bituminous paint.

4. Provide waterproof neoprene washers wherever required fasteners penetrate sheet metal. Exposed fasteners will not be permitted for any portion of this work.

E. Calking and Sealing: Calk or seal joints and laps of sheet metalwork as indicated or required for a waterproof installation. Beads of sealant which will be concealed in the finished work shall be continuous with no voids of material. Interface and coordinate the calking and sealing work of this Section with the work specified in Section 07 9000, Joint Sealants.

F. Flashing for Roof Penetrations:

1. Flashing of roof penetrations shall be 4 pound lead. Flashing shall be accurately formed to conform with roofing contours and configurations and as required to assure a watertight installation. Flashing shall be built in as the roofing work progresses. Flash and burn lead against any penetrations through its surface.

2. Except as indicated otherwise, plumbing and mechanical vent flashing shall be of 4 pound lead tubing. Flanges shall be minimum 18 inches square, and tubing shall be long enough to permit turning lead into the end of vent pipe.

3.02 Cleaning and Protection

A. Clean exposed metal surfaces, removing substances which might cause corrosion of metal or deterioration of finishes.

B. Protect flashing and sheet metal work during construction, to ensure that work will be without damage or deterioration, other than natural weathering at time of substantial completion.

End of Section

Division 08
Openings

Section 08 1100
Hollow Metal Doors and Frames

Part 1 General

1.01 Scope of Work

A. Pressed steel hollow metal doors and frames.

B. Fire-rated hollow metal doors and frames.

C. Hollow metal window-walls, glazed openings, and other hollow metal frames for glass.

D. Rough bucks, frame reinforcing, door reinforcing, door insulation, closer reinforcements, clip angles and anchorage.

E. Factory prime paint finish.

F. Grouting of hollow metal frames with masonry mortar where not covered under other Sections.

1.02 Related Work Specified Elsewhere

A. Section 08 7000: Door Hardware

1.03 Quality Assurance

A. Reference Standards:

1. ANSI/SDI-100-83 - Recommended Specifications - Standard Steel Doors and Frames, Steel Door Institute, unless herein specified.

2. Underwriters' Laboratories Inc. (UL) UL 10C-98 - Fire Tests of Door Assemblies.

3. NFPA-80-1995 - Standard for Fire Doors and Windows.

4. NFPA-101-1997 - Life Safety Code.

5. NFPA-105-1993 - Standard for Smoke and Draft Control Assemblies.

6. ASTM-A 366-95A - Specification for Steel, Sheet, Carbon, Cold-Rolled, Commercial Quality.

7. ASTM-A 568-95 - Specification for Steel, Sheet, Carbon, and High Strength, Low-Alloy, Hot-Rolled, and Cold-Rolled.

8. ASTM-A 569-91a - Specification for Steel, Carbon, (0.15 maximum percent), Hot-Rolled Sheet and Strip Commercial Quality.

9. ASTM-A 924-95 - General Requirements for Steel Sheet, Metallic Coated by the Hot-Dip Process.

10. ANSI A250.8-1998/SDI 100 - Recommended Specifications for Standard Steel Doors and Frames.

11. SDI-105-92 - Recommended Erection Instructions for Steel Frames.

12. ANSI A115.1-.17 - Specification for Door and Frame Preparation for Hardware.

13. ANSI A156.7 - Standard Template Hinge Dimensions.

14. ASTM C-236 / E-41 - Test procedures for Sound Rated (STC) Assemblies.

B. Supplier Qualification: Qualified direct distributor of products to be furnished. The distributor shall have in their regular employment an A.H.C./C.D.C. or person of equivalent experience who will be available at reasonable times to consult with ENGINEER, OWNER or CONTRACTOR regarding any matters affecting the total door and frame openings.

C. Installer Qualification: Experience with installation of similar materials.

D. Fire-Rated Door Assemblies: Where fire-rated door assemblies are indicated or required, provide fire-rated door and frame assemblies that comply with NFPA 80 "Standard for Fire Doors and Windows", and have been tested, listed, and labeled in accordance with ASTM E152 "Standard Methods of Fire Tests of Door Assemblies" by nationally recognized independent testing and inspection agency acceptable to authorities having jurisdiction.

E. Oversize Fire-Rated Door Assemblies: For door assemblies required to be fire-rated and exceeding sizes of tested assemblies, provide certificate or label from approved independent testing and inspection agency, indicating that door and frame assembly conforms to requirements of design, materials and construction as established by individual listings for tested assemblies.

F. Temperature Rise Rating: At stairwell enclosures, provide doors which have Temperature Rise Rating of 450 degrees F maximum in 30 minutes of fire exposure.

1.04 Submittals

A. Shop Drawings and Product Data:

B. Shop Drawings: In addition to requirements below, provide a schedule of standard steel doors and frames using same reference numbers for details and openings as those on Drawings:

1. Elevations of each door design.
2. Details of doors, including vertical and horizontal edge details.
3. Frame details for each frame type, including dimensioned profiles.
4. Details and locations of reinforcement and preparations for hardware.
5. Details of each different wall opening condition.
6. Details of anchorages, accessories, joints, and connections.
7. Details of glazing frames and stops showing glazing.
8. Details of conduit and preparations for electrified door hardware and controls.

C. Product Data: Include construction details, material descriptions, core descriptions, label compliance, fire-resistance rating, and finishes for each type of steel door and frame specified.

1.05 Delivery, Storage and Handling

A. Deliver hollow metal doors in manufacturer's protective covering. Handle hollow metal with care to prevent damage.

B. Door Storage: Store doors in upright position, under cover. Place doors on at least 4 inch high wood sills or on floors in manner that will prevent rust and damage. Do not use non-vented plastic or canvas shelters which create humidity chamber and promote rusting. If corrugated wrapper on door becomes wet, or moisture appears, remove wrapping immediately. Provide 1/4 inch space between doors to promote air circulation.

C. Frame Storage: Store frames under cover on 4 inch wood sills on floors in manner that will prevent rust and damage. Do not use non-vented plastic or canvas shelters which create humidity chamber and promote rusting. Store assembled frames in vertical position, 5 units maximum in stack. Provide 1/4 inch space between frames to promote air circulation.

1.06 Sequencing and Scheduling

A. Deliver doors and frames to the jobsite in a timely manner so as not to delay progress of other trades.

Part 2 Products

2.01 Manufacturers

A. Acceptable Manufacturers: (providing the products supplied comply with the provisions of this specification.)

1. Ceco Door Products; an ASSA ABLOY Group Company.
2. Curries Company; an ASSA ABLOY Group Company.
3. Pioneer Industries, Inc.
4. Steelcraft; an Ingersoll-Rand Company.

2.02 Materials

A. Cold Rolled Steel Sheets: Commercial quality, stretcher leveled flatness, cold-rolled steel, free from scale, pitting or other surface defects, complying with ASTM A366 and A568 general requirements.

B. Galvanealed Steel Sheets: ASTM A924, A60 zinc coating. Use galvanealed steel sheets for exterior hollow metal doors, door frames and door louvers. Internal reinforcing may be manufactured of hot rolled pickled and oiled steel per ASTM-A569.

C. Minimum gauges of hollow metal are specified below. Provide heavier gauge if required by details or specific condition. Entire frame shall be of same gauge.

1. 16 gauge: Interior door frames.
2. 16 gauge: Labeled frames
3. 18 gauge: Interior doors
4. 14 gauge: Exterior door frames.
5. 16 gauge: Exterior doors.
6. 20 gauge: Trim members.

D. Coating Materials, primer: Use manufacturer's standard rust inhibiting primer conforming to ANSI-A224.1-1990.

2.03 Related Materials

A. Steel Reinforcing: ASTM A36.
B. Door Bumpers or Silencers: Per ANSI A156.16.

2.04 Hollow Metal Frames

A. General:

1. Form to profiles indicated.

2. Where necessary, alternate details will be considered provided design intent is maintained. Consider and provide for erection methods.

B. Typical Reinforcing:

1. Provide minimum hinge reinforcement 3/16 inch by 1-1/2 inch by 9 inch and lock strike reinforcement 3/16 inch by 1-1/2 inch by 4 inch long.

2. Provide similar reinforcement for hardware items as required to adequately withstand stresses, minimum 12 gauge, including channel reinforcement for door closers and closer arms, door holders and similar items.

3. Provide reinforcement and clearances for concealed in-head door closers and for mortise locks.

4. Provide full height 12 gauge reinforcement for continuous hinges, spot welded to frame at 6 inch centers.

C. Reinforcement of Heads:

1. Provide continuous 7 gauge reinforcement full width of head for frames over 48 inches wide.

2. Reinforcement to be spot welded to inside of soffit at 6 inch centers.

D. Cover Plates:

1. For hinge and strike plate cutouts, provide fully enclosed pressed steel cover boxes spot welded to frames behind mortises.

E. Special Conditions for Electrified Hardware:

1. Provide fully enclosed pressed steel covered boxes spot welded to the frames for power transfer, power transfer hinges, door status switches, and electromagnetic locks.

a. Each cover box to be equipped with conduit containing wiring harness with ElectroLynx connectors at the hinge end and a bare wire end in a junction box at the head of the frame for standard connection to the building wiring.

2. Prepare frames in shop for openings listed to be equipped with door position switches by drilling a 1 inch diameter hole in the head of the frame to line up with the magnet hole in the top of the corresponding door.

3. Provide a 1-1/4 inch deep back box in the frame above the switch hole.

F. Hardware:

1. Mortise, reinforce, drill and tap for mortise hardware, except drilling and tapping for surface door closers, door closer brackets and adjusters shall be done in field.

G. Anchorage:

1. Provide standard and special anchorage items as required.

2. Provide 12 gauge angle clips at bottom of frames with punched holes for securing frames to floor, except where frames are secured entirely by rough bucks. Provide formed steel channel spreader at bottom of frames, removable without damaging frame.

3. At masonry, provide anchors wire masonry anchors approximately 16 inches on center.

H. Silencers:

1. Provide specified silencers, except where stop does not occur and at smoke gasketed openings, 3 per jamb at single door and one for each door at double doors.

I. Clearances:

1. Provide and be responsible for proper clearances at metal frames, including for weatherstripping, soundstripping and smoke gasketing.

2. Glass clearance shall be thickness of glass plus clearance each side (1/8 inch minimum exterior - 1/16 inch minimum interior), adjust for installation, glass thickness to allow for glazing and sealant.

a. Where sealed double glazing is indicated, provide rebates minimum of 3/4 inch and provide 1/4 inch clearance at glass edges.

3. Where units fit around concrete blocks (blocks built into frames) obtain actual dimensions of blocks being used to establish minimum clearances.

J. Labeled Frames:

1. Construct in accordance with requirements for labeled work.

2. Attach proper U.L. label, Warnok Hersey. "B" labeled frames shall be 1-1/2 hour construction. Use “B” label frames where “1 hour” rating is indicated.

K. Joinings:

1. At frames with equal width jambs and head, neatly miter on face (except locations as at transom bars and at frames with large head members).

2. Cope and butt stops.

3. Weld length of entire joint, including face and flat intersections.

4. Grind smooth, at other frames, provide same mitered joint wherever possible (at intersection of jamb-head or jamb-sill) and at other locations butt metal neatly and full weld.

5. If tight butt joints are utilized, joints shall be neatly caulked smooth.

L. Workmanship:

1. Fabricate so no grind marks, hollow or other out-of-plane areas are visible.

2. At joints of intermediate members (such as mullions and transom bars), provide tight joining, neatly accomplished without holes, burned out spots, weld build up or other defacing work.

3. Fill to close cracks and to preserve shapes. Tightly fit loose stops, to hairline joints.

M. Finish:

1. Clean frames by degreasing process and apply thorough coating of baked-on primer, covering inside as well as outside surfaces.

2. At galvanealed frames, coat welds and other disrupted surface with zinc-rich paint containing not less than 90 percent zinc dust by weight.

2.05 Hollow Metal Doors

A. Provide to design indicated including: Flush panel doors, flush panel with cut-out as indicated. Use galvanealed steel at exterior doors.

B. Flush Doors: Reinforce, stiffen and sound deaden. Provide cut-outs for glass and louvers with stops as shown. Provide flush steel closure at top of exterior and interior doors. Provide seamless edge. Following door construction types are acceptable.

1. Exterior Doors: 16 gauge – A60 galvanized face sheets, 20 gauge steel stiffener reinforced vertically 6 inches on center, full height and width, spot welded 5 inches on center, to both face sheets. Stiffeners welded together top and bottom. Insulate with 2-1/2 lb density mineral wool insulation.

2. Interior Doors: 18 gauge – cold rolled face sheets, 20 gauge steel stiffener reinforced vertically 6 inches on center, full height and width, spot welded 5 inches on center, to both face sheets. Stiffeners welded together top and bottom. Insulate with 2-1/2 lb density mineral wool insulation.

C. Labeled Doors:

1. Steel stiffened core as required by Underwriters Laboratories.

2. Build in special hardware and provide astragals as indicated.

3. At one hour and at 1-1/2 hour doors at enclosures, maximum transmitted temperature end point shall not exceed 450 degrees F above ambient at end of 30 minutes of fire exposure specified in U.B.C. Standard No. 43-2.

D. Seamless Vertical Edges:

1. Construct doors with smooth flush surfaces, without visible joints or seams on exposed faces or stile edges. Interior and exterior door edge seams shall be tack welded, filled and sanded smooth.

E. Typical Reinforcement:

1. Provide as required for hardware items.

2. For lock reinforcement, provide manufacturer's standard reinforcement.

3. Provide 12 gauge reinforcement for escutcheons or roses.

4. Centering clips to hold lock case in alignment.

5. For door checks, provide 3/16 inch channel type reinforcements, 3-1/2 inch deep by 14 inches long, or as required.

6. Hinge reinforcement minimum 7 gauge by 1-1/2 inch by 9 inch bar. Weld reinforcing to door.

7. Reinforce doors for surface items such as surface and semi-concealed closers, brackets, surface holders and door stops.

8. Drilling and tapping installation of these surface items shall be done in field by hardware installer.

F. Special Reinforcing:

1. At exterior doors, reinforce inside of door on hinge side with high frequency hinge preparation. Weld to door.

G. Hardware:

1. Mortise, reinforce, drill and tap for hardware furnished under Section 08 7000, except drilling and tapping for surface door closers, door closer brackets and adjusters shall be done in field.

2. Obtain templates from hardware supplier.

3. Height of doors to correspond with thresholds and sealing systems as specified in Section 08 7000.

4. Prepare doors for clear wire raceways to connection locations.

H. Electrified Hardware:

1. Provide doors to receive electro-mechanical function hardware with integral wire harness consisting of 15 conductors of 22 gauge wire in PVC jacket complete with ElectroLynx quick connect system to match electrified hardware.

2. Prepare doors in shop for openings listed to be equipped with door position switches by drilling a 1 inch diameter, 1-5/8 inch deep hole in the top of the door, on centerline of the thickness of the door, 6 inches from the strike side of the door.

I. Finish:

1. Provide prime coat finish on doors.

2. Thoroughly clean off rust, grease and other impurities.

3. Grind welds smooth, no marks shall show.

4. Apply metallic filler as required to fill cracks and joints and to level any weld areas or similar imperfections.

5. Sand filler coat smooth.

J. Glass and Glazing:

1. Provide U.L. Listed fire rated polished wire glass or clear tempered glass for light openings as listed on Door Schedule and shown on drawings.

2. Conform to manufacturers regulations for glazing compound in U.L. listed assemblies.

2.06 Fastenings

A. Provide fastenings, anchors and clips as required to secure hollow metal work in place. Provide Jackson head screws, or flatter. Dimple metal work to receive screw heads. Set stops and other non-structural fastenings with #6 Jackson head self-tapping screws.

Part 3 Execution

3.01 Examination

A. Examine supporting structure and conditions under which hollow metal is to be installed. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.02 Installation

A. Install hollow metal in accordance with reviewed shop drawings and manufacturer's printed instructions. Securely fasten and anchor work in place without twists, warps, bulges or other unsatisfactory or defacing workmanship.

1. Set hollow metal plumb, level, square to proper elevations, true to line and eye.

2. Set clips and other anchors with Ramset "shot" anchors or drill in anchors as approved.

3. Units and trim shall be fastened tightly together, with neat, uniform and tight joints.

B. Placing Frames:

1. Set frames accurately in position, plumbed, aligned, and braced securely until permanent anchors are set.

2. After wall construction is complete, remove temporary braces and spreaders leaving surfaces smooth and undamaged.

3. In masonry construction, building-in of anchors and grouting of frames with mortar is specified in Section 04 0511. At in-place concrete or masonry construction, set frames and secure in place using countersunk bolts and expansion shields, with bolt heads neatly filled with metallic putty, ground smooth and primed.

C. Place fire-rated frames in accordance with NFPA Standard #80.

D. Door Installation:

1. Fit hollow metal doors accurately in their respective frames, within following clearances:

a. Jambs and head 3/32 inch, meeting edges pair of doors 1/8 inch, sill where no threshold or carpet 1/4 inch above finished floor, sill at threshold 3/4 inch maximum above finished floor, sill at carpet 1/4 inch above carpet.

b. Place fire-rated doors with clearances as specified in NFPA Standard #80.

3.03 Adjusting And Cleaning

A. Prime Coat Touch-Up: Immediately after installation, sand smooth rusted or damaged areas of prime coat and apply touch-up of compatible air-drying primer.

B. Protection Removal: Immediately before final inspection, remove protective wrappings from doors and frames.

End of Section

Section 08 7000
Hardware

Part 1 General

1.01 Scope of Work

A. Section includes hardware for custom steel doors, spare hardware sets for OWNER storage, thresholds, weatherstripping, seals, and door gaskets.

1.02 Related Work Specified Elsewhere

A. Section 08 1100: Hollow Metal Doors

1.03 Reference Standards

A. ANSI A117.1 - Specifications for Making Buildings and Facilities Accessible to and Usable by Physically Handicapped People.

B. UL 305 - Panic Hardware.

1.04 Quality Assurance

A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum five years documented experience.

B. Hardware Supplier: Company specializing in supplying industrial quality door hardware, approved by manufacturer to install their products.

C. Hardware Supplier Personnel: Employ an Architectural Hardware Consultant (AHC) to assist in the work of this section.

1.05 Submittals

A. Shop Drawings and Product Data:

1. Shop Drawings: Indicate locations and mounting heights of each type of hardware, and material types.

2. Submit manufacturer's parts lists, and templates to steel door and frame manufacturers for mortising of steel doors and frames. All necessary templates and schedules shall be provided at such time so not to delay the Work. Refer to Delivery, Storage and Handling herein for forwarding requirements of hardware.

B. Manufacturer's Installation Instructions: Indicate special procedures, perimeter conditions requiring special attention.

C. Project Record Documents: Record actual locations of installed cylinders and their master key code.

D. Operation and Maintenance Data: Include data on operating hardware, lubrication requirements, and inspection procedures related to preventative maintenance.

1.06 Delivery, Storage, And Handling

A. CONTRACTOR shall submit physical hardware direct to door manufacturer's plant for installation.

B. As far as practical, door hardware shall be installed by the door manufacturer at its factory. Remaining hardware shall be shipped to the site with the doors and frames.

C. Package hardware items individually; label and identify each package with door opening code to match hardware schedule.

D. Provide construction cores and cylinders; upon completion of the Work, install new cores and cylinders as necessary for OWNER approval.

E. Provide spare hardware as specified in unopened boxes and packages, labeled for OWNER storage.

F. Deliver keys for final cylinders to OWNER by security shipment direct from hardware supplier.

1.07 Coordination

A. Coordinate the work with other directly affected sections involving manufacture or fabrication of internal reinforcement for door hardware.

1.08 Warranty

A. Provide five year warranty, including coverage for door closers.

1.09 Maintenance Materials

A. Provide special wrenches and tools applicable to each different or special hardware component.

B. Provide maintenance tools and accessories supplied by hardware component manufacturer.

Part 2 Products

2.01 Hardware for Doors

A. General:

1. The following description of designated hardware components is limited to elements that are established as constants throughout the project and are not intended to be complete.

2. When a description is coupled with criteria established under the heading "Hardware Sets," the hardware for a particular opening will be complete to the extent necessary for a satisfactory installation.

3. The descriptions contain "Key Words" which when used in the hardware sets in conjunction with other notations, will establish the hardware elements assigned to the individual door.

2.02 Hinges

A. Stainless steel with ball bearings, flat button tip, Stanley FBB 191 32D, Hanger BB 1191 or McKinney No. TB2314.

B. Hinges shall be 4-1/2" x 4-1/2" minimum .134 inches thick stainless steel with stainless steel pins.

C. Interior doors shall have a minimum of 1 1/2 pair per leaf, (U.N.O.); exterior doors shall have 2 pair, non-removable pins (NRP).

2.03 Mortise Locks

A. Corbin/Russwin ML2200 series hardware, for severe climatic conditions or marine use with all stainless steel and bronze construction to resist corrosion, including non-ferrous or stainless steel case.

B. Cylinder locks or unlocks outside lever. Inside lever always free for egress.

C. Minimum 3/4 inch latch bolt throw designed to accept 1-5/32 inch diameter standard cam cylinder and adjustable from flat front to standard bevel either hand.

2.04 Levers and Escutcheons

A. Levers shall be cast stainless steel; escutcheons shall be wrought stainless steel.

B. Each lockset set shall be furnished complete with one pair of levers and escutcheons. Model shall be Corbin/Russwin "ASP".

2.05 Exit Devices

A. US-26D smooth case with stainless steel touch bar and lever trim, mortised cylinder recess, Von Duprin, No. 9875L x 07 lever designed for exterior doors.

B. Interior doors do not require cylinders unless noted in the hardware sets below.

C. Provide blank escutcheons for these locations, trim shall always be operable.

D. Provide matching Von Duprin 98 Series UL labeled device for fire rated doors.

E. Strikes shall be stainless steel, dustproof; coordinate with exit devices, as required

F. Hex key dogging is acceptable.

2.06 Closers

A. Surface mounted closer with cast iron cylinder, adjustable back check, and spring power with key valve adjusting screws for closing and latching speeds and back check control.

B. Closer arms shall allow for minimum 100 degree swing.

C. Closers shall be LCN Smoothee Series, resistant to severe climatic conditions with a U.S.-26D sprayed finish on covers.

D. Provide SRI finish on closer bodies and arms.

E. Closers:

1. For pull side mounting: LCN 4011DA
2. For push side mounting: LCN 4111DA

2.07 Kickplates

A. Dull stainless steel (US32D), (.050) gage 10" high except at doors with narrow bottom stiles where the height shall be reduced to 1/2" less than the height of the rail, and shall be 1-1/2" LDW on push side of single doors, 1" LDW on push side of pairs of doors.

B. Mount kickplates flush with lock style edge of pairs of doors.

C. Provide kickplates push side of all hollow metal doors.

2.08 Thresholds

A. Thermally broken, Barrier Free Accessible, 5 inch wide, full width of door frame, Zero Model No. 625A, National Guard Products Model No. 8425, or Reese Model No. S282D.

B. Finish shall be aluminum mill finish.

C. Provide one threshold for each exterior door opening.

2.09 Weatherstripping

A. National Guard Products, Reese, Zero or Pemco. Model No. listed are National Guard Products (NPG).

B. Head and jambs, NPG No. 160VA vinyl; door bottom seal, NPG 312, vinyl (1/2 inch); Finish for weatherstripping shall be natural satin anodized aluminum.

C. Provide weatherstrip for all exterior doors.

2.10 Flush Bolts

A. Manual type, Glynn Johnson No. FB6 x US26D, one each top and bottom, spring loaded, forged brass construction with DP2.

2.11 Overhead Holder

A. Glynn Johnson No. 814H-US32D-SOC, stainless steel.

2.12 Keying

A. locks shall be capable of accepting minimum six (6) pin cores and cylinders matching the OWNER's present system, master keyed to OWNER's approved system.

B. Supply keys in the following quantities:

1. 4 keys per cylinders, plus
2. 4 master keys.

2.13 Finishes

A. Satin chrome, U.S. 32D or 26D, when U.S. 32D is not available, unless otherwise noted in hardware product descriptions or schedule.

B. Hardware screws, fasteners, etc. shall be Type 304 stainless steel.

Part 3 Execution

3.01 Examination

A. Verify that doors and frames are ready to receive work and dimensions are as indicated on shop drawings and instructed by the manufacturer.

3.02 Installation

A. Install hardware in accordance with manufacturer's instructions.

B. CONTRACTOR shall inspect each door opening and ensure that it is ready to receive this Work.

C. Use templates provided by hardware item manufacturer.

D. Mounting heights for hardware from finished floor to center line of hardware item shall be per current State of Michigan, Barrier Free Code requirements.

3.03 Field Quality Control

A. CONTRACTOR shall inspect installation and certify that hardware and installation has been furnished and installed in accordance with manufacturer's instructions and as specified.

3.04 Adjusting

A. Adjust hardware for smooth operation.

3.05 Protection of Finished Work

A. Do not permit adjacent work to damage hardware or finish.

3.06 Schedule

Number	Type	Material	Manufacturer
1 ea.	Continuous Hinge 651	32D	Stanley
1 ea.	Lockset 45H7AT 3H	26D	Best
1 ea.	Latch Protector 321	32D	Rockwood
1 ea.	Closer D4550 CS	AL	Stanley Ryobi
1 ea.	Kick Plate K1050 10” x 1 ½” LDW	32D	Rockwood
1 ea.	Threshold C206	AL	Durable
1 ea.	Sweep B-11	AL	Durable
1 ea.	Weatherstrip 306	AL	Durable

End of Section

Division 09
Finishes

Section 09 9100
Painting

Part 1 General

1.01 Scope of Work

A. Section includes painting Work complete with surface preparation and coating of exterior and interior surfaces.

1.02 Definitions

A. "Paint" shall include emulsions, enamels, varnishes, sealers, stains and other coatings whether used as prime, intermediate or finish coats.

B. "DFT" shall mean Dry Film Thickness

1.03 Quality Assurance

A. Reference Standards:

1. NACE - National Association of Corrosion Engineers
2. SSPC - The Society for Protective Coatings

B. Quality of Materials:

1. Upon request from other trades, furnish information on characteristics of finish materials proposed for use to ensure compatible prime coats are used. Provide barrier coats over incompatible primers or remove and re-prime as required. Notify ENGINEER in writing of any anticipated problems using specified coating systems with substrates primed by others.

C. Sample Areas:

1. Paint sample areas to establish standards of quality and workmanship as directed by ENGINEER and to establish a basis for acceptability of the painting Work and coloring.

1.04 Submittals

A. Color Samples:

1. Submit paint system manufacturer's standard color range and sheens for each paint system specified. Samples shall be not less than 12 square inches in size.

2. After receipt of color samples and before commencement of the Work, ENGINEER will furnish a color schedule, showing the location of the various colors.

B. Manufacturer's Data:

1. For information only, submit manufacturer's technical information including paint label analysis and application instructions for each material proposed for use. Transmit a copy of each manufacturer's instructions to the paint applicator.

1.05 Product Delivery, Storage, and Handling

A. Delivery:

1. Deliver specified products to job in manufacturer's unopened, sealed containers bearing manufacturer's name, brand name, type of paint, analysis showing important constituents of the paint, color of paint, and instructions for thinning.

B. Storage:

1. Store products in the space designated for the storage and mixing of paint. Whenever it may be necessary to change the location of storage space, promptly move products to the newly designated space. Protect latex paints from freezing. Take the necessary precautions to prevent fire.

1.06 Job Conditions

A. Environmental Requirements:

1. Apply water-base paints only when the temperature of surfaces to be painted and the surrounding air temperatures are between 50 degrees and 90 degrees Fahrenheit, unless otherwise permitted by the paint manufacturer's printed instructions.

2. Apply solvent-thinned paints only when the temperature of surfaces to be painted and the surrounding air temperatures are between 50 degrees and 95 degrees Fahrenheit, unless otherwise permitted by the paint manufacturer's printed instructions.

3. Do not apply paint in snow, rain, fog or mist; or when the relative humidity exceeds 85 percent; or to damp or wet surfaces; unless otherwise permitted by the paint manufacturer's printed instructions. Do not apply coatings over condensation or when surface temperature is within 5 degrees Fahrenheit of the dew point.

4. Painting may be continued during inclement weather only if the areas and surfaces to be painted are enclosed and heated within the temperature limits specified by the paint manufacturer during application and drying periods.

B. Protection:

1. Adjacent Work:

a. Protect Work of other Sections, whether to be painted or not, against damage by painting and finishing Work. Correct any damage by cleaning, repairing or replacing, and repainting, as acceptable to ENGINEER.

2. Fresh Paint:

a. Provide "Wet Paint" signs as required to protect newly-painted finishes. Remove temporary protective wrappings provided by others for protection of their work after completion of painting operations.

Part 2 Products

2.01 Acceptable Manufacturers

A. Manufacturers of paint products mentioned in this Specification are set up as standards of quality. This listing or description shall not be construed so as to eliminate from competition other equal or better products which are similar in design or function.

B. Acceptable manufacturers include Tnemec Company, Carboline Company, Sherwin-Williams, ICI Paint Company, Ameron Protective Coatings or ENGINEER approved equal.

Part 3 Execution

3.01 Contractor's Verification

A. Examine construction in place on which the Work of this Section is dependent. Defects which may influence satisfactory completion and performance of the Work of this Section shall be corrected in accordance with the requirements of the applicable section of the Specifications prior to commencement of the Work. Commencement will be construed as construction in place being acceptable for satisfying the requirements of this Section.

B. Surface Preparation - General:

1. Perform preparation and cleaning procedures in strict accordance with the paint manufacturer's instructions and as herein specified, for each particular substrate condition.

2. Remove hardware, hardware accessories, machined surfaces, plates, lighting fixtures, and similar items in place and not to be finish-painted, or provide surface-applied protection prior to surface preparation and painting operations. Remove, if necessary, for the complete painting of the items and adjacent surfaces. Following completion of painting of each space or area, reinstall the removed items by workmen skilled in the trades involved.

3. Clean surfaces to be painted before applying paint or surface treatments. Remove oil and grease prior to mechanical cleaning. Program the cleaning and painting so that contaminants from the cleaning process will not fall onto wet, newly-painted surfaces.

4. Mix and prepare painting materials in accordance with manufacturer's directions.

5. Store materials not in actual use in tightly covered containers. Maintain containers used in storage, mixing and application of paint in a clean condition, free of foreign materials and residue.

6. Stir materials before application to produce a mixture of uniform density, and stir as required during the application of the materials. Do not stir surface film into the material. Remove the film and if necessary, strain the material before using.

C. Cementitious Surfaces:

1. Prepare cementitious surfaces of concrete, concrete block, cement plaster and cement-asbestos board to be painted in accordance with SSPC-SP-13. Surface shall be free of contaminants, laitance, loosely adhering concrete, and dust, and shall be dry, sound, and uniform.

2. Determine the alkalinity and moisture content of the surfaces to be painted by performing appropriate tests. If the surfaces are found to be sufficiently alkaline to cause blistering and burning of the finish paint, correct this condition before application of paint. Do not paint over surfaces where the moisture content exceeds that permitted in the manufacturer's printed directions.

3. Power wash using a biodegradable solution to remove curing oils, form oils, laitance, soluble salts, and waxes. Acid etch with a 20% to 30% solution of muriatic acid or whip blast concrete surfaces to create a profile on the surfaces similar to medium to fine sandpaper. Allow concrete to cure a minimum to 28 days prior to application of coating materials.

4. Clean concrete floor surfaces scheduled to be painted with a commercial solution of muriatic acid, or other etching cleaner, flush floor with clean water to neutralize acid, and allow to dry before painting. Test for moisture per ASTM F1869 Moisture Test by use of Calcium Chloride or ASTM D4263 Plastic Sheet Method.

D. Ferrous Metal Surface:

1. Ferrous metal that is not galvanized or shop coated shall have rust, dust, and scale, as well as other foreign substances, removed by sandblasting in accordance with the current edition of SSPC-SP10. Cleaned metal shall be primed or pretreated immediately after cleaning. Ferrous metals not shop primed which have to be sandblasted shall be sandblasted in the field prior to the application of the primer, pretreatment, or paint in accordance with the latest edition of SSPC-SP10.

2. Ferrous metal that has been shop primed but that requires touch up cleaning in the field shall have rust, dust and scale, as well as other foreign substances removed by power tool cleaning in accordance with the current requirements of SSPC-SP1. Power cleaning procedures and degree of cleaning required shall be in accordance with the current requirements of SSPC-SP3 Power Tool Cleaning.

3. Touch up shop-applied prime coats wherever damaged or bare, where required by other sections of these Specifications. Clean and touch up with the same type shop primer.

4. Prepare welds by grinding smooth. Remove sharp edges, spatter, undercuts, recesses and pinholes.

E. Galvanized Metal Surface:

1. Clean free of oil and surface contaminants with a non-petroleum base solvent in accordance with SSPC-SP1 and ASTM D2092.

F. Wood Surfaces:

1. Clean wood surfaces to be painted of all dirt, oil, or other foreign substances with scrapers, mineral spirits, and sandpaper, as required. Sandpaper smooth those finished surfaces exposed to view, and dust off. Scrape and clean small, dry, seasoned knots and apply a thin coat of white shellac or other recommended knot sealer, before application of the priming coat. After priming, fill holes and imperfections in finish surfaces with putty or plastic wood-filler. Sandpaper smooth when dried.

2. Prime, stain, or seal wood required to be job-painted immediately upon delivery to job. Prime edges, ends, faces, undersides, and backsides of such wood, including cabinets, counters, cases, and paneling.

3.02 Application

A. General:

1. Apply paint in accordance with the manufacturer's directions. Use applicators and techniques best suited for the substrate and type of material being applied.

2. Allow sufficient time between successive coatings to permit proper drying. Do not recoat until paint has dried to where it feels firm, does not deform or feel sticky under moderate thumb pressure, and the application of another coat of paint does not cause lifting or loss of adhesion of the undercoat.

3. Apply additional coats when evidence of suction spots, burn through or other coating defects until the paint film is of uniform finish, color and appearance. Insure all surfaces, including edges, corners, crevices, welds and exposed fasteners receive a dry film thickness equivalent to that of flat surfaces.

4. Ensure that all edges of paint adjoining other materials or colors are sharp and clean without overlapping. Sand lightly between each succeeding enamel or varnish coat.

5. CONTRACTOR shall arrange to meet with site engineer and selected coatings manufacturers representative prior to application of coating materials to assure the scope and intent of this Section is fully understood.

B. Minimum Coating Thickness:

1. Apply each material at not less than the manufacturer's recommended spreading rate, to establish a total dry film thickness as indicated or, if not indicated, as recommended by manufacturer for the service intended.

C. Primer Coats:

1. Apply the first coat material to surfaces that have been cleaned, pretreated or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.

2. Apply primer coat on items that are to be painted or finished and that have not been shop primed by others or require touch up in the field.

D. Methods of Application:

1. General:

a. Application on cementitious and similar surfaces shall be done by brush or roller unless otherwise directed by ENGINEER. Combination spray and back-roll method may be used on the surfaces as approved by ENGINEER.

b. On other surfaces, exterior first coats shall be applied by brush, and interior first coats, except on shop primed surfaces, shall be applied by brush or roller. Succeeding coats over field primed surfaces and all coats over shop primed surfaces may be applied by brush, roller or sprayer.

c. Spray equipment shall be as recommended by the manufacturer of the paint used.

2. Surface Finish:

a. Enamel:

(1) Roll and redistribute paint to an even and fine texture. Leave no evidence of rolling such as laps, irregularity in texture, skid marks, or other surface imperfections. Rollers for application shall have a short nap.

b. Pigmented:

(1) Completely cover to provide an opaque, smooth surface of uniform finish, color, appearance and coverage. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness or other surface imperfections will not be acceptable.

(2) Match approved samples for color, texture and coverage. Remove, refinish or repaint work not in compliance with specified requirements.

3. Drying Time:

a. Drying time shall be construed to mean "under normal conditions" and where conditions are other than normal because of the weather or because painting must be done in confined spaces, longer drying times will be necessary. Additional coats of paint shall not be applied, nor will units be put into service until paints are thoroughly dry.

4. Inspection:

a. Work will be inspected as to proper surface preparation, pretreatment, priming, dry film thickness, curing, color and workmanship.

b. CONTRACTOR shall supply the following testing equipment and standard. This equipment shall be on the job site and available to the site inspector.

(1) SSPC-VIS-1-89 Photographic Blast Cleaning Standards
(2) Magnetic Dry Film Thickness Gauge, 0-45 mils
(3) Tinker & Rasor M-1 Holiday Detector or Equal

(4) Mark 5 Tooke Gauge or equal.

3.03 Items Not to be Painted

A. Finished Metal Surfaces:

1. Metal surfaces of anodized aluminum, stainless steel, chromium plate, copper, bronze and similar metals will not require finish painting, unless otherwise specified elsewhere.

B. Operating Parts and Labels:

1. Moving parts of operating units, mechanical and electrical parts, such as valve and damper operators, linkages, sinkages, sensing devices, motor and fan shafts will not require finish painting, unless otherwise specified elsewhere.

2. Do not paint over any code-required labels, such as Underwriter's Laboratories and Factory Mutual, or any equipment identification, performance rating, name or nomenclature plates.

C. Pre-finished Items:

1. Factory-finished or installer-finished materials, equipment and construction including the following:

a. Metal toilet enclosures, unless otherwise specified
b. Acoustic materials
c. Architectural woodwork and casework
d. Finished mechanical and electrical equipment
e. Switchgear
f. Distribution cabinets
g. Metal roofing
h. Galvanized components of prefabricated metal buildings
i. Factory painted mechanical equipment with approved finishes.

D. Equipment and Construction:

1. Factory finished surfaces such as:

a. Anodized aluminum
b. Stainless steel
c. Chromium plate
d. Glass
e. Bronze and brass
f. Fiberglass items and construction.

3.04 Items to be Painted

A. General:

1. Paint exposed surfaces whether or not colors are designated herein, except where surface or material is specifically indicated not to be painted or to remain natural.

2. Where an item or surface is not specifically mentioned, paint the same as similar adjacent materials or surfaces.

3. If color or finish is not designated, ENGINEER/OWNER will select from standard colors or finishes available.

4. It is preferred that exterior equipment be factory finished with a color that blends with the building colors. Provide available color samples with equipment submittals.

B. Electrical items to be painted include, but are not limited to:

1. Exposed conduit and fittings
2. Exposed cabinets, enclosures, junction boxes, and pull boxes
3. Exposed hangers

C. Mechanical items to be painted include, but are not limited to:

1. Exposed piping, vessels and equipment rooms shall be color coated per Part 3 of this Section.

2. Exposed piping, ductwork and hangers and supports in occupied areas shall be painted to match adjacent surfaces.

3. Exterior piping, uninsulated ductwork, and equipment shall be painted to match the building exterior.

D. Miscellaneous Surfaces:

1. Surfaces behind movable equipment and furniture the same as similar exposed surfaces.

2. Paint surfaces behind permanently-fixed equipment or furniture with prime coat only before final installation of equipment.

E. Metal Submerged, Nonpotable Water:

1. Coal Tar Epoxy Coating with total dry film thickness of 18.5 mils.

a. Surface Preparation: Near-White Blasting SSPC-SP10.

b. Field Prime Coat: Polyamide Epoxy

(1) Tnemec: Series 66-1211 HI-Epoxoline Primer
(2) Carboline: Bitumastic 300M

c. First and Second Coats: Polyamide Epoxy – Coal Tar

(1) Tnemec: Series 46-413 Hi-Build Tneme-Tar
(2) Carboline: Bitumastic 300M
(3) Sherwin-Williams: Targuard Coal Tar Epoxy B69B60/ B69V60.

F. Metal Submerged, Potable Water:

1. NSF approved high solids epoxy system, total dry film thickness of 16.0 mils

    a. Surface Preparation: Near-White Blasting SSPC-SP-10
    b. Field Prime Coat: Polyamide Epoxy

        (1) Tnemec: Series 20-1255 Pota-Pox
        (2) Carboline: Carboguard 891
        (3) Sherwin-Williams: Epoxide HS B62 Series

    c. First and Second Coat: Polyamidoamine Epoxy

        (1) Tnemec: Series 140 Pota-Pox Plus

G. Concrete Surfaces Submerged, Nonpotable Water:

1. Coal Tar Epoxy Coating, total dry film thickness of 18.5 mils

    a. Surface Preparation: Near-White Blasting SSPC-SP10

    b. Field Prime Coat: Polyamide Coal Tar Epoxy

        (1) Tnemec: Series 46-413 Tneme-Tar
        (2) Carboline: Bitumastic 300M
        (3) Sherwin-Williams: Targuard Coal Tar Epoxy B69B60/ B69V60

    c. First and Second Coats: Polyamide Coal Tar Epoxy

        (1) Tnemec: Series 46-413 Tneme-Tar
        (2) Carboline: Bitumastic 300M
        (3) Sherwin-Williams: Targuard Coal Tar Epoxy B69B60/ B69V60

H. Concrete Surfaces Submerged, Potable Water:

1. NSF approved High Solids epoxy system, total dry film thickness 16.0 mils

    a. Surface Preparation: Brush Off Blast SSPC-SP-13

    b. Field Prime Coat: Polyamide Epoxy

        (1) Tnemec: Series 20-1255 Pota-Pox
        (2) Carboline: Carboguard 891
        (3) Sherwin-Williams: Epoxide HS B62 Series

    c. First and Second Coat: Polyamidoamine Epoxy

        (1) Tnemec: Series 140 Pota-Pox Plus

I. Concrete Surfaces, Interior:

1. Surface Preparation: Clean and dry

2. First and Second Coats: Interior acrylic latex, flat finish, two coats with total dry film thickness of 6.0 mils.

J. Piping Systems, Steel, Ductile, or Cast Iron:

1. Epoxy-Polyamide Coating with total dry film thickness of 6.0 mils
   a. Surface Preparation (if not shop primed): Near-White Blasting SSPC-SP10

   b. First and Second Coats: Polyamide Epoxy

      (1) Tnemec: Series 66 Hi-Build Epoxoline
      (2) Carboline: Carboguard 890
      (3) Sherwin-Williams: Epolon II Multi-Mil Epoxy

K. Concrete Masonry Units (Interior):

1. Interior Polyamide Epoxy in Semi-Gloss Finish: Three coats with total dry film thickness not less than 4.0 mils.

   a. Filler:

      (1) Solvent-thinned block filler (FS-TT-F-1098). Apply filler coat at a rate to ensure complete coverage with pores filled.

         (a) Tnemec: 54-660 Masonry Filler
         (b) Sherwin-Williams: Epo-Plex Cementitious Water Based Epoxy Block Filler

   b. First Coat:

      (1) Shellac pigmented primer (TT-P-652) or undercoater as recommended by coating manufacturer.

   c. Second and Third Coats: Polyamide Epoxy.

      (1) Tnemec: Series 66 Hi-Build Epoxoline
      (2) Carboline: Carboguard 888
      (3) Devoe: Tru-Glaze 4508
      (4) Sherwin-Williams: Tile-Clad High Solids B62Z Series/ B60VZ75

L. Concrete Masonry Units (Exterior):

1. Lusterless (Flat) Acrylic Finish: Two coats over filler coat with total dry film thickness not less than 2.5 excluding filler coat.

   a. Filler Coat:

      (1) High-performance latex block filler; heavy-duty latex block filler.

         (a) Tnemec: Series 130

   b. First and Second Finish Coats:

      (1) Acrylic Emulsion (FS TT-P-19):

(a) Tnemec: Series 6
(b) Sherwin-Williams A-100 Exterior Flat Latex A6 Series

M. Ferrous Metal (Interior) (Mild Service):

1. Semi-gloss enamel finish: Two coats over primer, with total dry film thickness not less than 7.0 mils.

a. Surface Preparation: Commercial Blast Cleaning SSPC –SP6
b. Prime Coat:

(1) Rust Inhibitive primer. Prime coat is not required on items delivered shop primed.

(a) Tnemec: Series 10 Tnemec Primer
(b) Carboline: Carbocoat 150
(c) Sherwin-Williams: Kem Kromik Universal Primer B54 Series

c. First Coat and Second Coat:

(1) Interior enamel undercoat (FS TT-E-543)

(a) Tnemec: Series 23 Enduratone
(b) Carboline: Carbocoat 139 and Carbocoat 30
(c) Sherwin-Williams: Industrial Enamel B54 Series

N. Ferrous Metal (Interior) (Severe Service):

1. Epoxy-Polyamide Coating with total dry film thickness of 12.0 mils minimum

a. Surface Preparation: Near-White Blasting SSPC-SP10

b. Prime Coat:

(1) Rust Inhibitive primer. Prime coat is not required on items delivered shop primed.

(a) Tnemec: Series 37H Tnemec Primer
(b) Carboline: Carbocoat 150
(c) Sherwin-Williams: Kem Kromik Universal Primer B54 Series

c. First and Second Coats: Polyamide Epoxy

(1) Tnemec: Series 66 Hi-Build Epoxoline
(2) Carboline: Carboguard 890
(3) Sherwin-Williams: Epolon II Multi-Mil Epoxy

O. Ferrous Metal (Exterior):

1. Semi-gloss enamel finish: Two coats over primer, with total dry film thickness not less than 8.5 mils.

a. Surface Preparation: Commercial Blast Cleaning SSPC-SP6

b. Prime Coat:
(1) Rust Inhibitive primer./ Prime coat is not required on items delivered shop primed.

(a) Tnemec Series: Tneme Primer, Series 10
(b) Sherwin-Williams: Kem Kromik Universal Primer B54 Series

c. First Coat and Second Coat:

(1) Interior enamel undercoat (FS TT-E-543)
(2) Tnemec: Series 23 Enduratone
(3) Sherwin-Williams: Industrial Enamel B54 Series

P. Zinc Coated Metal (Interior):

1. Semi-Gloss Finish: Two coats over primer with total dry film thickness not less than 2.5 mils.

a. Surface Preparation: Commercial Blast Cleaning SSPC-SP6

b. Prime Coat:

(1) Zinc dust - zinc oxide primer coating (FS TT-P-641)
(2) Sherwin-Williams Galvite HS Primer B50WZ30

c. Second Coat:

(1) Interior Enamel Undercoat
(2) Sherwin-Williams ProMar 200 Alkyd Semi-Gloss Enamel B34 Series

d. Third Coat:

(1) Odorless interior alkyd semi-gloss enamel
(2) Sherwin-Williams ProMar 200 Alkyd Semi-Gloss Enamel B34 Series

Q. Zinc Coated Metal (Exterior):

1. High Gloss Alkyd Enamel: Two finish coats over primer.

a. Prime Coat:

(1) Zinc Dust-Zinc Oxide Primer
(2) Sherwin-Williams Galvite HS Primer B50WZ30

b. First and Second Finish Coats:

(1) High Gloss Alkyd Enamel
(2) Sherwin-Williams: Industrial Enamel B54 Series.

R. Painted Wood and Hardboard (Interior) (Living space exposure):

1. One or two finish coats over primer, total dry film thickness 4.5 mils minimum
   a. First Coat:

      (1) Interior Enamel Undercoat
      (2) Tnemec: Series 36 Undercoater
      (3) Sherwin-Williams: PrepRite Wall & Wood Primer B49 Series.

   b. Second and Third Coats:

      (1) Odorless interior semi-gloss enamel (FS TT-E-509)
      (2) Tnemec: Series 23 Enduratone
      (3) Sherwin-Williams: ProMar 200 Alkyd Semi-Gloss Enamel B34 Series

S. Painted Wood and Hardboard (Interior) (Chemical and Moisture Exposure):

1. One or two finish coats over primer, total dry film thickness 8.0 mils minimum

   a. First Coat (Alkyd primer/undercoater):

      (1) Tnemec: Series 36 Undercoater
      (2) Sherwin –Williams: Kem Kromik Universal Primer B54 Series

   b. Second and Third Coats (Waterborne Acrylic Epoxy – Semi gloss/satin):

      (1) Tnemec: Series 113 or 114 H.B. Tneme-Tufcoat
      (2) Sherwin-Williams: Epo-Plex Multi-Mil

T. Wood Trim (Exterior):

1. High Gloss Alkyd Enamel: Two finish coats over primer. Not less than 7.5 mil dry film thickness.

   a. First Coat (Alkyd primer/undercoater):

      (1) Tnemec: Series 36 Undercoater
      (2) Sherwin-Williams PrepRite Wall & Wood Primer B49 Series

   b. Second and Third Coats (Alkyd Enamel):

      (1) Tnemec: Series 2H Tneme-Gloss
      (2) Sherwin-Williams Industrial Enamel B54 Series

U. Stained Wood:

1. First Coat:

   a. Semi-Transparent oil stain
   b. Sherwin-Williams Wood Classics Interior Oil Stain

2. Second and Third Coats:

a. Polyurethane, lightly sanded between coats with steel wool.
b. Sherwin-Williams Wood Classics Polyurethane Varnish A67 Series.

V. Gypsum Wallboard:

1. Two coats over primer/sealer, not less than 7.5 mils dry film thickness

a. First Coat:

(1) Waterborne Vinyl Acrylic primer sealer
(2) Tnemec: Series 51-792 PVA Sealer

b. Second and Third Coats:

(1) Oderless interior semi-gloss enamel, Alkyd enamel (TT-E-509)
(2) Tnemec: Series 23 Enduratone
(3) Sherwin-Williams ProMar 200 Alkyd Semi-Gloss Enamel B34 Series

3.05 Schedules

A. Pipe Labeling and Color Schedule:

1. Exposed piping, fittings, valves, associated supports and hangers, and appurtenances shall be painted with color code as specified.

2. Pipes shall be labeled by white letters no larger than four inches high but no smaller than the diameter of the pipe less 1/2-inch.

3. Lines shall be identified at intervals no greater than 20 feet. Directional arrows or other data may be as required by ENGINEER.

Type	Base Color	Bands*
WATER LINES		
Finished or Potable	Dark Blue	
Service or Non-Potable	Light Blue	Black
Circulating - Hot and Return	Dark Blue	Red
Deionized	Dark Blue	White
Tempered	Dark Blue	Light Gray
CHEMICAL LINES		
Alum	Orange	
Caustic	Yellow	Green
Polymer Solution	Purple	
Chlorine (Gas or Solution)	Yellow	
Ferric Chloride Solution	Orange	
Fluorosilicic Acid	Light Blue	Red
Sulfur Dioxide	Yellow	Red
WASTE LINES		
Raw Sludge	Brown	Black
Sludge Recirculation Suction Line	Brown	Yellow

Type	Base Color	Bands*
Sludge Draw Off Line	Brown	Orange
Sludge Recirculation Discharge Line	Brown	
Sludge Gas Line	Red	
Sewer (Sanitary, Discharge, or Other)	Dark Gray	
Final Effluent	Light Gray	
Supernatant	Light Green	Dark Green
WASTE LINES		
Scum	Light Gold	
Drainage and Vent	**Black	
Mixed Liquor	Light Brown	
MISCELLANEOUS ITEMS		
Vacuum	Black	White
Compressed Air	Dark Green	
Natural Gas	Safety Red	Black
Fuel Oil/Diesel	Safety Red	
Steam Supply and Return	Safety Red	White
Sample Piping	To match piping sampled	
Electrical Conduit	**Light Gray	
Pumps, Valves, and Compressors	To match piping color of line it serves	
Low Pressure Air and Blowers	Black	Light Gray

* Banding shall be 6 inches wide at 30-inch c/c.

** When exposed to the building interiors above the basement areas, the color shall match the adjacent finish.

End of Section

Division 26
Electrical

Section 26 2923
Variable Frequency Motor Controllers

Part 1 General

1.01 Scope of Work

A. This section provides specification requirements for adjustable frequency drive, variable speed drives or here in identified (as AC Drives) for use with NEMA B design AC motors.

B. The AC Drive manufacturer shall furnish, field test, adjust and certify all installed AC Drives for satisfactory operation.

C. Exceptions/deviations to this specification shall be indicated in writing and submitted with the quotation.

1.02 Reference Standards

A. ANSI®/NFPA® 70 - National Electrical Code® (NEC®)

B. ANSI C84.1 - Voltages Tolerances for North America

C. CSA® C22.2 No. 14-M91 - Industrial Control Equipment

D. IEC® 60068-2-3 - Environmental Testing Procedures Part 2: tests - Test Ca: Damp Heat, Steady State

E. IEC 60146.1 - Semiconductor Converters-General Requirements and Line Commutated Converters, Part 1-1: Specifications of Basic Requirements

F. IEC 60664-1 - Insulation Coordination for Equipment Within Low-Voltage Systems

G. IEC 60447 - Man-Machine Interface Actuating Principles

H. IEC 60439-1 - Low Voltage Switchgear and Control-gear Assemblies

I. IEC 60947-1 - Low Voltage Switchgear and Control-gear Components

J. IEC 60364-1 - Electrical Installation of Buildings

K. IEC 60204-1/NFPA 79 - Electrical Equipment of Industrial Machines/Industrial Machinery

L. IEC 60106 - Guide for Specifying Environmental Conditions for Equipment Performance Rating

M. IEC 60529 - Degrees of Protection Provided by Enclosure

N. IEC 61000 - Electromagnetic Compatibility

O. IEC 60721 - Classification of Environmental Conditions

P. IEC 255-8 Overload Relays

Q. IEC 60801-2,-3,-4,-5 - Immunity Tests

R. NEMA ICS 6 - Industrial Control and Systems Enclosures

S. NEMA ICS, Part 4 Overload Relays

T. NEMA 250 Enclosures for Electrical Equipment

U. NEMA ICS 2-321 - Electrical Interlocks

V. NEMA ICS7 - Industrial Control and Systems Adjustable Speed Drives

W. NEMA ICS 7.1 - Safety Standards for Construction and Guide for Selection Installation and Operation of Adjustable Speed Drives

X. UL® 50 - UL Standard for Safety Enclosures for Electrical Equipment

Y. UL 98 - UL Standard for Disconnect Switches

Z. UL 507 - UL Standard for Safety Electric Fans

AA. UL 508 - UL Standard for Safety Industrial Control Equipment

BB. UL 508C - UL Standard for Safety Power Conversion Equipment

CC. UL 991 - UL Standard for Safety Tests for Safety Related Controls employing Solid State Devices

DD. OSHA® 1910.95 - AC Drive Controller Acoustical Noise

1.03 Submittals

A. Six (6) copies of approval drawings shall be furnished for Engineer's approval prior to factory assembly of the AC Drives. These drawings shall consist of elementary power and control wiring diagrams and enclosure outline drawings. The enclosure drawings shall include front and side views of the enclosures with overall dimensions and weights shown, conduit entrance locations and nameplate legends.

B. Standard catalog sheets showing voltage, horsepower, maximum current ratings and recommended replacement parts with part numbers shall be furnished for each different horsepower rated AC Drive provided.

1.04 Quality Assurance

A. Manufacturer of the AC Drive shall be a certified ISO 9001 facility.

B. AC Drive and all associated optional equipment shall be UL Listed according to UL508C Power Conversion Equipment. A UL label shall be attached inside each enclosure as verification.

C. AC Drive shall be designed constructed and tested in accordance with NEMA, NEC, VDE, IEC standards.

D. Every power converter shall be tested with an actual ac induction motor, 100% load and temperature cycled within an environmental chamber at 104 degrees Fahrenheit. Documentation shall be furnished to verify successful completion at the request of the engineer.

E. Drive door mounted pilot devices shall be tested to verify successful operation. Documentation shall be furnished upon written request of the engineer.

F. AC Drive shall be submitted to a hi-pot test with all enclosed devices mounted and wired, prior to shipment.

1.05 Warranty

A. An 18-month parts warranty shall be provided on materials and workmanship from the date of invoice from an authorized distributor.

Part 2 Products

2.01 Manufacturers

A. The AC Drive Power Flex 700 shall be provided by Allen Bradley as part of the Pump System Manufactures assembly enclosure.

B. Alternate control techniques other than pulse width modulated (PWM) are not acceptable.

2.02 General

A. The AC Drive shall convert the input AC mains power to an adjustable frequency and voltage as defined below:

1. For AC Drives rated up to 75 hp, the AC Drive manufacturer shall use at minimum 6-Pulse bridge rectifier design with line reactors, isolation transformers for effective harmonic mitigation. Diode rectifiers shall convert fixed voltage and frequency, AC line power to fixed DC voltage. The power section shall be insensitive to phase rotation of the AC line.

2. For AC Drives rated 100 hp and above, the AC Drive manufacturer shall supply at minimum an 18-Pulse topology using a multiple bridge rectifier design with integral reactor and phase shifting transformer. The 18-Pulse configuration shall result in a multiple pulse current waveform that approximates near sinusoidal input current waveform. The power section shall be insensitive to phase rotation of the AC line.

B. The output power section shall change fixed DC voltage to adjustable frequency AC voltage. This section shall use insulated gate bipolar transistors (IGBT) or intelligent power modules (IPM) as required by the current rating of the motor.

2.03 Construction

A. AC Drives shall be mounted in the new NEMA 12 enclosure with an external operated disconnect device.

B. A mechanical interlock shall prevent an operator from opening the AC Drive door when disconnect is in the "on" position. Another mechanical interlock shall prevent an operator from placing disconnect in the "on" position while the AC Drive door is open. It shall be possible for authorized personnel to defeat these interlocks.

C. Provisions shall be provided for locking disconnects in the "off" position with up to three padlocks.

D. Current-limiting fuses or breakers shall be installed and wired to the AC Drive input.

E. Provisions shall be made for accepting a padlock to lock the enclosure door.

2.04 Motor Data

A. AC Drive shall be sized to operate the following AC motor:

1. Motor Horsepower - See listing on plans as noted.
2. Motor full load ampere specify rating coordinated to NEC Table 430-150
3. Motor RPM see as note in plans and specs. at 60 Hz
4. Motor voltage, 480
5. Motor service factor 1.15

2.05 Application Data

A. AC Drive shall be sized to operate a wastewater pumping and transfer system using Variable Torque load drives.

B. The speed range shall be from a minimum speed of 0.5 Hz to a maximum speed of 400 Hz.

2.06 Environmental Ratings

A. AC Drive shall be of construction that allows operation in a pollution Degree 3 environment. AC Drive shall meet IEC 664-1 and NEMA ICS 1 Standards. AC Drives that are only rated for Pollution Degree 2 environment shall not be allowed.

B. AC Drive shall be designed to operate in an ambient temperature from 0 to + 40 degrees Celsius (+32 to 104 degrees Fahrenheit).

C. Storage temperature range shall be -25 to + 70 degrees Celsius.

D. Maximum relative humidity shall be 95% at 40 degrees Celsius, non-condensing.

E. AC Drive shall be rated to operate at altitudes less than or equal to 3,300 ft (1000 m). For altitudes above 3,300 ft, de-rate the AC Drive by 1.2% for every 300 ft (100 m).

F. AC Drive shall meet the IEC 68-2 Operational Vibration Specification.

2.07 Ratings

A. AC Drive shall be designed to operate from an input voltage of and 480 ± 10% Vac. Drive shall operate from an input voltage frequency range of 60 Hz ± 2%. Displacement power factor shall not be less than .95 lagging under any speed or load condition.

B. Efficiency of the AC Drive at 100% speed and load shall not be less than 96%.

C. Constant torque rated AC Drive over-current capacity shall be 110% for one minute.

D. Output carrier frequency of the AC Drive shall be randomly modulated and selectable at 2, 4, or 10 kHz depending on Drive rating for low noise operation. No AC Drive with an operable carrier frequency above 10 kHz shall be allowed.

E. Output frequency shall be from 0.1 to 400 Hz for AC Drives up to 75 hp. For horsepower ratings above 75 hp, the maximum output frequency will be 200 Hz.

F. AC Drive will be able to develop rated motor torque at 0.5 Hz (60 Hz base) in a sensor-less flux vector (SVC) mode using a standard induction motor without an encoder feedback signal.

2.08 Protection

A. Upon power-up the AC Drive shall automatically test for valid operation of memory, option module, loss of analog reference input, loss of communication, dynamic brake failure, DC to DC power supply, control power and the pre-charge circuit.

B. AC Drive shall be UL 508C listed for use on distribution systems with a minimum, 10,000 A, or 22,000 A maximum A RMS available fault current determined available utility fault current. The AC Drive have a coordinated short circuit rating designed to UL 508C and NEMA ICS 7.1.09 and listed on the nameplate.

C. Power Converter shall be protected against short circuits, between output phases and ground; and the logic and analog outputs.

D. AC drive shall have a minimum AC under-voltage power loss ride-through of 200 msec. The AC Drive shall have the user-defined option of frequency fold-back to allow motor torque production to continue to increase the duration of the power-loss ride-through.

E. AC drive shall have a selectable ride through function that will allow the logic to maintain control for a minimum of one second without faulting.

F. For a fault condition other than a ground fault, short circuit or internal fault, an auto restart function will provide up to 5 programmable restart attempts. The programmable time delay before restart attempts will range from 1 second to 600 seconds.

G. Deceleration mode of the AC drive shall be programmable for normal and fault conditions. The stop modes shall include free-wheel stop, fast stop and DC injection braking.

H. Upon loss of the analog process follower reference signal, the AC Drive shall fault and/or operate at a user-defined speed set between software programmed low-speed and high-speed settings.

I. AC drive shall have solid state I^2t protection that is UL Listed and meets UL 508C as a Class 10 overload protection and meets IEC 947. The minimum adjustment range shall be from 0.45 to 1.05% of the current output of the AC Drive.

J. AC Drive shall have a thermal switch with a user selectable pre-alarm that will provide a minimum of 60 seconds delay before over-temperature fault.

K. AC Drive shall use bonded fin heat-sink construction for maximum heat transfer.

L. AC Drive shall have a programmable fold-back function that will anticipate a controller overload condition and fold back the frequency to avoid a fault condition.

M. Output frequency shall be software enabled to fold back when the motor is overloaded.

N. There shall be three skip frequency ranges that can each be programmed with a selectable bandwidth of 2 or 5 Hz. Skip frequencies shall be programmed independently, back to back or overlapping.

2.09 Adjustments and Configurations

A. AC Drive shall self-configure to the main operating supply voltage and frequency. No operator adjustments will be required.

B. Upon power-up, the AC Drive will automatically send a signal to the connected motor and store the resulting resistance data into memory. The inductance data will be measured during no-load operation when operating at a frequency between 20-60 Hz. The AC Drive will automatically optimize the operating characteristics according to the stored data.

C. AC Drive will be factory pre-set to operate most common applications.

D. A choice of three types of acceleration and deceleration ramps will be available in the AC Drive software; linear, S curve and U curve.

E. Acceleration and deceleration ramp times shall be adjustable from 0.1 to 999.9 seconds.

F. The volts per frequency ratios shall be user selectable to meet variable torque loads, normal and high-torque machine applications.

G. The memory shall retain and record run status and fault type of the past eight faults.

H. Slip compensation shall be a software-enabled function.

I. Software shall have a NOLD (no load) function that will reduce the voltage to the motor when selected for variable torque loads. A constant volts/Hz ratio will be maintained during acceleration. Output voltage will then automatically adjust to meet the torque requirement of the load.

J. AC Drive shall offer programmable DC injection braking that will brake the AC motor by injecting DC current and creating a stationary magnetic pole in the stator. Level of current will be adjustable between 50-150% of rated current and available from 0.0-30 seconds continuously. For continuous operation after 30 seconds, the current shall be automatically reduced to 50% of the nameplate current of the motor.

K. Sequencing logic will coordinate the engage and release thresholds and time delays for the sequencing of the AC Drive output, mechanical actuation and DC injection braking in order to accomplish smooth starting and stopping of a mechanical process.

2.10 Operator Interface

A. Operator interface terminal will offer the modification of AC Drive adjustments via a touch keypad. All electrical values, configuration parameters, I/O assignments, application and activity function access, faults, local control, adjustment storage, self-test and diagnostics will be in plain English. There will be a standard selection of four additional language built-in to the operating software as standard.

B. Display will be a high-resolution, LCD backlit screen capable of displaying graphics such as bar graphs as well as 6 lines of 21 alphanumeric characters.

C. AC Drive model number, torque type, software revision number, horsepower, output current, motor frequency and motor voltage shall all be listed on the drive identification display as viewed on the LCD display.

D. Display shall be configured for up to two bar-graphs with numeric data selectable and scaleable by the operator. A user defined label function shall be available. As a minimum the selectable outputs shall consist of speed reference, output frequency, output current, motor torque, output power, output voltage, line voltage, DC voltage, motor thermal state, drive thermal state, elapsed time, motor speed, machine speed reference and machine speed.

E. A single keystroke scrolling function shall allow dynamic switching between display variables.

F. Terminal keypad will consist of programmable function keys. The functions will allow both operating commands and programming options to be preset by the operator. A hardware selector switch will allow the terminal keypad to be locked out from unauthorized personnel.

G. Operator terminal will offer a general menu consisting of parameter setting, I/O map, fault history, and drive configuration. A software lock will limit access to the main menu. The main menu will consist of keypad configuration, drive configuration, general configuration, diagnostic mode and drive initialization screens.

H. There will be arrow keys that will provide the ability to scroll through menus and screens, select or activate functions or increase the value of a selected parameter. A data entry key will allow the user to confirm a selected menu, numeric value or allow selection between multiple choices.

I. An escape key will allow a parameter to return the existing value if adjustment is not required and the value is displayed. The escape function will also return to a previous menu display.

J. A RUN key and a STOP key will command a normal starting and stopping as programmed when the AC Drive is in keypad control mode. The STOP key must be active in all control modes.

K. The AC Drive shall have three LEDs mounted on the front panel to indicate functional status. A green LED will verify that the AC Drive power supply is on. A red LED indicator will indicated an AC Drive fault. A yellow LED indicator will designate a pending fault condition.

L. The status LEDs shall be able to be remotely mounted up to 3 meters from the AC Drive.

M. A user interface shall be available that is a WINDOWS® based personal computer, serial communication link or detachable operator interface.

N. The keypad and all door mounted controls must be Type 12 rated.

2.11 Control

A. External pilot devices shall be able to be connected to a terminal strip for starting/stopping the AC Drive, speed control and displaying operating status. All control inputs and outputs will be software assignable.

B. 2-wire or 3-wire control strategy shall be defined within the software. 2-wire control allows automatic restart of the AC Drive without operator intervention after a fault or loss of power. 3-wire control requires operator intervention to restart the AC Drive after a fault or loss of power.

C. Control power for the digital inputs and outputs shall be 24 Vdc.

D. The internal power supply incorporates an automatic current fold-back that protects the internal power supply if incorrectly connected or shorted. The transistor logic outputs will be current limited and not be damaged if shorted or excess current is pulled.

E. Logic connections shall be furnished on pull apart terminal strips.

F. There will be (2) two software assignable, optically isolated analog inputs. The analog inputs will be software selectable and consist of the following configurations: 0-20 mA, 4-20 mA, 20-4 mA, x-20 mA (where x is user defined) 0 to 5 V, 1 to 5 V or 0 to 10 V.

G. There will be four software assignable, optically isolated logic inputs that will be selected and assigned in the software. The selection of assignments shall consist of run/reverse, jog, plus/minus speed (2 inputs required), setpoint memory, preset speeds (up to 2 inputs), auto/manual control, controlled stop, terminal or keypad control, by-pass (2 inputs required), motor switching, and fault reset.

H. There will be two software assignable optically isolated analog outputs that can be selected and assigned in the software. The analog output assignments shall be proportional to the following motor characteristics: frequency, current, power torque, voltage and thermal state. The output signal will be selectable from 0 to 20 mA or 4 to 20 mA.

I. Two voltage-free Form C relay output contacts will be provided. One of the contacts will indicate AC Drive fault status. The other contact will be user assignable.

J. There shall be a hardware input/output extension module that also provides interlocking and sequencing capabilities. Module shall be fully isolated and housed in a finger-safe enclosure with pull apart terminal strips. Module will add four logic inputs, two analog inputs, two relay outputs, and one analog output. All of the I/O will be user assignable in the software as previously defined.

K. AC Drive door-mounted Control Island shall include a Power ON, Drive RUN, Drive Fault Light and Hand-Off-Auto selector switch with Manual Speed Potentiometer.

L. AC Drive Control Island shall accept absolute indicating digital meters to display Power, Amperes, Voltage, and Hertz.

2.12 Harmonic Analysis

A. Harmonic distortion analysis shall be performed and priced as a separate line item by the AC Drive manufacturer based upon documentation supplied by CONTRACTOR.

The documentation shall consist of one-line diagrams, distribution transformer information (kVA, %Z, and X/R ratio) and emergency standby generator performance specifications. The harmonic distortion analysis report shall be part of the approval drawing process, submitted to the engineer for approval.

B. If the calculations determine that harmonic distortion values are higher than the voltage and current values specified, the drive manufacturer shall provide [line reactors, isolation transformers, harmonic suppressors] to meet the intent of IEEE 519-192 guidelines.

Part 3 Execution

3.01 Inspection

A. Verify that the location is ready to receive work and the dimensions are as indicated.

B. Do not install AC Drive equipment until the building environment can be maintained within the service conditions required by the manufacturer.

3.02 Protection

A. Before and during the installation, the AC Drive equipment shall be protected from site contaminants.

3.03 Installation

A. Installation shall comply with manufacturer's instructions, drawings and recommendations.

B. AC Drive manufacturer shall provide a factory certified technical representative to supervise the contractor's installation, testing and start-up of the AC Drive(s) furnished under this specification for a maximum total of 3 days. The start-up service shall be quoted as a separate line item.

3.04 Training

A. An on-site training course of two (2) training days shall be provided by a representative of the AC Drive manufacturer plant and/or maintenance personnel and quoted as a separate line item.

End of Section

Division 31
Earthwork

Section 31 2200
Grading

Part 1 General

1.01 Scope of Work

A. This Section includes site grading as indicated on the Plans, complete with removing and salvaging topsoil, rough grading, finish grading, adjusting structures, and reconstructing structures.

1.02 Related Work Specified Elsewhere

A. Section 01 2200: Unit Prices
B. Section 01 5713: Temporary Erosion and Sediment Control
C. Section 01 8900: Site Construction Performance Requirements
D. Section 31 2313: Subgrade Preparation
E. Section 31 2316: Structural Excavation and Backfill
F. Section 32 9219: Seeding

1.03 Soil Erosion and Sedimentation Control

A. CONTRACTOR, at his expense, shall provide, maintain and remove such temporary and/or permanent soil erosion and sedimentation control measures as specified on the Plans or as determined by ENGINEER.

B. Measures shall prevent surface runoff from carrying excavated materials into the waterways, to reduce erosion of the slopes, and to prevent silting in of waterways downstream of the Work.

C. Measures should include provisions to reduce erosion by the wind of all areas stripped of vegetation, including material stockpiles.

D. Comply with requirements of Section 01 5713, Temporary Erosion and Sediment Control.

Part 2 Products (Not Used)

Part 3 Execution

3.01 Site Grading

A. Sites shall be graded as specified on the Plans or as determined by ENGINEER. CONTRACTOR shall carry out the grading operation to prevent standing water and soil saturation detrimental to structures and improvements.

B. Provisions shall be made to preserve and protect trees and other vegetation specified on the Plans or determined by ENGINEER as not to be removed.

3.02 Removing and Salvaging Topsoil

A. Topsoil encountered along the route of the construction shall be pushed back and preserved for use in restoration following completion of the construction.

B. Topsoil must remain on each given parcel and lot throughout the Project including the existing road right-of-way adjoining the parcel or lot where it existed.

C. Removal of topsoil from the Project or movement of topsoil from one portion of the Project for use in another portion of the Project will not be allowed.

D. If there is insufficient working area, the topsoil may be removed, stockpiled and later replaced on the original lot or parcel. CONTRACTOR shall furnish ENGINEER with written permission obtained from the property owner of the property on which the topsoil is to be stockpiled, prior to commencing the stockpiling operation.

E. Topsoil shall be salvaged in an amount equivalent to the quantity required by the Plans. Topsoil salvaged in excess of that required by the Plans or as required by ENGINEER will be disposed of by CONTRACTOR at his expense.

F. Before removing topsoil, all vegetation shall be reduced to a height of approximately four inches (100 mm) and all such vegetation and all brush, stones, rocks, and any other objectionable litter or foreign material shall be removed and disposed of before the ground is broken for topsoil removal.

G. Equipment and methods of operations shall be such as to avoid the lifting of the subsoil. If soil or weather conditions are unsuitable, CONTRACTOR shall cease stripping until stripping can resumed in a suitable manner.

H. Topsoil shall be removed within the grading limits for cuts and shall be removed to a width and depth specified on the Plans or as determined by ENGINEER.

I. Topsoil shall be stockpiled within the limits of construction in areas designated on the Plans, or in areas out of the way of construction as determined by CONTRACTOR. Stockpiles shall be located and shaped so as to avoid diversion of storm water runoff, either in or out of the limits of construction, towards buildings, creation of standing water or interference of controlled irrigation. CONTRACTOR shall not place topsoil around trunks and root areas of trees to be preserved.

J. Topsoil shall be kept separate from other excavated materials that are to be used for embankment and shall be completely removed from any designated area prior to the beginning of regular excavation or placing embankment in the area.

K. Topsoil stockpiles shall be located as near the original location as possible and no payment will be made for overhaul.

L. After the completion of construction, the topsoil shall be screened through a 5/8-inch maximum size mesh screen, spread, graded, raked and prepared for seeding or sodding.

3.03 Existing Sand Onsite

A. In those instances where the construction takes place within private easements, the sand shall not be removed from each parcel or lot. Sand encountered in existing road right-of-way may be used for construction purposes throughout the Project providing it meets the requirements for the material it is intended to be used for.

B. Removal of sand from the Project will not be allowed, except for the volume displaced by the new construction.

C. If there is insufficient working area, the sand may be removed, stockpiled and replaced on the original lot or parcel. CONTRACTOR shall furnish ENGINEER with written permission obtained from the property owner of the property on which the sand is to be stockpiled, prior to commencing the stockpiling operations.

3.04 Rough Grading

A. Site shall be graded as necessary to comply with the Plans or as determined by ENGINEER. The subgrade shall be roughly established by cut or fill, approximately parallel to proposed finished grades and to elevations which allow for thickness of topsoil and installation of site or roadway improvements.

B. In fill areas all debris shall be removed from the area to be filled. Material detrimental to site improvement shall be removed from the site and acceptably disposed of as specified in Section 01 8900 Site Construction Performance Requirements.

C. Original ground shall be scarified and benched or otherwise treated to provide adequate bond and to prevent slippage of fill.

D. Fill material shall be free of debris or other detrimental material and shall have a moisture content within 2 percent of optimum moisture when placed. All fill shall be compacted to a density not less than 95% of the maximum unit weight and placed in layers no less than nine inches (230 mm) and no greater than 15 inches (380 mm). The maximum unit weight shall be determined by ASTM D698, Method B.

E. If possible fills or embankments shall be constructed when the ground is frost-free and there is favorable weather. However if winter grading is necessary, all ice and snow shall be removed from the surface of the ground before the fill or embankment is placed. No frozen material will be allowed in the fill area or in the embankment being constructed. Any frozen material on a partially completed fill shall be removed before placing any more fill. Frozen material shall be stockpiled outside the grading limits until thawed. Thawed material from the stockpiled frozen material may be used in the fill and embankment areas.

3.05 Finish Grading

A. General:

1. Subgrade shall be smoothed parallel to proposed finished grades and elevations specified on the Plans. The subgrade shall be scarified to assure bond with the topsoil prior to spreading of the topsoil.

2. Topsoil shall be spread uniformly to provide a smooth, even surface at a finish grade specified on the Plans or acceptable to ENGINEER. After spreading, the topsoil shall be compacted lightly as necessary to minimize settlement. Final grades shall not vary more than one-tenth of a foot (30 mm) from the elevations indicated on the Plans.

3. Finished grading shall be done when the ground is frost-free and weather is favorable.

B. Adjust Structures:

1. Structures to be adjusted shall be as called for on the Plans or as indicated by ENGINEER.

2. Adjustment of structures shall apply where the elevation of the casting is either raised 12 inches (300 mm) or less, or lowered six (6) inches (150 mm) or less.

C. For Rehabilitation/Resurfacing Projects:

1. For structures in existing pavement, the pavement shall be sawcut a minimum of 5-foot by 5-foot unless otherwise shown on the plans.

2. For structures in concrete pavement, the structure shall be adjusted, backfilled and compacted as noted below.

3. Six inches of aggregate base course, unless otherwise noted on the plans, shall be placed below the proposed concrete pavement.

4. In areas of new concrete pavement, the concrete pavement around the structure shall be poured integral with the rest of the pavement.

5. For resurfacing projects, expansion or epoxy anchored hook bolts shall be placed 18-inches on center around the edges of the existing concrete pavement, unless otherwise shown on the plans.

6. Concrete pavement, minimum 8-inches thick, shall be replaced around the structure to the grade of the adjoining concrete pavement.

7. For structures in bituminous pavement, the pavement shall not be sawcut until after the bituminous base or leveling courses have been completed.

8. Structure shall be adjusted, backfilled and compacted as noted below.

9. Six inches of aggregate base course, unless otherwise noted on the plans, shall be placed below the proposed pavement.

10. A minimum of 8-inches of concrete pavement, unless otherwise noted on the plans, shall be placed to the elevation of the adjoining bituminous base or leveling courses.

11. The bituminous wearing course around the structure shall be placed integral with the wearing course on the remainder of the project.

D. For Bituminous Reconstruction or New Construction Projects:

1. Frame and cover on all new and existing structures shall be removed and the structure plated prior to placing the bituminous base or leveling courses.

2. Bituminous base and leveling courses shall be placed over the plated structures.

3. Prior to placing the bituminous wearing course, the bituminous base and leveling courses shall be sawcut a minimum of 5-foot by 5-foot unless otherwise shown on the plans.

4. Structure shall be adjusted, backfilled and compacted as noted below.

5. Six inches of aggregate base course, unless otherwise noted on the plans, shall be placed below the proposed pavement.

6. A minimum of 8-inches of concrete pavement, unless otherwise noted on the plans, shall be placed to the elevation of the adjoining bituminous base course.

7. Bituminous wearing course around the structure shall be placed integral with the wearing course on the remainder of the project.

8. Sawcutting, removal and replacement of concrete and bituminous pavement, and aggregate base course, shall be incidental to the adjusting the structure unless otherwise noted in the Contract Documents.

9. Existing frame and cover shall be carefully removed and stored, and shall be reinstalled on the same structure, unless a new frame and cover are called for on the Plans.

10. Brick courses or concrete adjustment rings shall be removed or installed as necessary to adjust the structure's frame and cover to the proper elevation.

11. Brick or concrete adjustment rings shall be set in mortar or installed as shown on the Plans and as determined by ENGINEER.

12. Outside surface of the new brick or block structures shall receive a masonry plaster coat, a minimum of 1/2 inch (10 mm) thick.

13. Structure shall be properly backfilled with Class II granular material, compacted in place, and meeting the approval of ENGINEER.

14. Flow in the entire system shall be maintained, at CONTRACTOR's expense, while performing any part of the Work. Also, the structure shall be cleaned and all unsuitable material shall be disposed of at CONTRACTOR's expense.

3.06 Reconstruct Structures

A. General:

1. Structures to be reconstructed shall be as called for on the Plans or as determined by ENGINEER.

2. Reconstruction of structures shall apply where the elevation of the casting must be raised in excess of 12 inches (300 mm), lowered in excess of six (6) inches (150 mm), or to rebuild portions of the existing structure which are deteriorated.

B. For Rehabilitation/Resurfacing Projects:

1. For structures in existing pavement, the pavement shall be sawcut a minimum of 5-foot by 5-foot unless otherwise shown on the plans.

2. For structures in concrete pavement, the structure shall be reconstructed, backfilled and compacted as noted below.

3. Six inches of aggregate base course, unless otherwise noted on the plans, shall be placed below the proposed concrete pavement.

4. In areas of new concrete pavement, the concrete pavement around the structure shall be poured integral with the rest of the pavement.

5. For resurfacing projects, expansion or epoxy anchored hook bolts shall be placed 18-inches on center around the edges of the existing concrete pavement, unless otherwise shown on the plans.

6. Concrete pavement, minimum 8-inches thick, shall be replaced around the structure to the grade of the adjoining concrete pavement.

7. For structures in bituminous pavement, the pavement shall not be sawcut until after the bituminous base or leveling courses have been completed.

8. Structure shall be reconstructed, backfilled and compacted as noted below.

9. Six inches of aggregate base course, unless otherwise noted on the plans, shall be placed below the proposed pavement.

10. A minimum of 8-inches of concrete pavement, unless otherwise noted on the plans, shall be placed to the elevation of the adjoining bituminous base or leveling courses.

11. Bituminous wearing course around the structure shall be placed integral with the wearing course on the remainder of the project.

C. For Bituminous Reconstruction or New Construction Projects:

1. Frame and cover on new and existing structures shall be removed and the structure plated prior to placing the bituminous base or leveling courses.

2. Bituminous base and leveling courses shall be placed over the plated structures.

3. Prior to placing the bituminous wearing course, the bituminous base and leveling courses shall be sawcut a minimum of 5-foot by 5-foot unless otherwise shown on the plans.

4. Structure shall be reconstructed, backfilled and compacted as noted below. Six inches of aggregate base course, unless otherwise noted on the plans, shall be placed below the proposed pavement.

5. A minimum of 8-inches of concrete pavement, unless otherwise noted on the plans, shall be placed to the elevation of the adjoining bituminous base course.

6. Bituminous wearing course around the structure shall be placed integral with the wearing course on the remainder of the project.

7. Sawcutting, removal and replacement of concrete and bituminous pavement, and aggregate base course, shall be incidental to the reconstructing the structure unless otherwise noted in the Contract Documents.

8. Existing frame and cover shall be carefully removed and stored, and shall be reinstalled on the same structure unless a new frame and cover are called for on the Plans.

9. Existing corbel entrance sections or precast concrete chimney type entrance shall be removed along with any additional brick courses or precast concrete sections necessary to achieve the amount of reconstruction called for on the Plans or as determined by ENGINEER.

10. The necessary brick work and precast concrete sections shall be installed to meet the design grade.

11. Manhole steps shall be furnished and shall be installed, as necessary, so that maximum spacing is 24-inches (600 mm).

12. Brick or concrete adjustment rings shall be set in mortar or installed as shown on the Plans and as determined by ENGINEER.

13. Outside surface of the new brick or block structures shall receive a masonry plaster coat, a minimum of 1/2 (10 mm) inch thick.

14. Structure shall be properly backfilled with Class II granular material, compacted in place, and meeting the approval of ENGINEER.

15. Flow in the entire system shall be maintained, at CONTRACTOR's expense, while performing any part of the Work.

16. Structure shall be cleaned and all unsuitable material shall be disposed of at CONTRACTOR's expense.

End of Section

Section 31 2313
Subgrade Preparation

Part 1 General

1.01 Scope of Work

A. This Section includes preparing subgrade for pavement construction complete with excavation, embankments, proof rolling, subgrade undercut and backfill, subgrade stabilization fabric, subbase, right-of-way ditching, right-of-way restoration, field quality control, and appurtenances.

1.02 Related Work Specified Elsewhere

A. Section 01 2200: Unit Prices
B. Section 01 5713: Temporary Erosion and Sediment Control
C. Section 01 8900: Site Construction Performance Requirements
D. Section 32 9219: Seeding

1.03 Reference Standards

A. Unless otherwise specified, the Work for this Section shall conform to the applicable portions of the following Standard Specifications:

1. ASTM - ASTM International

2. AASHTO - American Association of State Highways and Transportation Officials

3. MDOT - Michigan Department of Transportation, Standard Specifications for Construction, latest edition

1.04 Allowable Tolerances

A. Finish subgrade surface shall be shaped to conform to plan grade and cross section within a tolerance of one-inch (25 mm) in ten (10) feet (3.0 m).

1.05 Submittals

A. Test Reports:

1. Testing lab shall provide ENGINEER with two (2) certified copies of the sieve analysis of the backfill material.

2. Testing of the material and the certification of the test results shall be performed by a testing laboratory approved by ENGINEER.

3. Testing lab shall provide ENGINEER with two (2) certified copies of the compaction and moisture tests of the backfill and subgrade materials.

4. Testing of the materials and the certification of the test results shall be performed by a testing laboratory approved by the ENGINEER.

B. Samples:

1. Submit sample of the proposed subgrade stabilization fabric measuring not less than 1 yd^2 (1 m^2) in area, and the manufacturer's certification that the proposed fabric meets or exceeds all requirements listed in Article 2.03 of this Section.

2. Submissions shall be made not later than 10 working days prior to any installation.

1.06 Product Delivery Storage and Handling

A. Geotextile fabric shall be furnished and stored in a wrap that will protect the geotextile from ultraviolet radiation and abrasion.

B. Geotextile shall be covered with the aggregate base as per plan within two (2) weeks of its placement.

1.07 Soil Erosion and Sedimentation Control

A. CONTRACTOR shall provide, maintain and remove such temporary and/or permanent soil erosion and sedimentation control measures as specified on the Plans or as determined by ENGINEER.

B. Measures shall prevent surface runoff from carrying excavated materials into the drain, to reduce erosion of the slopes, and to prevent silting in of drain downstream of the Work.

C. Measures should include provisions to reduce erosions by the wind of all areas stripped of vegetation, including material stockpiles.

D. Comply with requirements of Section 01 5713, Temporary Erosion and Sediment Control.

Part 2 Products

2.01 Granular Materials

A. Granular material gradation shall conform to the grading requirements for granular material Class II as specified in MDOT, Section 902.08.

2.02 Aggregate Materials

A. Aggregate materials, used for undercut backfill shall be crushed limestone, natural aggregate, blast furnace slag, or crushed concrete, meeting the requirements of 21AA, 21A or 22A as specified in MDOT Section 902.06.

B. Crushed concrete shall be free of all steel and other deleterious materials.

2.03 Subgrade Stabilization Fabric

A. Subgrade stabilization fabric shall be composed of synthetic fibers formed into a woven fabric. The fibers shall be composed of 85% propylene or ester polymers. The geotextile shall conform to the following requirements listed below:

Property	Test Procedure	Test Result
Grab Tensile	ASTM D4632	270 lbs. (min)
Elongation	ASTM D4632	15% (min)
Trapezoidal Tear	ASTM D4533	100 lbs. (min)
CBR Puncture Strength	ASTM D6241	900 lbs. (min)
Apparent Opening Size	ASTM D4751	40 – 70 U.S. Sieve
Permittivity	ASTM D4491	0.05 per sec (min)

Part 3 Execution

3.01 Removing Structures

A. Structures and sewers to be removed shall be called for on the Plans or as determined by ENGINEER. Removal or abandonment of structures shall be in accordance with Section 01 8900, Site Construction Performance Requirements.

3.02 Holes

A. Earth removed during any phase of the excavation or removal operations, resulting in a hole or void, shall be replaced by backfilling to the proposed subgrade with a suitable granular material approved by ENGINEER.

B. Material shall be compacted to 95% of its maximum unit weight.

C. Furnishing, placing and compacting of the backfill material shall be at CONTRACTOR's expense.

3.03 Salvaging and Stockpiling Topsoil

A. Topsoil, within the grading limits for cuts, and where the fill is less than five (5) feet (1.5 m) in height to the top of proposed road, shall be removed to a depth and width specified on the Plans.

B. Topsoil from peat and muck areas shall not be removed.

C. Topsoil salvaged in excess of that required by the Plans will be disposed of by the CONTRACTOR at his expense.

D. Removing and salvaging topsoil shall be in accordance with Section 31 2200, Grading.

3.04 Preparing Roadway Subgrade

A. Muck, peat and other unsuitable material within the roadway shall be removed, displaced or otherwise treated, as shown on the Plans or as directed by ENGINEER.

B. Deposits of frost heave material within lines two (2) feet (0.6 m) outside the proposed roadbed shall be removed to a depth of three (3) feet (0.9 m) below the surface of the earth grade, unless otherwise shown on the Plans or as determined by ENGINEER.

C. Ice and snow shall be removed from the surface of the ground before the embankment is placed.

D. Muck, peat, frost heave material and other unsuitable material shall be disposed of outside the highway limits or shall be spread uniformly in low places beyond the roadway limits when so approved by ENGINEER.

E. Old road surfacing or gravel, crushed stone, or other nonrigid type surfacing, occurring within the area of the roadbed and underlying proposed embankment less than 1-foot in depth, and which is not to be salvaged and incorporated in the new Work, shall be plowed or scarified full depth, spread and compacted to form a uniform foundation, before any new embankment is placed.

F. Old pavement and other rigid structures, occurring within the area of the roadbed and underlying the proposed embankment less than 1-foot in depth and which are not to be incorporated into the new Work, shall be broken up and removed.

3.05 Subgrade

A. Area to be paved shall be excavated and smoothed to the line, grade and cross section as indicated on the Plans.

B. Subgrade between the lines two (2) feet (0.6 m) on either side of the proposed edge of pavement or curb shall be compacted to 95% of the maximum unit weight for a depth of seven (7) inches (175 mm), by rolling with a roller weighing not less than ten (10) tons (9000 kg).

C. Subgrade shall be completed ahead of placing forms or paving a distance equal to the distance of one day's average paving operation. Prior to the paving operation, the subgrade shall be shaped and compacted to the Plan cross section by approved mechanical means.

3.06 Pavement Excavation

A. Pavement excavation shall consist of all Work required to construct the earth grade and its appurtenances true to the lines, grades, and cross sections called for on the Plans and in accordance with these Specifications.

B. Excavation shall consist of the following items, any of which or all of which may be included or incidental to it; removing trees, stumps, hedges, roots, culverts, sewers, miscellaneous structures, roadway excavation, removing of all asphalt or concrete pavements, curbs, curb and gutters, sidewalks, end headers, removing aggregate surfaces, salvaging and stockpiling topsoil, subgrade undercut, excavation for structures, trimming and finishing earth grade, fine grading, right-of-way ditching and restoration, and the disposal of all unsuitable material.

C. Large stones, trees, stumps, brush, shrubs, logs, matted roots, other vegetation and debris occurring between lines three (3) feet (0.9 m) outside the grading limits or as otherwise shown on the Plans shall be completely removed and properly disposed of as specified in Section 31 1100, Clearing and Grubbing.

D. Earth and other existing materials shall be excavated for the full depth and width of the cross section as shown on the Plans. Material shall be excavated sufficiently for setting of forms or slip-form equipment. Excavation shall be limited to 3,000 linear feet (900 m) of right-of-way unless additional lengths are requested in writing and approved by ENGINEER.

E. Excess excavated material shall be removed from the project by CONTRACTOR along approved routes to disposal sites approved by OWNER. Disposal of excess excavation and maintenance of the dump sites shall be considered incidental to the price paid for excavation and shall be as specified in Section 01 8900, Site Construction Performance Requirements.

3.07 Borrow Excavation

A. Materials which are secured from locations outside of the project limits for the purpose of completing embankments and other items, will be considered as borrow excavation.

B. Borrow pits and the materials to be removed therefrom shall be subject to the inspection of ENGINEER and shall be secured by CONTRACTOR, unless otherwise provided.

C. Borrow excavation will be measured by volume in cubic yards compacted in place, based on the neat lines called for on the Plans or as authorized by ENGINEER. To facilitate the accurate measurement of borrow quantities, unless otherwise specified in the Contract Documents, CONTRACTOR shall perform all the regular excavation and grading with existing materials for any designated area and ENGINEER will cross section these areas prior to CONTRACTOR furnishing and placing the required borrow material. ENGINEER will then resection the completed area and compute the volume of borrow material in its compacted-in-place state. Any borrow material placed beyond the neat lines called for on the Plans or which is not authorized by ENGINEER in writing will not be measured and computed as borrow excavations. Measurement of borrow material by truck count will not be acceptable.

D. Public and private roads used by CONTRACTOR between the source of borrow and the Project shall be maintained by ONTRACTOR, at his expense, including repairs of any damage caused by his operations. Also included is the application of a dust palliative when necessary, as determined by ENGINEER.

3.08 Embankments

A. Embankments shall be constructed with sound earth. Materials shall be deposited and compacted by either the Twelve Inch Layer Method, or the Controlled Density Method. The Controlled Density Method will be required unless the twelve inch layer method or some other method is specifically called for on the Plans.

B. Topsoil shall be stripped from the entire fill area. Depth of the topsoil to be removed shall be as shown on the Plans or as determined by ENGINEER. After the topsoil is removed, the entire area upon which the embankment is to be constructed shall be compacted to not less than 90% of the maximum unit weight, to a depth of nine (9) inches (225 mm).

C. Where stones are prevalent, the material shall be carefully placed so that all large stones will be well distributed and the crevices completely filled with smaller stones, earth, sand or gravel so as to form a solid embankment. Rock or fragmental material of such size as would prohibit it from being placed in layers of the specified depth shall not be placed in the embankment. In no case shall stones over three (3) inches (75 mm) in diameter be placed within 12 inches (300 mm) of the surface of the earth grade within the areas between lines two (2) feet (0.6 m) outside of the edges of proposed roadbed.

D. Frozen material shall not be placed in the embankment nor shall embankment be placed upon frozen material.

E. Construction requirements for the two (2) methods of placing and compacting embankments are as follows:

1. Twelve-Inch Layer Method:

a. Material shall be deposited and spread in layers not more than 12 inches (300 mm) in depth, loose measure, parallel to the finished grade and extending to the full width of the embankment. Material shall be deposited by operating the conveying equipment over the layer being placed, insofar as feasible.

b. Each layer shall be compacted to not less than 95% of the maximum unit weight as determined at the existing moisture content. Operation of compacting shall be continued until each layer is compacted to the required density for its full width.

2. Controlled Density Method:

a. Material for the embankment shall be deposited and spread in layers not more than nine (9) inches (225 mm) in depth, loose measure, and extending to the full width of the embankment, except that granular material may be spread and compacted in layers not more than 15 inches (375 mm) in thickness if the specified density is obtained.

b. Material for embankments of five (5) feet (1.5 m) or less and the bottom four (4) feet (1.2 m) of embankments of more than four (4) feet (1.2 m) above the surface of the ground upon which the embankment is to be constructed shall have not more than the optimum moisture content at the time of compaction.

c. Material for that part of the embankment more than five (5) feet (1.5 m) above the surface of the ground upon which the embankment is to be constructed shall have a moisture content of not greater than three (3) percent above optimum at the time of compaction, except that the moisture content of the top three feet (0.9 m) of the embankment shall not exceed optimum. If granular material is used to construct the embankment, it shall be at a moisture content below saturation.

F. If the material contains an excess of moisture, it shall be dried to the required moisture content before being compacted.

G. Each layer of material containing the required amount of moisture shall be compacted to not less than 95% of its maximum unit weight, unless otherwise specified, before the succeeding layer is started.

H. When the original ground upon which the embankment is being placed, or any section of compacted embankment, or the soil in cut sections becomes rutted or distorted by CONTRACTOR's equipment, the method of operation shall be changed to eliminate this condition. CONTRACTOR shall reshape and recompact any areas so rutted or distorted at his own expense. This shall be done before any succeeding layers are placed.

3.09 Rough Grading

A. CONTRACTOR shall rough grade as close as possible to finished subgrade leaving a minimum to be removed in fine grading.

B. Excavated material removed during grading and stored along the line of Work between curb and sidewalk on improved lawns shall not be left longer than 48 hours. Lawns or otherwise improved areas shall be left in a neat and clean state within the specified 48 hours.

C. During the excavation operation, including the placing of the subbase, the Work area shall be kept free of water. A dewatering system shall be provided and maintained by CONTRACTOR at his expense. The dewatering system shall remain in operation until the paving is completed.

3.10 Proof Rolling

A. After removal of topsoil or other overburden and after construction of embankments, proof roll the existing subgrade with six passes of a minimum 15 ton pneumatic-tired roller. Operate the roller in a systematic manner to assure the number of passes over all areas, and at speeds between 2.5 and 3.5 miles per hour. When proof rolling under structures, one-half of the passes made with the roller shall be in a direction perpendicular to the other passes.

B. Proof rolling shall be done in the presence of ENGINEER. Rutting or pumping shall indicate unsatisfactory material and that material shall be undercut as determined by ENGINEER, and replaced with the appropriate fill material.

C. Perform proof rolling only when weather conditions permit. Do not proof roll wet or saturated subgrades. Materials degraded by proof rolling a wet or saturated subgrade shall be replaced by CONTRACTOR as determined by ENGINEER at no cost to OWNER. Notify ENGINEER 3 days prior to proof rolling.

3.11 Subgrade Undercut Excavation

A. Unsuitable subgrade excavation shall be the operation of:

1. removing unsuitable soils as determined by ENGINEER, below the level of the ground after topsoil has been stripped in fill areas where the embankment is to be five (5) feet (1.5 m) or less in height to plan grade, or

2. the removal of unsuitable soils below the subgrade elevation, as determined by ENGINEER in cut areas after the subgrade has been established.

B. In fill areas, after topsoil has been stripped in accordance with Article 3.03 of this Section, ENGINEER will inspect the embankment area to certify the adequacy of the native soils and to determine the extent of any additional excavation of unsuitable soils prior to placing the first lift of the embankment.

C. In cut areas after the subgrade elevation has been established by the mass grading operation, ENGINEER will inspect the subgrade to determine the extent of any additional excavation of unsuitable soils.

D. The areas excavated of unsuitable material, unless otherwise specified in the Contract Documents, shall be backfilled with nonfrost heaving material similar to the adjacent soil. However, in areas as determined by ENGINEER where free water due to seepage is present, the excavation shall be backfilled with Granular Material, Class II, and drainage shall be provided. Backfill shall be compacted to not less than 95% of the maximum unit weight, unless otherwise specified.

3.12 Subgrade Stabilization Fabric

A. Place Subgrade Stabilization Fabric on prepared subgrade or subbase in the manner and at the location as called for on the plans. Fabric shall be laid smooth and free of tension stress, wrinkles or creases.

B. Fabric strips shall be placed to provide a minimum overlap of 24 inches (600 mm) for each joint.

C. Fabric shall be placed so that the upper strip will overlap the next lower strip.

D. Should the geotextile be damaged during construction, the torn or punctured section shall be repaired by placing a piece of fabric that is sufficiently large to cover the damaged area plus two feet (0.6 m) to adjacent undamaged geotextile in all directions.

3.13 Trimming and Finishing Earth Grade

A. After the earth grade has been constructed to the required grade, all stones and rocks more than 3 inches (75 mm) in diameter, appearing on the surface of the subgrade shall be removed.

B. Earth grade and the subgrade shall be trimmed to the grade called for on the Plans. Subgrade, where a subbase or base course is required, shall be trimmed to the established grade within ± 0.1 foot (30 mm). Where a subbase or base course is not required, the subgrade shall be trimmed to the established grade within ± 3/4 inch (20 mm).

C. Earth grade outside the subgrade shall be trimmed, all irregularities made smooth and the entire site or roadway completed to the required lines, grades, and cross sections. Backslopes and fill slopes shall be finished as either Class A or Class B slopes. Class A slopes shall be required unless otherwise specified in the Contract Documents.

1. Class A Slopes:

   a. Class A slopes shall be finished to the average slopes shown on the Plans with no variations at any point more than 0.1 foot (30 mm) above or below the established grade measured at right angles to the slopes.

2. Class B Slopes:

   a. Class B backslopes shall be finished to the average slopes shown on the Plans with no variations at any point more than 0.5 foot (150 mm) above or below the established grade measured at right angles to the slope. The degree of finish of the slopes shall be that obtainable from machine operations. The smoothness of surface finish ordinarily associated with template or string line and hand operations will not be required, but abrupt variations will not be permitted. Debris except sod, leaf mold and rotted forest litter shall be removed and loose clods of earth extending beyond the 0.5 foot (150 mm) tolerance shall be broken or removed.

   b. Class B fill slopes shall be finished to within 0.2 foot (60 mm) of the established grade and cross section from the outside shoulder line for a distance of three (3) linear feet (0.9 m) down the slope. The remainder of the completed fill slope shall conform to the requirements for Class B backslopes.

c. Where waste earth or other surplus material is deposited on fill slopes, the slopes may be flattened or otherwise altered as directed by ENGINEER, to produce a uniform cross section which blends with the topography and presents a pleasing appearance.

D. Where trees or other restrictions do not interfere, the tops of backslopes, bottoms of fill slopes and all other angles in the lines of the cross section shall be rounded to form vertical curves as shown on the Plans or as determined by ENGINEER. Transitions in length of vertical curves shall be gradual and shall present a uniform and attractive appearance. When ditches are constructed in peat, vertical curves may be omitted.

3.14 Subbase

A. Granular material for subbase shall be evenly spread and compacted as specified in MDOT Section 301.

B. Thickness of each layer placed shall be determined by the required density obtained but shall not exceed 15 inches (375 mm) in depth, loose measure.

C. Subbase shall be constructed to the alignment, grade and cross section shown on the Plans. Should the subgrade at any time prior to or during the placing of the subbase become soft or unstable so that rutting occurs in the subgrade, or if the subgrade material is forced up into the subbase material, the operation shall immediately cease and the mixed material shall be removed and disposed of. Subgrade shall be corrected and new subbase material placed and compacted. This Work shall be considered incidental to the construction of the Project.

3.15 Scarify, Re-Grade and Compact Existing Subgrade

A. Existing subgrade (base) shall be scarified to a depth of 9-inches to the limits as shown on the plans. Subgrade shall then be re-shaped to the cross section as shown on the plans and compacted. Subgrade shall then be compacted to 95% of the maximum unit weight by rolling with a roller weighing not less than ten (10) tons (9000 kg).

3.16 Roadway Ditching

A. Ditching shall be constructed at the locations called for on the Plans or as determined by ENGINEER. Ditch may be shaped by "Machine Grading" or another method approved by ENGINEER to achieve the cross section, line and grade shown on the Plans.

B. Excess material from the ditch construction shall be disposed of by CONTRACTOR at his expense.

C. Ditch section shall be graded to receive either topsoil and seed or topsoil and sod. Topsoil, seed, sod, fertilizer and mulch shall conform to the requirements specified on the Plans and in Section 32 9219, Seeding or Section 32 9223, Sodding.

D. CONTRACTOR, at his expense, shall furnish, place and compact any additional material needed to construct the ditch at the location and cross sections called for on the Plans.

3.17 Right-of-Way Restoration

A. Right-of-way shall be restored in accordance with the type and location specified on the Plans. Right-of-way may be shaped by "Machine Grading" or another method approved by ENGINEER to achieve the cross section, line and grade shown on the Plans.

B. Excess material from the right-of-way restoration operation shall be disposed of by the CONTRACTOR at his expense, as specified in Section 01 8900, Site Construction Performance Requirements.

C. Right-of-way shall be graded to receive either topsoil and seed or topsoil and sod. Topsoil, seed, sod, fertilizer and mulch shall conform to the requirements specified on the Plans and in Section 32 9219, Seeding or Section 32 9223, Sodding.

D. CONTRACTOR, at his expense, shall furnish, place, and compact any additional fill, meeting the approval of ENGINEER, needed to construct the right-of-way to the cross sections called for on the Plans.

3.18 Machine Grading

A. Work of machine grading shall consist of light grading of such character that, in general, the excavation from ditches and roadbed will be utilized in shaping shoulders and adjacent shallow fills and the work can be performed by a blade grader or similar equipment. Machine grading shall apply on the sections shown on Plans or specified in the Proposal.

B. Work shall include all necessary scarifying, plowing, discing, moving and shaping the earth to develop the cross section shown on Plans.

C. Ditches shall be in reasonably close conformity with the line and grade as shown on the Plans or as directed and must drain runoff waters to outlets shown on the Plans or designated by ENGINEER.

D. Roadbed shall be finished to grade with a blade grader or equivalent equipment.

E. Intersections, approaches, entrances, and driveways shall be graded as shown or as directed, except that loading and hauling of earth will not be required as part of this Work.

3.19 Maintenance Aggregate

A. CONTRACTOR shall furnish and install 21A, 21AA or 22A maintenance aggregate to maintain pedestrian and traffic access. Aggregate shall be placed and compacted to maintain access in areas as determined by ENGINEER. Maintenance aggregate will be incidental to the Project unless otherwise specified in the Contract Documents.

3.20 Testing

A. During the course of the Work, ENGINEER may require testing for compaction, sieve analysis and moisture content of the backfill and subgrade materials.

B. Taking of samples and the testing required shall be performed by a testing laboratory suitable to OWNER and approved by ENGINEER. Cost for testing and sampling shall be at the expense of OWNER.

C. ENGINEER shall determine the location and number of samples to be made. The testing laboratory shall furnish the ENGINEER with two (2) certified copies of the results of all tests.

D. Testing procedures shall conform to current MDOT Standards for Construction.

E. Maximum unit weight when used as a measure of compaction or density of soils shall be understood to mean the maximum unit weight per cubic foot (or cubic meter) as determined by ASTM D1557, Method D, modified to include all the material passing the 1-inch (25 mm) sieve.

3.21 Defective Work

A. Any portion of the backfill, subbase or subgrade which is deficient in the specified density shall be corrected by methods meeting the approval of ENGINEER.

B. Extra testing or sampling required by ENGINEER, because of deficiencies, shall be at CONTRACTOR's expense.

End of Section

Section 31 2316
Structural Excavation and Backfill

Part 1 General

1.01 Scope of Work

A. This Section includes excavation for structures, removal and disposal of excavated materials, backfilling, backfill materials and compaction.

1.02 Related Work Specified Elsewhere

A. Section 01 5713: Temporary Erosion and Sediment Control
B. Section 01 8900: Site Construction Performance Requirements
C. Section 31 2200: Grading
D. Section 32 9219: Seeding
E. Section 33 1100: Water Utility Distribution Piping
F. Section 33 3000: Sanitary Utility Sewerage Piping

1.03 Reference Standards

A. Unless otherwise specified, the Work for this Section shall conform to the applicable portions of the following Standard Specifications:

1. ASTM - ASTM International

2. AASHTO - American Association of State Highways and Transportation Officials

3. MDOT - Michigan Department of Transportation, Standard Specifications for Construction, latest edition

1.04 Submittals

A. Testing laboratory shall provide ENGINEER with two (2) certified copies of the test results of the compaction of the backfill. The testing for compaction and the certification of the test results shall be performed by a testing laboratory approved by ENGINEER.

1.05 Soil Erosion and Sedimentation Control

A. CONTRACTOR shall provide, maintain and remove such temporary and/or permanent soil erosion and sedimentation control measures as specified on the Plans or as determined by ENGINEER.

B. Measures shall prevent surface runoff from carrying excavated materials into the waterways, to reduce erosion of the slopes, and to prevent silting in of waterways downstream of the Work.

C. Measures should include provisions to reduce erosion by the wind of areas stripped of vegetation, including material stockpiles.

D. Comply with requirements of Section 01 5713, Temporary Erosion and Sediment Control.

Part 2 Products

2.01 Granular Materials

A. Granular material gradation shall conform to the grading requirements for granular material, Classes I and II, as specified in MDOT, Section 902. Granular material shall be natural bank run sand.

2.02 Coarse Aggregate

A. Coarse aggregate gradation shall conform to coarse aggregate, 6A, as specified in MDOT, Section 902.

Part 3 Execution

3.01 Dewatering

A. Area within the vicinity of the new Work shall be dewatered in accordance with Section 31 2319, Dewatering prior to the excavation operation.

B. Depth of the dewatering shall be sufficient to allow the excavation to remain in a dry condition during the construction of the structure, including the excavating, backfilling and compacting operations.

3.02 Sheeting, Shoring, and Bracing

A. CONTRACTOR shall furnish, place and maintain at all times such sheeting, shoring, and bracing of the excavated area as may be required for safety of the workmen and for protection of the new Work or adjacent structures, including pavement, curbs, sidewalks, pipelines and conduits next to, or crossing the excavated area, and for the protection and safety of pedestrian and vehicular traffic.

B. CONTRACTOR shall be responsible for the complete design of all sheeting, shoring and bracing Work.

C. The design shall be appropriate for the soil conditions, shall be of such strength, quality, dimension and spacing as to prevent caving or loss of ground or squeezing within the neat lines of the excavation, and shall effectively restrain movement of the adjacent soil.

D. Prior to installing the sheeting, shoring or bracing, CONTRACTOR shall submit Plans for this Work to ENGINEER for informational purposes only.

E. Sheeting, shoring, and bracing, and excavation shall conform to current federal or state regulations for safety.

F. Where indicated on the Plans and where necessary in the Work, install and leave sheeting, shoring, and bracing in place. No extra compensation shall be paid to CONTRACTOR for sheeting, shoring or bracing left in place unless otherwise indicated in the Proposal.

G. Supports for pipes, conduits, etc., crossing the excavated area shall conform to the requirements of the owners of such facilities and if necessary, shall be left in place.

H. Furnishing, placing, maintaining and removing of sheeting, shoring, and bracing materials shall be at CONTRACTOR's expense unless otherwise indicated in the Proposal.

I. CONTRACTOR shall not remove the sheeting, shoring or bracing until the structure has obtained sufficient strength to support the external loads.

J. Sheeting, shoring and bracing material shall not come in contact with the structure, but shall be installed so that no concentrated loads or horizontal thrusts are transmitted to the structure.

3.03 Cofferdams

A. A cofferdam shall consist of the maintenance, installation and removal of a substantially watertight enclosure or a well-point system or similar system, which will permit construction of the substructure, above seal or subfooting, in the dry and without damage to the Work. Alternate methods, where used in lieu of cofferdams, will be permitted by authorization only. Such authorization will be considered only after receipt of a permit from all federal, local or State agencies with jurisdiction for the alternate method.

B. Stream diversion and earth dikes, where used in lieu of cofferdams or a well-point system will be permitted by authorization only. Such authorization will be considered only after receipt of a permit from all federal, local or State agencies with jurisdiction for such construction.

C. Interior dimensions of cofferdams shall be such as to give sufficient clearance for the construction of forms and the inspection of their exteriors, and to permit dewatering outside of the forms.

D. Cofferdams, caissons or cribs which are tilted or moved laterally during the process of sinking shall be righted or enlarged so as to provide the necessary clearance.

E. Cofferdams shall not be braced to substructure forms. They shall be constructed so as to protect the Work in place against damage from high water and to prevent injury to the foundation by erosion. No timber bracing shall extend into or remain in the finished concrete.

F. Cofferdams shall be removed in such a manner as not to disturb or mar the finished concrete. When called for on the Plans or where necessary in the Work, cofferdam sheeting shall be left in place.

G. Furnishing, construction, maintenance and removal of the cofferdams including pumping shall be at CONTRACTOR's expense. If CONTRACTOR elects to use a well-point system or similar system, he shall be responsible for any claims for damages resulting therefrom.

3.04 Excavation

A. Excavation shall include the site clearing and grubbing, the excavating and disposing of materials encountered, the supporting and protecting of structures and/or utilities encountered above and below the ground surface, and the removal of water from the construction site.

B. Excavation shall also include the removal of existing structures, as shown on the Plans or as determined by ENGINEER.

C. Rock excavation, if applicable, shall be performed as a part of the excavation in accordance with specifications contained elsewhere.

D. CONTRACTOR shall keep the limits of his excavation operations within a reasonable close conformity with the location and grade, of each structure.

E. Excavated materials shall be temporarily stored in a manner that will not cause damage to trees, shrubs, fences, improvements, utilities, private property or traffic. The excavated materials shall not be placed at such locations that will endanger the banks of the excavation by imposing loads thereon.

F. Excavation shall be of sufficient size to allow for the construction of the new Work, the placing and compacting of the backfill and for the dewatering operation.

G. When concrete is to bear on or against an excavated surface other than rock, special care shall be taken not to disturb the surface. The final removal of the foundation material to grade shall not be made until just prior to the placing of the concrete.

H. Concrete shall not be placed until the depth of the excavation has been checked and the suitability of foundation material has been reviewed by ENGINEER.

I. Excavated material, determined by ENGINEER as suitable for backfill may be used. All excess materials shall be disposed by CONTRACTOR, at his expense, as specified in Section 01 8900, Site Construction Performance Requirements.

J. Elevations for the bottom of footings shall be subject to such changes as are necessary to insure a satisfactory foundation. Any changes required shall be reviewed by ENGINEER prior to making the change.

K. Surface of all rock or other hard material upon which concrete is to be placed shall be free of all loose fragments, cleaned and cut to a firm surface. The surface shall be level, stepped or serrated, as shown on the Plans.

L. Unsound material underlying proposed structures shall be removed and replaced with granular material approved by ENGINEER, in layers not exceeding six (6) inches (150 mm) in depth. Each layer shall be compacted to 95% of maximum unit weight unless indicated otherwise on the Plans, or within these specifications.

3.05 Backfill

A. Backfill material shall be placed only after the new Work and backfill material have been inspected by ENGINEER.

B. Backfill shall not be placed against any portion of the new Work until the required curing, surface finishing and waterproofing of such portions have been completed. Backfill which will place an unequalized horizontal loading on the new Work shall not be placed until the concrete has attained at least 70% of its design strength. To equalize horizontal loadings, the required backfill around the new Work shall be placed on opposite sides at the same time.

C. Granular material shall be used for backfilling within three (3) feet (1 m) of manholes, chambers, valve wells, valve boxes, other pipeline structures, footings, piers, abutments, columns, walls, foundations, etc., unless otherwise indicated in the Contract Documents.

D. Spaces excavated and not occupied by the new Work or by the specified backfill material, shall be backfilled with suitable material from the excavation.

E. After the backfill has been placed and compacted to the flow line elevation of any weep holes indicated on the Plans, the back end of each weep hole shall be covered with not less than two (2) cubic feet (0.5 m^3) of coarse aggregate.

F. Large stones, boulders, broken rocks, concrete, and masonry shall not be used in the backfill.

G. Backfill shall be carried up to the surface of the adjacent ground or to the elevation of the proposed earth grade, and its top surface shall be neatly graded. Fills around all new Work shall be trimmed to the lines shown on the Plans or as directed by ENGINEER.

3.06 Compacting Backfill

A. Backfill behind and around the new Work shall be placed in layers, not more than nine (9) inches in depth, and shall be compacted to not less than 95% of the maximum unit weight.

B. Areas where the density does not affect the construction, as determined by ENGINEER, shall be compacted to not less than 90% of maximum unit weight.

C. Backfill material shall be placed as specified in MDOT, Section 206.03.B, except for the following modifications. Backfill material shall have a moisture content not greater than three (3) percent above optimum, at the time of compaction. If the material contains an excess of moisture, it shall be dried to the required moisture content before being installed.

D. Each layer of material containing the required amount of moisture shall be compacted to not less than 95% of the maximum unit weight, unless otherwise specified on the Plans or authorized by ENGINEER, before the succeeding layer is started.

E. Compaction of the backfill will not be paid for separately, but shall be considered incidental to the Work of backfilling and shall include all the Work of manipulating the soil to obtain the specified densities. No additional compensation will be allowed for any delay required to obtain the specified moisture content or the specified density.

3.07 Cleanup

A. Immediately following the placing and compacting of the backfill, the excess material shall be removed and disposed of by CONTRACTOR, at his expense, as specified in Section 01 8900, Site Construction Performance Requirements.

B. Construction area shall be graded and left in a neat, workmanlike condition.

C. At a seasonally correct time, the disturbed area shall be raked, having topsoil placed thereon, fertilized and restored per the requirements of Section 32 9219, Seeding, or Section 32 9223, Sodding.

3.08 Testing

A. During the course of the Work, ENGINEER may require testing for compaction or density of the backfill. The taking of samples and the testing required shall be performed by a testing laboratory approved by ENGINEER. The cost for testing and sampling shall be at the expense of OWNER.

B. Testing laboratory shall furnish ENGINEER with two (2) certified copies of the results of all tests. Testing procedures shall conform to current MDOT, Standards for Construction.

C. Maximum unit weight, when used as a measure of compaction or density of soils, shall be understood to mean the maximum unit weight per cubic foot or per cubic meter as determined by ASTM D1557, Method A, for granular materials conforming to MDOT, Class I, and Method D, for granular materials and all other soils.

3.09 Defective Work

A. Any portion of the backfill which is deficient in the specified density shall be corrected by the methods meeting the approval of ENGINEER. Extra testing or sampling required because of apparent deficiencies shall be at CONTRACTOR's expense.

End of Section

Section 31 2333
Trenching and Backfilling

Part 1 General

1.01 Scope of Work

A. This Section includes open trench construction for utility installation, complete with trenching, sheeting, bracing, bedding, bedding materials, backfilling, backfill materials, and compaction.

1.02 Related Work Specified Elsewhere

A. Section 01 5713: Temporary Erosion and Sediment Control
B. Section 01 8900: Site Construction Performance Requirements
C. Section 31 2200: Grading
D. Section 31 2316: Structural Excavation and Backfill
E. Section 33 1100: Water Utility Distribution Piping
F. Section 33 3000: Sanitary Utility Sewerage Piping

1.03 Reference Standards

A. Unless otherwise specified, the Work for this Section shall conform to the applicable portions of the following Standard Specifications:

1. ASTM - ASTM International

2. AASHTO - American Association of State Highways and Transportation Officials

3. MDOT - Michigan Department of Transportation, Standard Specifications for Construction, latest edition

1.04 Test Reports

A. Testing laboratory shall provide ENGINEER with two (2) certified copies of the test results of the compaction of the backfill.

B. Testing for compaction and the certification of the test results shall be performed by a testing laboratory approved by ENGINEER.

1.05 Mix Design

A. Submit mix designs for any concrete or flowable fill mixtures to be used on the Project. Include certified test results for seven day and 28 day strengths, together with any technical information for admixtures.

1.06 Soil Erosion and Sedimentation Control

A. CONTRACTOR, at his expense, shall provide, maintain and remove such temporary and/or permanent soil erosion and sedimentation control measures as specified on the Plans or as determined by ENGINEER.

B. Measures shall prevent surface runoff from carrying excavated materials into the drain, to reduce erosion of the slopes, and to prevent silting in of drain downstream of the Work.

C. Measures should include provisions to reduce erosions by the wind of all areas stripped of vegetation, including material stockpiles.

D. Comply with requirements of Section 01 5713, Temporary Erosion and Sediment Control.

Part 2 Products

2.01 Class II Granular Materials

A. Class II granular material gradation shall conform to the grading requirements for granular material Class II, as specified in MDOT, Section 902 except as follows. Class II granular material shall be natural bank run sand with a maximum size of 1½-inches (38 mm).

2.02 Crushed Stone Bedding

A. Crushed, angular, natural stone material, meeting the requirements of MDOT 21AA. Crushed concrete and slag are not allowed.

2.03 Concrete

A. Concrete shall conform to MDOT, Section 701, use grade S3; 3,000 psi (21 MPa) strength; Type I-A cement; 5.5 sacks cement per cubic yard (307 kg/m^3); 6A coarse aggregate; 2NS fine aggregate; 6.5% ± 1.5% air content; 3-inch (75 mm) maximum slump; no admixtures without ENGINEER's review.

2.04 Flowable Fill for Backfilling

A. Materials:

1. Fly Ash: Fly Ash shall have a maximum loss on ignition of 12% and meet the other requirements of ASTM C618 (Class F).

2. Water: Water shall meet the requirements of ASTM C94.

3. Cement: ASTM C150 or C595, Type I or IA.

B. Mixture (Strength 100 - 120 psi, (690 - 825 kPa)):

1. Fly Ash: 2000 lbs/c.y. (1190 kg/m^3) min
2. Cement: 70 lbs/c.y. (40 kg/m^3) min
3. Water: Sufficient water to produce desired flowability, 700 lbs/c.y. (415kg/m^3) ±

C. Temperature of the flowable fill mix as manufactured and delivered shall be at least 50 degrees Fahrenheit (10 degrees Celsius). Flowable fill can be mixed by pugmill, central concrete mixer, ready mix truck, turbine mixer, or other acceptable equipment or method.

Part 3 Execution

3.01 Dewatering

A. Area within the vicinity of the trenching operation shall be dewatered in accordance with Section 31 2319, Dewatering prior to the trenching operation.

B. Depth of the dewatering shall be sufficient to allow the trench excavating operation including backfilling and compacting to proceed in a dry condition.

3.02 Trench Excavation

A. Open cut trench excavation shall include the site clearing and grubbing, the excavating of all materials encountered, the supporting and protecting of all structures and/or utilities encountered above and below the ground surface, and the removal of water from the construction site.

B. Trenching operation shall commence at the downstream or outlet end of the new Work and proceed upstream, unless otherwise specified on the Plans or directed by ENGINEER.

C. Trench shall be excavated in reasonably close conformity with the lines and grades specified on the Plans or as established by ENGINEER.

D. Excavated materials shall be temporarily stored along the trench in a manner that will not cause damage to trees, shrubs, fences, improvements, utilities, private property, public property or traffic. The excavated materials shall not be placed at such locations that will endanger the trench banks by imposing loads thereon.

E. Trench shall be of sufficient width to provide adequate working space to permit the installation of the pipe and the compaction of the bedding material under and around the pipe. However, for rigid pipe, the width of the trench from below the pipe bedding to 12 inches (300 mm) above the top of the pipe shall not exceed the following dimensions:

Diameter of Pipe	Width of Trench
6-inch thru 12-inch pipe (150 thru 300 mm)	30 inches wide (750 mm)
15-inch thru 36-inch pipe (375 thru 900 mm)	outside diameter plus 16 inches (400 mm)
42-inch thru 60-inch pipe (1050 thru 1500mm)	outside diameter plus 20 inches (500mm)
over 60-inch pipe (1500mm)	outside diameter plus 24 inches (600 mm)

F. Support the additional load of the backfill when the maximum trench width as specified for rigid pipe is exceeded, CONTRACTOR shall install, at his expense, concrete encasement which shall completely surround the pipe and shall have a minimum thickness at any point of 1/4 of the outside diameter of the pipe or four (4) inches (100mm), whichever is greater, or at his expense, install another type bedding, approved by ENGINEER. Concrete encasement shall consist of 3,000 psi (21 MPa) strength concrete.

G. For flexible pipe, the minimum width shall be not less than the greater of either the pipe outside diameter plus 16 in. (400 mm) or the pipe outside diameter times 1.25, plus 12 in. (300 mm). Maximum trench width for flexible pipe shall not exceed the minimum width by more than 6-inches.

H. To support the additional load of the backfill when the maximum trench width as specified for flexible or semi-rigid pipe is exceeded, CONTRACTOR shall install, at his expense, crushed stone pipe bedding to the full width between undisturbed trench walls or at least 2.5 pipe diameters on each side of the pipe.

I. When through, CONTRACTOR's construction procedure or because of unsuitable existing ground conditions, it becomes impossible to maintain alignment and grade properly, CONTRACTOR, at his expense, shall excavate below the normal trench bottom grade and shall fill the void with a large size aggregate or 3,000 psi (21 MPa) concrete as approved by

ENGINEER to ensure that the pipe when laid in the proper bedding will maintain correct alignment and proper grade.

J. Trench excavations, including those for shafts and structures, shall be adequately braced and/or sheeted where necessary to prevent caving or squeezing of the soil.

3.03 Sheeting, Shoring, and Bracing

A. CONTRACTOR shall furnish, place and maintain at all times such sheeting, shoring, and bracing of the trench and/or shaft as may be required for safety of the workmen and for protection of the new Work or adjacent structures, including pavement, curbs, sidewalks, pipe lines, conduits next to or crossing the trench, and the protection and safety of pedestrian and vehicular traffic.

B. CONTRACTOR shall be responsible for the complete design of all sheeting, shoring and bracing Work. The design shall be appropriate for the soil conditions, shall be of such strength, quality, dimension and spacing as to prevent caving or loss of ground or squeezing within the neat lines of the excavation, and shall effectively restrain movement of the adjacent soil. Prior to installing the sheeting, shoring or bracing, CONTRACTOR shall submit Plans for this Work to ENGINEER for informational purposes only.

C. Sheeting, shoring, bracing, and excavation shall conform to the current federal or state regulations for safety.

D. Where indicated on the Plans and where necessary in the Work, install and leave sheeting, shoring, and bracing in place. No extra compensation shall be paid to CONTRACTOR for sheeting, shoring or bracing left in place.

E. Supports for pipes, conduits, etc., crossing the trench shall conform to the requirements of the owners of such facilities, and if necessary, shall be left in place.

F. The furnishing, placing, bracing, maintaining, and removing of sheeting, shoring, and trenching materials shall be at CONTRACTOR's expense. CONTRACTOR shall not remove the trench sheeting, shoring and bracing unless the pipe has been properly bedded, and the trench backfilled to sufficiently support the external loads. Also the sheeting, shoring, and bracing material shall not come in contact with the pipe, but shall be installed so that no concentrated loads or horizontal thrusts are transmitted to the pipe.

3.04 Pipe Bedding

A. Install and compact in six inch layers. Particular care shall be taken to assure filling and tamping all spaces under, around, and above the top of the pipe. Work in and around pipe by hand to provide uniform support.

B. Rigid Pipe Bedding:

1. Rigid pipe bedding shall conform to ASTM C12, except as noted.

a. Class R-A:

(1) Pipe shall be bedded in crushed stone bedding material placed on the trench bottom. Bedding shall have a minimum thickness beneath the pipe of four (4) inches (100 mm) or 1/4 of the outside diameter of the pipe, whichever is greater, and shall extend up the

sides of the pipe to the horizontal centerline. The top half of the pipe shall be covered with a monolithic plain concrete arch having a thickness of at least four (4) inches (100 mm) or 1/4 of the inside diameter of the pipe, whichever is greater, at the pipe crown and a minimum width equal to the outside diameter of the pipe plus eight (8) inches (200 mm) or 1-1/4 of the diameter of the pipe, whichever is greater.

b. Class R-B:

(1) Pipe shall be bedded in crushed stone bedding material placed on the trench bottom. Bedding shall have a minimum thickness beneath the pipe of four inches (100 mm) or 1/8 of the outside diameter of the pipe, whichever is greater, and shall extend up the sides of the pipe to the horizontal centerline. Backfill from pipe horizontal centerline to a level not less than 12 inches (300 mm) above the top of the pipe shall be Class II granular material. This material shall be placed in 6-inch (150 mm) layers with each layer thoroughly compacted by mechanical means with the finished compacted material a minimum of 12 inches (300 mm) above the top of pipe.

c. Class R-C:

(1) Pipe shall be bedded in Class II granular material, placed on the trench bottom. Bedding shall have a minimum thickness beneath the pipe of four (4) inches (100 mm) or 1/8 of the outside diameter of the pipe, whichever is greater, and the bedding shall extend to a level not less than 12 inches (300 mm) above the top of the pipe. This material shall be placed in 6-inch (150 mm) layers with each layer thoroughly compacted by mechanical means with the finished compacted material a minimum of 12 inches (300 mm) above the top of pipe.

C. Flexible Pipe Bedding:

1. Flexible pipe bedding shall conform to ASTM D2321, except as noted. Continuous and uniform bedding shall be provided in the trench for all buried pipe.

a. Class F-I:

(1) Pipe shall be bedded in crushed stone bedding material placed on the trench bottom. Bedding shall have a minimum thickness beneath the pipe of four (4) inches (100 mm), and shall extend up the sides of the pipe until the top of pipe is covered by a minimum thickness of 12 inches (300 mm).

(2) Where allowable trench widths are exceeded, Class F-I bedding shall be used to the full width between undisturbed trench walls. Concrete cradle bedding shall not be used.

b. Class F-II:

(1) Pipe shall be bedded in crushed stone bedding material placed on the trench bottom. Bedding shall have a minimum thickness beneath the pipe of four (4) inches (100 mm), or 1/8 of the outside diameter of the pipe, whichever is greater, and shall extend up the sides of the pipe to the horizontal centerline. Backfill from pipe horizontal centerline to a level not less than 12 inches (300 mm) above the top of the pipe shall be Class II granular material. This material shall be placed in 6-inch (150 mm) layers with each layer thoroughly compacted by mechanical means with the finished compacted material a minimum of 12 inches (300 mm) above the top of pipe.

(2) Where allowable trench widths are exceeded, Class F-I bedding shall be used to the full width between undisturbed trench walls. Concrete cradle bedding shall not be used.

c. Class F-III:

(1) Pipe shall be bedded in Class II granular material, placed on the trench bottom. Bedding shall have a minimum thickness beneath the pipe of four (4) inches (100 mm) or 1/8 of the outside diameter of the pipe, whichever is greater, and the bedding shall extend to a level not less than 12 inches (300 mm) above the top of the pipe. This material shall be placed in 6-inch (150 mm) layers with each layer thoroughly compacted by mechanical means with the finished compacted material a minimum of 12 inches (300 mm) above the top of the pipe.

(2) Where allowable trench widths are exceeded, Class F-I bedding shall be used to the full width between undisturbed trench walls. Concrete cradle bedding shall not be used.

3.05 Backfilling Trenches

A. Backfill material shall be placed on sections of bedded pipes only after such pipe bedding and backfill materials have been approved by ENGINEER.

B. Trench backfilling shall follow the pipe laying as closely as possible. However, at no time shall the pipe laying in any trench precede backfilling of that trench by more than 100 feet (30 m), unless otherwise directed by ENGINEER.

C. Backfilling shall not be done in freezing weather except by permission of ENGINEER. Frozen materials shall not be used in trench backfilling.

D. Following trench backfill specifications are for use in that portion of the trench beyond the scope of the pipe bedding requirements which normally stops at a point 12 inches (300 mm) above the top of pipe.

1. Backfill material to be placed above pipe bedding shall be free of cinders, ashes, refuse, boulders, roots, stumps, trees, timbers, brush, debris, or other extraneous materials which in the opinion of ENGINEER, are unsuitable.

2. Rocks or stones having a dimension larger than six (6) inches (150 mm) shall not be placed within three (3) feet (1 m) of the top of the pipe .

3. Large stones may be placed in the remainder of the trench backfill only if well separated and arranged so that no interference with backfill settlement will result.

E. The type and method of backfilling is dependent on its location and function and shall conform to the following requirements:

1. Trench "A":

a. All other trenches shall be backfilled with suitable excavated material placed in uniform layers that can be adequately compacted and tested from the surface of that layer. Each layer shall be thoroughly compacted by approved mechanical methods to a density equivalent to the undisturbed adjacent soil or 90% of its maximum unit weight which ever is less.

2. Trench "B":

a. Trenches under road surfaces, pavement, curb, driveway, sidewalk and where the trench edge is within three (3) feet (1m) of the pavement and as noted on the plans shall be backfilled with natural bank run sand meeting the requirements of Class II granular material, unless otherwise indicated on the Plans. The material shall be placed in uniform layers that can be adequately compacted and tested from the surface of that layer and shall be compacted to 95% of the materials maximum unit weight. Trenches under pavement to be constructed in the near future, as noted or shown on the Plans, shall be backfilled with natural bank run sand, meeting the requirements of Class II granular material, unless otherwise indicated on the Plans, as herein provided.

b. Where a pipe is installed under an existing or proposed utility, the backfill between the two shall be natural bank run sand meeting the requirements of Class II granular material, unless otherwise indicated on the Plans, constructed as herein specified.

F. Unless otherwise specified on the Plans or as directed by ENGINEER, the trench backfill shall be carried to the adjacent existing ground.

G. Where any backfill or bedding as shown on the plans or specified is to be flowable fill, care shall be used to avoid displacing any pipes or structures due to fluid pressure. Pipes in backfill areas may need to be secured to avoid the bouyancy effect.

3.06 Compacting Trench "B" Backfill

A. Trench "B" backfill shall be compacted to 95% of the maximum unit weight, unless otherwise specified on the Plans or authorized by ENGINEER.

B. Compaction of the backfill will not be paid for separately, but shall be considered incidental to the Work of backfilling and shall include all the Work of manipulating the soil, to obtain the specified densities. No additional compensation will be allowed for any delay required to obtain the specified moisture content or the specified density.

3.07 Cleanup

A. Immediately following the placing and compacting of the backfill, the excess material shall be removed and disposed of by CONTRACTOR, at his expense, as specified in Section 01 8900, Site Construction Performance Requirements. The construction area shall be leveled and left in a neat workmanlike condition.

B. At a seasonally correct time, approved by ENGINEER, the disturbed area shall be raked, having topsoil placed thereon, fertilized and seeded per the requirements of Section 32 9219, Seeding, or sodded in accordance with Section 32 9223, Sodding.

3.08 Field Testing

A. During the course of the Work, ENGINEER may require testing for compaction or density of the backfill. Taking of samples and the testing required shall be performed by a testing laboratory suitable to OWNER and approved by ENGINEER. The cost for testing and sampling shall be at the expense of OWNER.

B. Maximum unit weight, when used as a measure of compaction or density of soils, shall be understood to mean the maximum unit weight per cubic foot or per cubic meter as determined by ASTM D1557, Method D.

3.09 Defective Work

A. Any portion of the trench backfill which is deficient in the specified density shall be corrected by methods meeting the approval of ENGINEER.

B. Any extra testing or sampling required because of deficiencies shall be at CONTRACTOR's expense.

End of Section

Division 32
Exterior Improvements

Section 32 1313
Concrete Paving

Part 1 General

1.01 Scope of Work

A. This Section includes both plain and reinforced portland cement concrete paving complete with concrete material admixtures, joints, forms, equipment requirements, field quality control and appurtenances required to complete the portland cement concrete paving Work indicated on the Plans.

1.02 Related Work Specified Elsewhere

A. Section 01 2200: Unit Prices
B. Section 31 2313: Subgrade Preparation
C. Section 32 9219: Seeding

1.03 Reference Standards

A. Unless otherwise specified, the Work for this Section shall conform to the applicable portions of the following Standard Specifications.

1. ASTM - ASTM International

2. AASHTO - American Association of State Highway and Transportation Officials

3. ACPA - American Concrete Paving Association

4. MDOT - Michigan Department of Transportation, Standard Specifications for Construction, latest edition

1.04 Material Reports

A. At the request of ENGINEER, CONTRACTOR shall provide ENGINEER with certification that the various materials to be used conform to the Standards referred to in the Specifications.

B. CONTRACTOR shall submit a list of his source of material supply to ENGINEER for review prior to placing any order.

C. CONTRACTOR shall provide ENGINEER, prior to the actual delivery of the ready-mixed concrete, the mix design as required by paragraph 5.3.2 of ASTM C94.

1.05 Thickness and Compressive Strength Reports

A. The testing lab shall provide the ENGINEER with two (2) certified copies of the test results of the thickness and compressive strength of the concrete. The core drilling, testing for thickness and compressive strength, and the certification of the test results shall be performed by a testing laboratory approved by ENGINEER.

1.06 Water Quality Test Reports

A. The testing lab shall provide ENGINEER with two (2) certified copies of the test results of the quality of water to be used in the concrete.

B. Sampling and testing of water quality shall be in accordance with AASHTO T-26 requirements, and the certification of the tests' results shall be performed by a testing laboratory approved by ENGINEER.

1.07 Request for Material Variance

A. Requests for variances in the materials, as specified, shall be made in writing to ENGINEER.

B. Two (2) copies of the request shall be submitted for ENGINEER's review and approval.

1.08 Environmental Requirements

A. Comply with the requirements for concrete installation due to outside ambient air temperatures specified under Articles 3.21 and 3.22 of this Section.

B. Comply with the requirements for protecting new Work against damage from rain, as specified under Article 3.20 of this Section.

C. Comply with the requirements for protecting new Work against damage from cold weather, as specified under Article 3.21 of this Section.

Part 2 Products

2.01 Cement

A. Cement shall be low alkali, air-entraining Portland cement conforming to ASTM C150, Type IA or Type IIIA.

2.02 Fine Aggregates

A. Fine aggregate gradation shall conform to ASTM C33 and to fine aggregate, 2NS, as specified in MDOT Section 902.

2.03 Coarse Aggregate

A. Coarse aggregate gradation shall conform to ASTM C33 and to coarse aggregate, 6A, or 6AA as specified in MDOT Section 902.

2.04 Water

A. Water to be used for mixing and curing concrete shall be reasonably clean and free from oil, salt, acid, alkali, sugar, vegetable, or other substances injurious to the finished product.

B. Waters from sources approved by the Michigan State Department of Public Health as potable may be used without testing.

C. Water requiring testing shall be tested in accordance with the current Method of Test for Quality of Water to be used in Concrete, AASHTO T-26, and specified in MDOT Section 911.

2.05 Concrete Admixtures

A. Air-Entraining Admixtures:

1. Air-entraining admixtures for concrete shall conform to ASTM C260 and as specified in MDOT Section 903.

B. Concrete Accelerators:

1. Chemical admixtures, other than calcium chloride, for accelerating the set of Portland cement concrete shall conform to ASTM C494, Type C or Type E.

2. Calcium chloride in flake or pellet form shall conform to ASTM D98, Type S, Grade 1 or grade 2, flake or pellet form, and as specified in MDOT Section 903.

3. Calcium chloride in solution form shall conform to MDOT Section 903.

C. Water-Reducing and Water-Reducing Retarding Admixtures:

1. Water-reducing admixtures and water-reducing retarding admixtures shall conform to ASTM C494, Type A or Type D, except that neither type of admixture shall contain calcium chloride, and as specified in MDOT Section 903.

D. Pozzolanic Admixtures:

1. Fly Ash shall conform to ASTM C618, Type F, and as specified in MDOT Section 901.

2. Ground granulated blast furnace slag shall conform to ASTM C989, Grade 100, minimum.

2.06 Concrete Curing Compounds

A. White membrane curing compound for curing concrete shall conform to ASTM C309, Type 2, Class B Vehicle, and as specified in MDOT, Section 903.05.

B. Transparent membrane curing compound for curing base course concrete shall conform to ASTM C309, Type 1-D, Class B Vehicle, and as specified in MDOT, Section 903.05.

2.07 Lane Tie Bars

A. Bar reinforcement for pavement tie bars shall conform to ASTM A706, or Grade 60 of ASTM A615, A616-96a, or A617-96a, and as specified in MDOT Section 914.

2.08 Steel Welded Wire Fabric

A. Welded steel wire fabric for concrete mesh reinforcement shall conform to ASTM A185, MDOT Section 905, and shall be fabricated as shown on the Plans.

2.09 Dowel Bars

A. Dowel Bars and basket assemblies for Transverse expansion and contraction joints shall be ASTM A615 Grade 40 and conform to MDOT Section 914.

2.10 Steel Hook Bolts

A. Hook bolts shall conform to ASTM A706, or Grade 60 of ASTM A615, A616-96a, or A617-96a. Hook bolts shall be 5/8 inch (16 mm) diameter. Along the edge of existing concrete, expansion anchored hook bolts shall be used.

2.11 Joint Fillers

A. Fiber joint filler material for expansion joints shall conform to ASTM D1751, and as specified in MDOT, Section 914.03.

B. Bituminous premolded joint filler material shall conform to ASTM D994 and AASHTO M33.

C. Polyethylene premolded joint filler for pressure relief joints shall be a flexible, low-density, expanded, extruded polyethylene plank. Polyethylene plank shall be formed by the expansion of polyethylene base resin in an extrusion process and shall be homogeneous, closed-cell and multi-cellular.

2.12 Joint Sealants

A. Hot-poured type joint sealant shall conform to AASHTO M301 or ASTM D6690 Type II and as specified in MDOT Section 914.

B. Cold-applied, single component type, joint sealant shall conform to ASTM D5893.

2.13 Concrete Mix

A. Concrete shall contain a minimum of six (6) sacks, 94 pounds per sack, of cement per cubic yard (335 kg/m^3) and shall yield a minimum compressive strength of 3,500 psi (24 Mpa) when cured in a moist room at a temperature within a range of 65 to 75 degrees Fahrenheit (18^o to 24^o Celsius) for a period of 28 days.

1. Mixes with less than six sacks of cement per cubic yard with water reducers, pozzolans, ground granulated blast furnace slag (GGBFS), etc., may be used when approved by ENGINEER, providing CONTRACTOR provides documentation from actual mixes used on projects showing 28 day compressive strength of not less than 3,500 psi when tested under field conditions.

2. GGBFS or Flay Ash must replace cement on a pound for pound basis. The fly ash quantity may not exceed 15%, GGBFS quantity shall be not less than 25% and not more than 40%. Maximum total replacement of cement shall not exceed 40%.

B. Cement shall be air-entraining Portland cement ASTM C150, Type IA. If high-early strength concrete is desired, Type IIIA is required.

C. High early strength concrete shall be 4500 psi (31 MPa), 7 sacks cement per cubic yard (390 kg/m^3) with a water reducer. Water cement ratio shall be between 0.38 and 0.39.

D. Air content of the concrete shall be dependent on the maximum size aggregate as follows:

Size of Aggregate in inches (mm)	Air by Volume (in % ±1%)
1-1/2, 2, or 2-1/2 (40 to 65 mm)	5
3/4 or 1 (20 to 25 mm)	6
3/8 or ½ (9 or 10 mm)	7-1/2

E. Slump of the concrete shall be between 1-1/2 and 2-1/2 inches (40 to 65 mm) where machine methods are used for striking off and consolidating the concrete. If ENGINEER permits hand finishing, the slump may be increased to 3-1/2 inches (90 mm).

F. Ready-mixed concrete shall be in accordance with ASTM C94, Alternate 2, and shall yield a minimum compressive strength of 3,500 psi (24 Mpa) when cured in a moist room at a temperature within a range of 65 to 75 degrees Fahrenheit (18 to 24 Celsius) for a period of 28 days.

G. ENGINEER shall be provided with the mix design for review and approval, prior to the actual delivery of the concrete.

Part 3 Execution

3.01 Verification of Excavation and Forming

A. Prior to the installation of any concrete, examine the excavation and forms for the grades, lines, and levels required to receive the new Work. Ascertain that all excavation and compacted subgrades are adequate to receive the concrete to be installed.

B. Correct defects and deficiencies before proceeding with the Work.

3.02 Verification of Subgrade Conditions

A. Prior to the installing of any concrete, examine the subgrade to ascertain that it is adequate to receive the concrete to be installed. If the subgrade remains wet after all surface water has been removed ENGINEER may require the installation of edge drain.

3.03 Existing Improvements

A. Investigate and verify location of existing improvements, including structures, to which the new Work is to be connected. Make necessary adjustments in line and grade to align the new Work with the existing improvements after approval by ENGINEER.

3.04 Batch Plant

A. An adequate site for the batch plant shall be obtained by CONTRACTOR, at his expense. The site shall be maintained, and the plant operated in accordance with the conditions and requirements established by the community in which the plant is located.

3.05 Fine Grading

A. Subgrade shall be fine graded to the cross section shown on the Plans and shall be thoroughly compacted prior to the placing of forms or concrete.

3.06 Installation - General

A. The width, thickness, and type of concrete pavement shall be specified on the Plans or as approved by ENGINEER.

B. At street intersections, curb drops, conforming to the current rules and regulations of Act 8, Michigan PA 1973, shall be provided for the construction of sidewalk ramps. In addition, curb drops for sidewalk and driveway approaches shall be provided as specified in locations called for on the Plans or as approved by ENGINEER.

C. Construction operations shall be restricted to the existing right-of-way. If additional area is required, CONTRACTOR shall furnish ENGINEER with written permission from the property owner for any part of the operation he conducts outside the established right-of-way.

D. CONTRACTOR shall maintain traffic access at all intersections. Vehicle access shall also be maintained to all commercial and public properties and elsewhere as designated by ENGINEER.

3.07 Equipment Requirements

A. General:

1. Approved, mechanical concrete placing and finishing equipment shall be used for concrete paving except for gapped areas or where otherwise approved by ENGINEER.

2. CONTRACTOR shall furnish sufficient equipment for the placing of concrete pavement.

3. Equipment shall be on the job site and ready for normal operation before the paving operation is started.

4. Equipment shall be in good working order.

5. Equipment shall be subject to inspections and testing during construction.

6. Equipment shall be of sufficient capacity that the paver can operate continuously and obtain a rate of production that insures good workmanship and eliminates overloading of equipment or frequent interruptions or delays.

7. Equipment operating on or near the pavement shall be equipped with rubber-tired wheels.

B. Forms:

1. Except when paving with a slip-form paver, forms shall be used and shall be made of metal, having an approved section, which shall insure their rigidity under impact, thrust and weight of the heaviest machine carried on them.

a. The thickness of the metal shall be not less than 1/4 of an inch (5 mm), except that a minimum thickness of 3/16 of an inch (4.5 mm) will be permitted if the form is a trapezoidal cross section.

2. Forms shall have a minimum length of ten (10) feet (3 m) and a depth not less than the edge thickness of the Work prescribed, except the subgrade may be a maximum of 1-inch (25 mm) lower than the bottom of the forms when so approved by ENGINEER.

    a. The width of the base in direct bearing on the soil shall be not less than 0.75 of the form depth except that a width of less than eight (8) inches (200 mm) will not be permitted.

3. Each 10-foot (3 m) section of form shall have at least three (3) stake pockets. The forms shall be straight, free from distortion, and shall show no vertical variation greater than 1/8 of an inch (3 mm) in 10-foot lengths (3 m) from the true plane surface on the top of the form when tested with a 10-foot (3 m) straightedge and shall show no lateral variation greater than 1/4 of an inch (5 mm) from the true plane surface on the vertical face of the form when tested with a 10-foot (3 m) straightedge.

4. Approved wood or flexible forms and hand finishing will be required on all pavement where the radius for the edge of the pavement is less than 200 feet (60 m).

5. The method of connection between form sections shall be such that a locked joint is formed free from vertical movement in excess of 1/8 of an inch (3 mm) and from horizontal movement in excess of 1/4 of an inch (5 mm) under the impact, thrust and weight of the heaviest machine carried on the forms.

6. Sufficient forms shall be provided so that it will not be necessary to remove them in less than 12 hours, or longer if required, after the concrete has been placed.

C. Subgrade Roller or Compactor:

1. Equipment shall be self-propelled steel-wheeled or a pneumatic-tired roller weighing not less than eight (8) Tons (7 metric tons) or a self-propelled vibratory compactor of adequate size to compact the subgrade to the required density.

D. Subgrade Planer:

1. Steel-shod subgrade planer supported by two (2) flanged wheels resting on the side forms may be used for trimming the subgrade in small areas when approved by ENGINEER.

2. Steel-shod template shall be adjustable to fit the shape of the bottom of the pavement and shall have adequate connection to a rigid frame to maintain the crown.

3. Planer shall be of sufficient weight to plane off all high spots encountered.

E. Base Trimmer:

1. For slip-form construction, a powered, self-propelled base trimmer will be required. This base trimmer shall be capable of trimming the base to the required cross section.

F. Water Supply Equipment:

1. Pumps and pipe lines shall be such capacity and nature as to insure an ample supply and adequate pressure of water, simultaneously, for all the requirements of machinery, mixing, sprinkling subgrade, and other requirements of the Work

2. Water may be supplied in tank wagons to augment inadequate pipe lines or to replace them entirely if a sufficient number of units are employed.

G. Finishing Machine:

1. Finishing machine shall be power driven and of an approved type which will strike off and compact the concrete with a screeding and troweling action.

   a. Machine shall be capable of finishing the concrete in the manner specified herein, and shall provide a minimum of two (2) oscillating screeds.

2. A combination concrete spreader/finishing machine (i.e.: Pav-Saver®) may be used for residential streets not exceeding 100-feet (305 m) in length and 18-feet (3.7 m) in width or when approve by ENGINEER.

   a. The combination type machine must have suitable automatic vibrators, strike-off bars, augers, screeds, finishing pan, etc., in accordance with the requirements of this section, to produce a densely compacted, homogeneous concrete slab, true to line, grade and cross section.

H. Concrete Spreader:

1. An approved concrete spreader with a strike-off board or a separate strike-off shall be used to level each layer of concrete, before placing of reinforcement, and before finishing the concrete.

   a. It shall have sufficient weight and rigidity to retain its shape under working conditions to properly strike off the concrete.

   b. Two separate spreaders are not required where an approved mesh depresser type machine is used.

2. A concrete spreader is not required for the construction of residential street concrete pavement when approved by ENGINEER.

I. Vibratory Screed:

1. An approved hand-propelled vibratory screed shall be provided for use in gapped areas at driveways and intersections, and where machine methods are not feasible to screed and consolidate the concrete.

   a. Gaps finished by this method shall be limited to one (1) joint spacing in length and one (1) single lane width.

2. Screed shall consist of a steel-shod strike board having a minimum thickness of two (2) inches (50 mm) and equipped with a gasoline engine capable of producing at least 5,000 vibrations per minute.

a. Other vibratory screeds may be approved by ENGINEER.

J. Membrane Sprayer:

1. A mechanically-pumped pressure sprayer capable of applying a continuous uniform film of curing compound will be required.

2. Equipment shall provide adequate stirring of the compound during application.

K. Slip-Form Paving Equipment:

1. When pavement is placed by the slip-form method, the slip-form paving equipment shall spread, consolidate, screed, and mechanically float the freshly-placed concrete in such a manner that only a minimum of hand finishing will be necessary to provide a dense and homogeneous pavement.

2. The machine shall be equipped to vibrate the concrete for the full width and depth of the pavement being placed.

L. Floats:

1. Mechanical float shall be a combination float finisher. Where a mechanical float is an integral part of a slip-form paver, a separate mechanical float will not be required.

2. A float finisher shall consist of a machine having two (2) screeds and be equipped with a suspended pan float. The second screed and the pan float shall be suspended in such a manner that they operate independently of the side forms.

3. A mechanical float will not be required for the construction of residential street concrete pavement.

M. Footbridge:

1. A movable bridge shall be provided when necessary to satisfactorily finish the pavement or construct joints. The bridge shall be designed and constructed so that it will not come in contact with the concrete.

N. Transverse Float:

1. This float shall be made of metal and shall be at least ten (10) feet (3 m) in length and of the box or channel type with a floating face at least six (6) inches (150 mm) in width. It shall be constructed so as to be light in weight, rigid and free from warps.

O. Vibrator:

1. Vibrator for consolidating the concrete along the faces of the forms and adjacent to joints shall be an approved electric or mechanical vibrator of an internal type, not less than 2 inches (50 mm) in diameter.

2. It shall have minimum frequency of 5,000 vibrations per minute for a tube 2 inches (50 mm) in diameter, 3,600 vibrations per minute for a tube 4 inches (100 mm) in diameter, or a proportionate frequency for an intermediate size.

3. At least 2 vibrators shall be provided for each concrete paving unit on the project.

4. Vibrators used adjacent to the forms in conventional paving shall be connected with the equipment on which they are mounted such that vibration of the concrete will start automatically with the forward movement of the equipment and stop automatically whenever forward movement stops.

P. Form Tamper:

1. A mechanical form tamper of approved design will be required on all projects. It shall be capable of thoroughly and uniformly compacting the soil under the forms.

Q. Strike-Off for Reinforcement:

1. An approved strike-off shall be used to level the concrete before placing the pavement reinforcement.

2. It shall be adjustable and shall be supported by two (2) flanged wheels on each end which rest on the side forms.

3. It shall have sufficient weight and rigidity to retain its shape under working conditions and properly strike off the concrete.

4. An approved hand strike-off resting on the forms shall be used for irregular areas.

5. The strike-off may be a part of the concrete spreader or a finishing machine.

R. Lane Tie Bar Installer:

1. When not placed on approved chairs, lane tie bars shall be installed by use of an approved mechanical device.

S. Reinforcement Carrier:

1. Reinforcement not placed on chairs shall be transferred from the hauling equipment to a movable bridge which spans the pavement being cast or placed by other approved means which will not result in contamination of the concrete.

2. Bridge shall be capable of carrying the reinforcement load without appreciably deflecting the forms.

T. Joint Filling and Sealing Equipment:

1. Equipment for filling and sealing joints shall be available for inspection and testing at least 48 hours prior to its use.

2. Heating kettle for hot poured sealing material shall be of the indirect-heating or double boiler type, using oil as the heat transfer medium. It shall have a thermostatically controlled heat source, a built-in automatic agitator, and thermometers installed to indicate both the temperature of the melted sealing material and that of the oil bath.

    a. CONTRACTOR shall demonstrate that the equipment proposed for use will consistently produce a joint sealer of proper pouring consistency.

3. Hot-poured sealing material shall be applied directly from the heating kettle; the kettle shall be equipped with a pressure pump, hose and nozzle suitable for forcing the sealing material to the bottom of the joint and completely filling the joint.

    a. The rate of application shall be controlled so as to completely fill the joint and not spill the material on the surface of the pavement.

    b. The hose and nozzle shall maintain the temperature of the sealing materials so that the loss in temperature is not over 10 degrees Fahrenheit (12° Celsius) between the nozzle and the heating tank.

    c. Heat from a direct flame on the nozzle shall not be used to maintain the proper temperature of the sealing material.

    d. Eeating equipment shall be mounted on rubber-tired wheels, and only rubber-tired equipment shall be used to move the heating equipment on the pavement.

4. Cold applied sealing compound shall be applied by means of pressure equipment that will force the material to the bottom of the joint and completely fill the joint without overflowing onto the surface of the pavement.

5. Sealing machine shall include a mechanical mixer capable of mixing the sealing components into a uniform, homogeneous mass.

U. Preformed Neoprene Joint Sealing Equipment:

1. Equipment for applying the lubricant and installing the preformed joint seal may be either power or hand operated equipment suitable for installing the joint seal as recommended by the manufacturer.

V. Sandblasting Equipment or Power Wire Brush:

1. Sandblasting equipment shall be of proper size and capacity to obtain the cleaning specified and shall operate at a nozzle pressure adequate for the performance of the Work. Nozzles shall be of proper diameter in relation to the width of joint and shall be replaced as necessary due to enlargement by wear.

2. A power wire brush may be used in place of sandblasting equipment.

W. Air Compressors:

1. Air compressors shall be portable and capable of furnishing sufficient air to maintain a nozzle pressure adequate to remove all loose fragments of concrete and foreign material from the joints.

2. Suitable traps shall be employed to maintain the compressed air free of oil and moisture.

X. Power Broom:

1. A mechanical broom with pickup suitable for cleaning the pavement will be required.

Y. Concrete Saw:

1. Two (2) self-propelled concrete saws which are adequately powered to cut hardened concrete to a minimum depth as shown on the Plans will be required.

2. Minimum thickness of the saw blade shall be 3/16 of an inch (5 mm). Saws shall be equipped with suitable guards.

Z. Miscellaneous Equipment**:**

1. Small tools to completely and satisfactorily finish the Work, including straightedges for testing pavement and forms, shall be provided by CONTRACTOR.

3.08 Placement of Forms

A. Forms shall be placed and checked for line and grade at least 500 feet (150 m) in advance of placing concrete.

B. Forms shall be adequately staked and braced to resist the pressure of concrete and the thrust of the equipment.

C. Forms shall have uniform bearing on the subgrade throughout their entire length and width.

D. After setting the forms to grade, thoroughly tamp both the inside and outside with an approved mechanical form tamper.

E. Forms shall be thoroughly cleaned before they are placed.

F. Forms shall be neatly and tightly joined, and shall be securely staked by at least three (3) stakes per form.

G. Forms shall be oiled before concrete is placed against them.

H. Forms shall be checked for line and grade, after being set.

I. Forms showing a variance from the staked line by more than 1/4 inch (5 mm) or from the staked grade by more than 1/8 inch (3 mm) in ten (10) feet (3 m) shall be adjusted.

J. Where the use of flexible forms are required, sufficient back bracing shall be provided to prevent undue deflection of the forms during placement of the concrete.

3.09 Placing Concrete

A. Placing of concrete should not commence or continue until the condition of the subgrade has been approved by ENGINEER.

B. Concrete shall be spread or distributed as soon as placed. If a mechanical spreader is not used, the concrete shall be deposited in a manner that requires a minimum of re-handling to avoid segregation and separation of materials. Concrete shall be deposited to a height sufficiently above grade so that when consolidated and finished it shall conform to the required finished grades.

C. Concrete along the faces of forms and adjacent to joints shall be consolidated and compacted to fill all voids.

D. Forms shall not be vibrated to consolidate the concrete.

E. When the pavement is placed in two (2) layers, the first layer may be cast three (3) to six (6) inches (75 to 150 mm) narrower on each side than the proposed pavement slab, so that the full depth of pavement, at the edges, will be cast with the second layer. Equipment shall vibrate concrete placed full depth for the complete width and depth of the pavement being placed. For concrete placed in two (2) layers, only the second layer will be required to be vibrated.

F. Placing of concrete shall be continuous as much as possible between transverse joints.

G. Whenever a temporary halt in operation occurs, the concrete and unfinished end of the slab shall be covered with wet burlap or plastic.

H. If the interruption of Work continues for more than 20 minutes, a construction joint shall be placed, provided the proposed construction joint is 15 feet (4.5 m) or more from the last joint for reinforced pavement and at last ten (10) feet (3 m) or more from the last joint in plain concrete pavement. Sections of pavement shorter in lengths will not be permitted and, if constructed, shall be removed and replaced at CONTRACTOR's expense.

I. Integral curbs, where specified or required, shall be constructed monolithic with the pavement slab. Curb material shall be placed before the pavement has started its initial set and shall be of the same mix as the concrete pavement.

J. Base and back forms will be required when constructing straight curbs, and back forms with templates of the required curb shape shall be used when constructing rolled and mountable curbs. Curb concrete shall be spaded sufficiently to eliminate all voids and tamped to bring the mortar to the surface, after which the curb shall be given a final finish to match the texture of the pavement.

K. After removing forms, any visible areas of honeycomb or minor defects shall be immediately filled with mortar, having one part of Portland cement and two parts fine aggregate, and shall be applied with a wooden float.

L. Where adjacent pavement lanes are constructed in separate pours, no equipment shall be operated upon recently placed concrete until the pavement has attained at least 85% of the design strength as determined by testing cores taken from the project, or until the pavement is 14 days old, at the option of ENGINEER.

M. Equipment wheels operating on the pavement, shall operate at least one foot (300 mm) from the edge of the pavement. Equipment wheels shall be rubber-tired.

N. The paver shall not be permitted on the new slab until the pavement has attained full design strength. The paver shall not operate on any new slab without using wood mats having an approved thickness and width to insure that the pavement will not be marked or structurally damaged.

O. Pavers are not permitted to operate on residential streets.

P. If the curing compound is damaged, it shall be repaired by spraying additional curing compound on the damaged areas as soon as the Work is completed.

Q. The filler strip on pavement widening projects shall be poured as soon as possible but not later than the first working day following the placing of the slab.

R. At intersections and where access is required to property along the Project, construction shall be completed by gapping the proposed pavement. Load transfer, contraction, of end-of-pour joint devices shall be placed at the gapped ends of the pavement.

S. In lieu of pavement gapping, CONTRACTOR may elect to place a temporary bridge, of a design approved by ENGINEER, to provide access. Furnishing, placing, maintaining, and removing the bridge shall be at CONTRACTOR's expense.

3.10 Placing Pavement Reinforcing

A. Where reinforcement is required, the sheets or mats shall be placed at the depth below the surface of the finished pavement, as shown on the Plans.

B. Pavement reinforcement shall be shipped and delivered to the Work in flat sheets or mats.

C. Adjacent sheets or mats shall be lapped, as indicated on the Plans, and shall be fastened to each other in no less than two (2) places in each pavement lane.

D. Where the width of pavement varies, the reinforcement requirements shall be the same as called for on the Plans. Split sheets or mats may be used to conform to the particular pavement configuration. Side laps shall not be less than the spacing of the longitudinal wires or bars.

E. On widening Projects where the pavement slab is less than six (6) feet (1.8 m) in width, 1/2 inch (10 mm) diameter longitudinal reinforcing bars may be substituted for standard reinforcement, providing the bars are spaced not more than 12 inches (300 mm) center-to-center. The first bar shall be not more than three (3) inches (75 mm) from the edges of the widened slab, and the bars shall be lapped a minimum of 12 inches (300 mm).

F. Reinforcement shall be installed by one of the following methods:

1. Chairs upon which reinforcement is to be mounted shall support the reinforcement and shall have such bearing on the base that there will be no undue penetration of the base. Maximum spacing of the chairs shall be sufficient to maintain the reinforcement at the specified depth. The reinforcement shall be placed directly from the hauling unit unto the chairs.

2. When reinforcement is placed between two (2) layers of concrete, the first layer shall be mechanically spread and struck off to the required depth below the proposed finished surface. Reinforcement shall be placed directly from the carrier onto the struck off concrete.

3. Any area where the use of the mechanical spreader or mechanical strike-off is not feasible, the reinforcement shall be mounted on chairs.

3.11 Joints

A. General:

1. Longitudinal and transverse joints shall conform to the details and shall be constructed at the locations shown on the Plans or as directed by ENGINEER.

2. Joints shall be constructed true to line with their faces perpendicular to the surface of the pavement.

3. Transverse joints shall be constructed at right angles to the centerline of the pavement, unless otherwise called for on the Plans or as determined by ENGINEER. Joints shall not vary more than 1/4 of an inch (5 mm) from a true line.

4. The surface of the pavement adjacent to all joints shall be finished to a true surface. Where indicated on the Plans, joints shall be edged to the radius shown or a minimum 1/4 inch (5 mm) radius. Surface across the joints shall be tested with a ten (10) foot (3 m) straightedge as the joints are finished and any irregularities shall be corrected before the concrete has hardened.

5. When pavement is laid in partial width slabs, transverse joints in the succeeding slabs shall be placed in line with the like joints of the first slab. In the case of widening existing pavements, transverse joints shall be placed as shown on the Plans, or as directed by ENGINEER.

6. Keyways, where required, shall be accurately formed with templates of metal, wood, or paper securely pinned in place. The gauge or thickness of the material in the templates shall be such that the full keyway, as specified, is formed in the correct location.

B. Longitudinal Joints:

1. General:

a. Longitudinal joints shall be sawed, longitudinal lane tie joint with tie bars or bulkhead construction joints with hook bolts.

b. Where called for on the Plans a keyway shall be constructed in the bulkhead construction joint.

2. Longitudinal Lane Tie Joint (D):

a. Longitudinal lane tie joints with tie bars shall be planes of weakness formed by sawing a groove in the hardened concrete according to the alignment, width and depth shown on the Plans.

b. Tie bars of the type, diameter and length called for on the Plans, shall be placed at the required depth parallel to the finished surface, at right angles to the joint and at the uniform spacing also called for on the Plans or as approved by ENGINEER.

c. Bar chairs shall be used to support the lane tie bars or the lane tie bars may be installed by use of a mechanical device, approved by ENGINEER. Placing of lane tie bars in the concrete by hand methods will not be permitted.

d. The joint shall be sawed as soon as the concrete will not spall or not more than 3 days after placement, and shall be completed before traffic of any kind uses the pavement. Immediately following the sawing of the joint, the slurry resulting from the sawing operation shall be completely removed from the joint, and the immediate area by flushing with a jet of water under pressure.

e. The joint shall be blown out with a jet of compressed air to remove the flushing water. After the joint is dry it shall be cleaned out with a jet of compressed air with a working pressure of at least 90 psi (620 kPa) and then shall be sealed in accordance with Article 3.18, with an application of an approved hot or cold applied type joint sealing compound. Sealing compound shall be applied with approved pressure type equipment with the nozzle extending into the groove and the groove shall be filled until the sealer overlaps the pavement about 1/8 of an inch (3 mm).

3. Longitudinal Bulkhead Construction Joint (D):

a. Longitudinal bulkhead construction joints with hook bolts shall be used in part-width construction of concrete pavement and elsewhere as shown on the Plans, or as approved by ENGINEER. Size, spacing, and depth of the hook bolts below the surface of the pavement shall be as shown on the Plans.

b. For slip-form paving, lane ties of an approved type may be substituted for hook bolts and shall be spaced at 30-inch (750 mm) centers, unless otherwise indicated on the Plans. Lane ties for slip-form paving shall be placed in the concrete with a pneumatic powered installer or equipment producing equal results. Lane ties, which are not set with adequate consolidation of the concrete or are not within 30 degrees of being perpendicular to the pavement edge in a horizontal plane, shall be replaced with drilled-in expansion-anchored lane ties.

c. Where a bulkhead joint is to be constructed, hook bolts and couplings shall be attached to the forms and shall be held in position during the placing and finishing of the concrete so as to permit the removal of the pavement forms without damage to the concrete or hook bolt assembly. Ends of the couplings shall be protected so that the concrete, dirt or other materials cannot enter the couplings and prevent a satisfactory connection with either hook bolt.

d. Where hook bolts or lane ties are installed for use in future pavement widening, in curb or curb and gutter construction, a rust preventive oil shall be inserted into the open end of the couplings immediately after removal of the pavement forms by means of a hand operated pump in sufficient quantity to completely cover the internal threads. After application of the protective oil, neoprene or plastic plugs shall be inserted into the ends of the couplings to completely seal the opening without protruding outside of the couplings more than 3/8 inch (9 mm).

e. Concrete shall be edged with a tool having the radius of curvature and depth of lip shown on the Plans. The second pour of concrete shall be edged with a longer lipped edging tool than that used on the first concrete pour.

f. After the concrete has cured for the required time, all extraneous material shall be removed from the joint and the joint then sealed with an approved hot-poured or cold-applied elastic-type compound. The use of sandblasters and a jet of compressed air will be required to clean the joint before sealing.

C. Transverse Joints:

1. General:

a. Transverse joints shall be contraction joints, plane of weakness joints, dummy joints, expansion joints, construction joints, end-of-pour joints and pressure relief joints.

2. Contraction Joints (C):

a. Contraction joints shall consist of a load transfer unit and a joint groove formed by sawing. Contraction joints shall be constructed as indicated on the Plans and shall be spaced a maximum of every 57'-3" (17.5 m) or as provided for elsewhere.

b. The load transfer unit shall be epoxy coated dowel bars, spaced and arranged in the positions indicated on the Plans, accurately held in place by an approved metal device so as to be perpendicular to the plane of the cross section of the pavement and parallel to the centerline at a distance from the surface equal to 1/2 the thickness of the slab.

c. This device shall consist of connected transverse and longitudinal members arranged to hold each dowel so firmly that its final position after concreting operations shall not vary more than 1/8 of an inch per foot of length (3 mm per meter) from its designated line and grade. The device shall be such as will permit the joint to be completely assembled alongside the Work, and it shall be sufficiently rigid so that the joint can be lifted into place on the subgrade as a unit.

d. One end of each dowel bar shall be free to move in the slab as the concrete contracts and expands. To accomplish this, 2/3 the length of each dowel shall be thoroughly lubricated with liquid asphalt. The liquid asphalt coating shall be applied to a sawed end of the dowel bar or, in the case of dowel bars with sheared ends, a metal cap shall be placed on the coated end of the dowel bar. The asphalt coating shall be sufficiently dry before using the dowels so that it will not be removed by handling and placing the dowels in the joint. The bars shall be installed so that the alternate bar on each side of the joint shall be the coated end of the bar.

3. Plane of Weakness Joints (WT):

a. Plane of Weakness joints shall be placed in plain concrete pavements only and is to be constructed immediately after the finishing operation has been completed. A groove shall be formed in the plastic concrete with a metal forming bar to the depth indicated on the Plans. A premolded bituminous filler strip shall be placed in the groove formed by the metal bar, from a bridge operating on the pavement forms. The concrete shall then be floated against the sides of the filler, and the joint edged to a 1/8 inch (3 mm) radius.

4. Plane of Weakness Joint for Concrete Base Course (WTB):

a. Dummy joints shall be placed in reinforced concrete pavements only where called for on the Plans. It shall be constructed immediately after the finishing operation has been completed by forming a groove in the plastic concrete with a metal forming strip into which expanded polystyrene or other approved temporary filler is placed. The material shall be installed flush with the surface of the pavement and the area on both sides of the joint shall be finished. Transverse joints with a temporary filler shall not be edged. The pavement reinforcement shall be continuous through this joint.

5. Expansion Joints (E) and (E_1):

a. Expansion joints (E_1) shall consist of a load transfer unit and a premolded fiber filler and shall be used on reinforced concrete pavements or where shown on the plans.

b. Expansion joints (E) shall consist of a premolded fiber filler without the load transfer unit and shall be used for joints in concrete capping, end connections with structures or existing pavements, plain concrete pavements, and other places where shown on the Plans where installation of the load transfer unit is not feasible as approved by ENGINEER.

c. The load transfer units shall be assembled and the epoxy coated bars lubricated with liquid asphalt. Liquid-asphalt-coated end of each bar shall be provided with a close fitting metal cap.

d. The fiber filler shall extend the full depth and width of the joint. After installation, the top shall be not less than 1/2 inch (10 mm) and no more than 1-inch (25 mm) below the finished surface. It shall be furnished in lengths not less than the lane widths being poured. Where additional partial lengths are necessary, the minimum length of load transfer unit and premolded fiber filler shall be sufficient to span two (2) dowel bar spacings. Where more than one (1) section is allowed and used in a joint, the sections shall be securely joined together.

e. Expansion joints in curb lanes with integral curb, the fiber filler used in the pavement shall extend completely through the curb section. The fiber filler placed in the curb above the slab shall be 1-inch (25 mm) in width.

f. During installation, the joint shall be held in place by an approved installing device which shall be securely staked. The top edge of the filler shall be protected, while the concrete is being placed, by a metal channel cap of at least 10-gage material having flanges not less than 1-1/2 inches (40 mm) in depth. The channel cap shall be shaped to the proposed crown of the pavement and shall extend over the full length of the filler.

6. Pressure Relief Joints (PR):

a. The method of constructing a pressure relief joint shall be as indicated on the Plans.

b. Pressure relief joint material shall be a flexible, low-density, expanded, extruded polyethylene plank. Joint material shall be cut off to 1/2 inch (10 mm) below the top of the pavement surface and shall extend entirely through and to within 1/2 inch (10 mm) of the face and top of the curb.

7. End of Pour Joints and Construction Joints:

a. End of pour joints in reinforced pavement shall be formed by placing a bulkhead and installing a load transfer device, as specified for contraction joints, except that the ends of the dowel bars shall not be lubricated. The load transfer device shall be so installed that each dowel bar will be embedded in the concrete for 1/2 of its length.

b. When the next pour is made, a space for hot-poured rubber joint filler shall be provided by placing temporary filler in the fresh concrete. End-of-pour joints shall be constructed using 2-piece dowels and a bulkhead and shall be placed where it is anticipated that three (3) days or more will elapse between the casting of adjacent pours.

c. Construction and end-of-pour joints shall be sealed as specified for transverse contraction joints.

d. End of pour joints in plain concrete pavements shall be formed by placing a bulkhead, fiber keyway, and installing 1/2 inch (10 mm) diameter deformed bars, 30 inches (75 mm) in length, at 18-inch (450 mm) intervals across the end of the pavement.

e. The pavement across the end of both slabs shall be thickened and the joint shall be edged and sealed.

8. Transverse joints in a concrete pavement shall extend entirely through the integral curb. The material used to construct the joint in the curb shall be of the same kind as provided for the pavement.

9. Bituminous fiber filler shall be used to construct the expansion joints in the integral curb of reinforced concrete pavements. The thickness of the fiber filler material in the curb above the gutter shall be 1-inch (25 mm). Joint material shall be precut so as to conform to the geometric shape and cross-sectional area of the curb, and shall be placed in intimate contact with the filler material in the pavement.

10. The edges of transverse joints in the integral curb shall be rounded with an approved finishing tool, having a radius of 1/4 inch (5 mm).

3.12 Consolidating and Finishing

A. The sequence of operations after the placing of concrete shall be: striking off and consolidating, floating, straightedging and finishing with burlap drag, edging and final finishing with burlap drag.

B. Mechanical methods shall be employed to strike off and consolidate or compact the concrete, except in gapped areas or where the pavement width will not permit the use of machine methods. Gaps less than 1 joint opening in length may be finished by hand methods, provided they are finished in single-lane widths.

C. Strike off, consolidate and compact the concrete to such an elevation that when all finishing operations are completed, the surface will conform to the required finished grade and cross section. At least 4 inches (100 mm) of concrete above the finished pavement grade shall be maintained ahead of the screed for its entire length. In consolidating the surface of the pavement, on residential street construction when a single screed finishing machine is used, it shall operate over each section of the pavement twice. Only sufficient mortar shall be worked to the surface to provide a dense smooth finish. Excessive operation of the machine over a given area will not be permitted. Segregated particles of coarse aggregate which may collect in front of the screed shall be thoroughly mixed by hand with the mass of concrete already on the subgrade.

D. If it is not possible to use mechanical equipment on irregular areas, an approved, self-propelled vibratory screed shall be employed to strike off and properly consolidate the concrete surface to the required finish grade. Where it is not possible to use a vibratory screed, a hand strike board of an approved design, will be permitted. The entire area of the pavement shall be consolidated to insure an absence of voids.

E. Strike-off boards shall be moved forward with a combined longitudinal and transverse motion, with neither end raised from the side forms during the process. A slight amount of excess concrete shall be kept in front of the front edge at all times. When striking off and consolidating by hand, pours will be limited to single lanes or 1/4 of intersections.

F. After striking off and consolidating, the surface shall be made uniform by longitudinal or transverse floating by a mechanical method unless the pavement is permitted to be constructed in single lane widths.

G. Where mechanical floating is an integral part of the operation of a slip-form paver, separate mechanical floating methods will not be required.

H. Mechanical longitudinal floating will not be required for residential street construction.

I. When mechanical equipment is not used for floating, a transverse float at least 10 feet (3 m) in length shall be operated across the pavement by starting at the edge and slowly moving to the center and back again to the edge. The float shall then be moved ahead 1/2 of its length and the operation repeated.

J. Care shall be taken to preserve the crown and cross section of the pavement. Float finishing operation shall not proceed until the concrete has attained a consistency so that no excess concrete is carried ahead of the float but the entire surface can be floated and sealed.

K. Immediately following the float finishes and while the concrete is still plastic, CONTRACTOR shall test the slab surface for trueness by means of a 10-foot (3 m) straightedge or acceptable float.

L. The straightedge shall be placed at the center of the slab with the blade parallel to the centerline and pulled slowly and uniformly to the edge. This operation shall be repeated until the surface of the concrete is free from irregularities and makes contact at all points with the bottom of the straightedge. The straightedge shall then be moved forward 1/2 its length and the operations repeated.

M. Depressions found in the surface shall be filled with fresh concrete and consolidated by floating with a long-handled float not less than 10 feet (3 m) in length. Float may also be used to smooth sections of the surface that may have become rough or torn by dragging with the straightedge.

N. For pavement constructed by the slip-form method, the edge settlement shall be determined as soon as practical after paving operations begin. Edge settlement in excess of 3/8 inch (9 mm) shall be corrected before the concrete has hardened. When edge settlements in excess of 1/4 inch (5 mm) persist, paving shall be suspended and operational corrections made before ENGINEER will permit the resumption of paving. If CONTRACTOR consistently fails to construct pavement within these tolerances, the use of slip-form methods shall be discontinued and pavement placed by means of conventional forms. When paving is accomplished by the slip-form paving method, all mortar paste shall be wiped from the sides of the slab.

O. The surface shall then be tested for smoothness with the straightedge. During this operation, the contact of the straightedge with the concrete shall be uniform over the entire length tested. At the time of testing, the surface shall be free from soft mortar or excessive water. The testing straightedge shall be used for this purpose only.

P. Where the float finisher method is not utilized, as soon as the hand floating is completed, all laitance, surplus water, and inert material shall be worked entirely off the pavement and the surface made smooth by dragging with a rigid straightedge 10 feet (3 m) in length and the surface shall be tested.

Q. As soon as all excessive moisture has disappeared and while it is still possible to produce a uniform surface of gritty texture, the pavement shall be finished by dragging a seamless strip of damp burlap or cotton fabric, not less than 5 feet (1.5 m) nor more than 6 feet (1.8 m) in width, over the full width of the pavement. Burlap or cotton drag shall be pulled by a bridge supported on a pavement forms. Fabric shall be renewed as often as necessary to obtain the required texture.

R. Immediately after the initial finishing with burlap, the edges of the slab and all specified joints shall be finished with an edging tool to the radii indicated on the Plans. Pavement shall then be given a final finish by dragging the damp burlap or cotton fabric over that portion of the pavement disturbed by the edging operation.

3.13 Surface Requirements

A. High spots in the surface, exceeding 1/8 inch (3 mm) from the straightedge but not more than 1/2 inch in 10 feet (10 mm in 3 m) shall be removed or reduced by rubbing with a carborundum brick and water until contact with coarse aggregate is made.

1. If contact with coarse aggregate is made before reaching an acceptable tolerance, such high spots shall be removed by an approved surface-grinding machine before acceptance of the pavement.

B. High spots in excess of 1/2 inch in 10 feet (10 mm in 3 m) will be evaluated by ENGINEER and if the Work is rejected, it shall be removed and replaced at CONTRACTOR's expense. CONTRACTOR shall take immediate steps to eliminate the cause of the defective surface.

3.14 Curing

A. After the finishing operations have been completed and immediately after the free water has left the surface, the surface of the slab shall be completely coated and sealed with a uniform layer of white membrane curing compound.

B. Compound shall be applied in a continuous uniform film by means of mechanically pumped pressure sprayer equipment at a rate of 1 gallon per 200 square feet (4 L per 20 m^2) of surface. Curing compound shall not be thinned. The equipment shall provide adequate stirring of the compound during application. Equipment for applying the compound must be on the Project and approved by ENGINEER before Work is started.

C. Hand-spray equipment will be permitted only for the application of the curing compound over the sides of the slab, and for any minor damaged areas. If rain falls on the newly coated pavement before the film has dried sufficiently to resist damage, or if the film is damaged in any other way, CONTRACTOR will be required to apply a new coat of material to the affected areas. The treated surface shall be protected by CONTRACTOR from injury for a period of at least 7 days. Traffic, either foot or otherwise, will be considered as injurious to the film of the applied compound. A minimum of foot traffic will be permitted on the dried film as necessary to properly carry on the Work including the removal of any high spots, provided any damage to the film is immediately repaired by the application of a second coat of the compound.

D. Immediately after the forms are removed, the entire area of the side of the slab shall be coated with the curing compound at the rate specified for the pavement surfacing.

E. CONTRACTOR shall provide on the Project sufficient burlap or polyethylene coverings for the protection of the pavement in case of rain or breakdown of the spray equipment. Failure to provide proper curing will be considered as sufficient cause for immediate suspension of the concreting operations.

3.15 Removal of Forms

A. Forms may be removed from freshly placed concrete after it has set for 12 hours, provided it can be done without damage to the pavement or curb edge.

1. If during form removal the pavement or curb edge is being damaged, the form removal shall cease until the concrete has attained greater strength.

2. The period of time for removing forms may be increased or decreased when approved by ENGINEER.

B. Immediately after removal of the forms, the ends of all joints shall be cleaned, and any visible areas of honeycomb or minor defects shall be filled with mortar, composed of 1-part Portland cement and 2 parts fine aggregate from the same source as used in the pavement, applied with a wooden float.

1. Immediate steps shall be taken by CONTRACTOR to correct the conditions contributing to these defects.

2. The sides of the pavement shall be sprayed with curing compound immediately upon removal of the forms, except where honeycombed areas are to be pointed, and them immediately cured.

C. Forms and pins shall not be placed on new pavement that is being cured with membrane.

3.16 Sawing Joints

A. General:

1. Contraction joints, longitudinal lane-tie joints with tie bars, and end of pour joints shall be sawed.

2. Joints shall be sawed before any traffic is permitted on the pavement. The concrete saw will be permitted on the pavement to saw the joints, but the water supply truck will not be permitted on the pavement until the compressive strength is not less than 3,000 psi (21 MPa). When permitted on the pavement, the water supply truck must be kept a minimum of 50 feet (15 m) behind the sawing operation. At least two (2) approved concrete saws shall be available for use at all times, and one saw shall be capable of sawing a joint groove 2-1/2 inches (65 mm) deep.

3. The saw cut for transverse end-of-pour joints shall be made to receive the joint sealing material.

4. Longitudinal lane-tie joints with the tie bars shall be sawed in accordance with the alignment and dimensions indicated on the Plans.

5. For joints formed in one operation, the joint groove shall be sawed before any transverse cracks develop. Raveling or spalling along the joint shall be repaired as specified in Article 3.17 of this Section.

B. Transverse contraction joints shall be sawed in two stages:

1. Stage 1 Sawing:

a. The first stage shall be a relief cut directly over the center of the load transfer assembly. The initial relief cut shall be made as soon as the saw can be placed on the freshly poured concrete, and the sawing shall continue as long as the pavement can support the saw without making or appreciably raveling of the joint.

b. When water is not used in the sawing operation, membrane curing compound shall be applied immediately.

c. When water is used in the sawing operation, the slurry resulting from the sawing operation shall be completely removed from the cut and from the immediate area by flushing with a jet of water. Additional membrane curing compound shall be applied within 12 hours after the relief cut has been made.

C. Stage 2 Sawing:

1. Second stage sawing of joints shall not start until the concrete has cured for a minimum of 48 hours. The joint groove shall be centered over the relief cut and sawed to the specified dimensions shown on the Plans plus any increase in width of the relief cut due to shrinkage or contraction. The groove width tolerance shall be ± 1/16 inch (2 mm).

2. Joints sawed without the use of water shall be blown clean of all foreign material by a jet of compressed air.

3. If water was used in the sawing operation, the slurry resulting from the sawing operation shall be completely removed from the groove and the immediate area by flushing with a jet of water and then blown dry with compressed air.

4. Transverse joint grooves shall receive a final cleaning with a jet of compressed air adequate to remove all foreign material, just prior to permanent sealing.

5. If the specified seal is not installed within seven days of final sawing, the joint groove shall be temporarily sealed with a suitable material or device to prevent the infiltration of foreign material.

6. Traffic shall not be permitted over the full width joint grooves prior to the installation of either the permanent seal or temporary seal.

3.17 Patching Joints

A. General:

1. After the joints have been sawed and cleaned, they shall be inspected for spalls and voids.

2. Loose, unsound or damaged concrete shall be removed to the satisfaction of ENGINEER.

3. Spalls and voids will be classified as minor, intermediate or major spalls and shall be repaired accordingly.

B. Minor Spalls:

1. Spalls or voids which have increased the specified size of the joint groove beyond any of the following limits, but less than 36 square inches (250 cm^2), shall be repaired by patching with an approved epoxy mortar before the seal is installed.

2. Spalls which extend more than 1/4 inch (5 mm) from the joint face and over 1/2 inch (10 mm) below the surface of the pavement.

3. Spalls which extend more than 1/4 inch (5 mm) from the joint face and two (2) inches (50 mm) or more in length, regardless of the depth of spall below the surface of the pavement. Void areas larger than 1/2 inch (10 mm) in diameter in the upper 1-inch (25 mm) of the joint face or larger than 1-inch (25 mm) in diameter regardless of location.

4. Spalled concrete surface shall be thoroughly cleaned by sandblasting, power-wire brushing, or hand-wire brushing. The patch area shall then be blown clean with a jet of compressed air. A heavy polyethylene sheet or a rigid material shall be inserted into the joint groove and held tightly against the joint face that is to be patched.

5. Concrete shall be clean and dry when the epoxy resin mortar is placed. The surface shall be made free of frost by heating with a clean source of heat, approved by ENGINEER, until dry. Care shall be taken not to damage the concrete by heating.

6. Epoxy binder will be a mixture of 2 parts epoxy resin to 1 part curing agent by volume, or as approved by ENGINEER.

7. Epoxy resin compound shall be mixed in a clean metal or polyethylene container with approved stirrer operating at 250 to 500 rpm. While the epoxy resin is being mixed, the curing agent compound shall be gradually added. The mixture shall then be stirred for a minimum of 3 minutes until it is uniform.

8. After the epoxy binder is thoroughly mixed, a small portion shall be reserved for priming. The dry 2MS sand shall be uniformly blended into the balance of the mixture to give an epoxy mortar of stiff or trowellable consistency. One part of mixed binder to about 3.5 parts of dry sand, by volume, will usually give a workable mix.

9. Spalled surface shall be primed with the freshly mixed epoxy binder scrubbed into the surface with a suitable applicator to insure complete wetting and coverage of all areas to which the epoxy mortar must bond.

10. Immediately after priming, the epoxy mortar shall be placed in the spalled area and finished to the shape of the original pavement surface. If the bond coat is not tacky when the mortar is placed, a second application shall be made. The edge of the patch shall conform with the rest of the joint groove. Dry 2NS sand shall be sprinkled onto the fresh epoxy mortar surface to eliminate any gloss. After the epoxy mortar has cured sufficiently so that it will not be damaged during sealing operations, the polyethylene insert shall be carefully removed. Joints shall receive a final cleaning with a jet of compressed air to remove al foreign material.

11. When the temperature of the air and the pavement is above 50 degrees Fahrenheit (10° Celsius), the hot poured elastic type joint seal may be placed on the day following the placing of the epoxy resin mortar patch. When the temperature of the air and the concrete is below 50 degrees Fahrenheit (10° Celsius), the time of curing required for the epoxy mortar shall be as determined by ENGINEER.

C. Intermediate Spalls:

1. Spalls larger than 36 square inches (250 cm^2), but not extending below the reinforcing mat, shall be repaired by sawing and chiseling out the unsound concrete and patching with Portland cement mortar.

2. A saw cut at least 1-inch (25 mm) deep shall be made parallel to the joint groove at the outer extremity of the spalled area. The concrete shall be chipped out to the saw cut so that a vertical face is present at the back of the repair area, and the two ends of the repair area shall be trimmed to approximately vertical faces.

3. The area to be repaired shall be sandblasted to remove all loose particles and then blown clean with a jet of compressed air to remove the sand and all other foreign materials. The repair area shall be flushed with clean water and the excess water shall be blown out with compressed air.

4. A heavy polyethylene sheet or a rigid material shall be inserted into the joint groove and held tightly against the joint face that is to be patched.

5. The bottom and vertical faces of the repair area shall be primed with a grout of creamy consistency made with a 1:1 mixture of Portland cement and 2NS sand with water.

6. Prime coat will be scrubbed into the surface with a suitable applicator to insure complete wetting and coverage of all areas to which the Portland cement mortar must bond. Cement grout shall be carefully applied to the rough surfaces of the spall area and shall be applied immediately prior to placing of fresh mortar so that the prime coat is wet when covered by mortar.

7. Portland cement patching material shall be tamped into the repair area and finished level to the pavement surface. Portland cement mortar shall consist of 1-part Portland cement 2 parts 2NS sand with a water content of not more than four (4) gallons per sack of cement (35 L per 100 kg of cement). A liquid air-entraining agent to maintain an air content of 8% to 11% shall be added. Calcium chloride in an amount of 1 percent of the cement content may be added as an accelerator, if approved by ENGINEER.

8. The edge of the patch at the joint face shall conform with the rest of the joint groove.

9. White membrane curing compound shall be sprayed on the patch surface immediately after the mortar is cast and finished. After 72 hours the polyethylene form shall be carefully removed and all patched joints shall receive a final cleaning with a jet of compressed air to remove all foreign material.

D. Major Spalls:

1. When a joint is damaged beneath the depth of the reinforcing mat, it shall be considered a major repair. These major repairs shall be handled on an individual basis under the direction of ENGINEER.

3.18 Sealing Joints

A. Transverse expansion, contraction, construction, and longitudinal bulkhead construction joints shall be filled and sealed with an approved hot-poured elastic type compound.

B. Longitudinal lane-tie joints shall be pressure filled and sealed with either an approved hot-poured or cold-applied elastic type compound. These sealing compounds shall not be placed when the atmospheric or pavement temperatures are less than 50° Fahrenheit (10° Celsius) or when the weather is rainy or foggy.

C. After the shoulders are completed and the pavement has cured, the joints and pavement surfaces on each side of the joints shall be cleaned of extraneous matter. The cleaning shall be done by sandblasting or other methods approved by ENGINEER that will be equally effective in cleaning the concrete. The dust and sand present after the sandblasting or cleaning shall be removed by a jet of compressed air. Hand tools shall be used to remove stones and other foreign materials from the joint groove.

D. Immediately after the joints are cleaned with the compressed air, and with the surface of the concrete in the joint dry, the joint shall be sealed with an approved hot-poured elastic type compound.

E. The hot-poured compound shall be melted in an approved double boiler type kettle. Direct heating will not be permitted. Also, any sealing material heated in excess of the safe heating temperature shall not be used in the Work.

F. During the process of pouring the joints, ENGINEER may, at his discretion, require that sufficient compound be taken from the melting unit to make flow tests. ENGINEER may require CONTRACTOR to modify his method of heating or of charging the heating unit with compound that will produce satisfactory results.

G. Pouring shall be from the melting kettle equipped with an approved pressure pump hose and nozzle. When authorized by ENGINEER, the sealing compound may be poured with a hand-type pouring pot for curbs and short miscellaneous joint lengths, provided a satisfactory joint is obtained.

H. Pouring of the sealing compound shall be done so as to fill the joint to 1/4 inch (5 mm) below top of pavement. Sealing compound spilled on the surface of the pavement shall be removed immediately. After the first pour has cooled to the temperature of the pavement and settled, a second pour shall be made to bring the sealing compound to 1/4 inch (5 mm) of the surface of the pavement. Traffic shall not be permitted over the poured joint until the compound has hardened sufficiently to resist pickup.

I. Longitudinal lane-tie joints shall be cleaned and immediately filled with either an approved hot-poured or cold-applied elastic type compound. Sealing compounds shall be applied with pressure equipment, capable of completely filling the joint.

J. To protect hot-poured and cold-applied sealing compound while it is curing and to prevent pickup by traffic, the sealed joint shall be covered with a strip of paper, 1-1/2 inches (40 mm) wide, or other approved means, immediately following application of the compound. The paper strip shall be left in place until worn off by traffic.

3.19 Traffic Control

A. Provide all measures necessary to protect and maintain traffic and to protect the Work in accordance with Section 01 5000, Temporary Facilities Controls, and with the Michigan Manual of Uniform Traffic Control Devices (M.M.U.T.C.D.).

3.20 Protection against Rain

A. CONTRACTOR shall adequately protect the new concrete from the effects of rain before the concrete has sufficiently hardened.

1. For this Work, CONTRACTOR shall have available on the job site at all times enough burlap or 6-mil (150 μm) thick polyethylene film to cover and protect one day's Work.

B. When rain appears eminent, all operations shall stop and personnel shall begin covering. As soon as the rain ceases, the concrete shall be uncovered and the surface burlap dragged where necessary.

C. Curing compound shall be applied to any areas where the compound has been disturbed or washed away. Protection of the new concrete against rain shall be at CONTRACTOR's expense.

3.21 Cold Weather Protection

A. Any time there is a danger of freezing temperatures, CONTRACTOR shall have available on-site a sufficient amount of clean, dry straw or hay or polyethylene film or other approved materials to cover at least 1 day's production. Cold weather protection shall be at CONTRACTOR's expense.

B. The source of the temperature shall be taken from forecasts prepared by the local weather bureau, recognized as the Official Weather Bureau for the area the new Work is being constructed. The predicted low temperature shall be that forecast to occur during the next 24 hours.

C. Frozen material shall not be charged into the mixer at any time.

D. Frost or ice shall be removed from the forms and any steel used in the pavement, prior to placing concrete.

E. Concrete shall not be placed directly upon a frozen subgrade. The subgrade shall be covered with a layer of straw or hay 12 inches (300 mm) in thickness to protect it against freezing. The straw or hay shall be removed from the finished subgrade immediately ahead of paving operations and piled along the line of construction for use in covering the finished pavement. Prior to the placing of concrete, the subgrade shall be cleaned of loose straw and otherwise prepared in a manner satisfactory to ENGINEER. Other covering materials as approved by ENGINEER may be used to prevent subgrade freezing.

F. To accelerate hardening of the concrete when the temperature of the air in the shade and away from artificial heat is between 45 and 40 degrees Fahrenheit (7° to 4° Celsius), calcium chloride shall be added to the mix at the rate approved by ENGINEER. The calcium chloride shall be spread on the materials immediately before discharging into the drum of the mixer. A method approved by ENGINEER, shall be used for measuring the amount of dry calcium chloride to be added to each batch of concrete. The calcium chloride shall not be placed in contact with the cement.

G. Immediately after finishing of the concrete and as soon as hardening of the concrete will permit, the pavement shall be covered and the protective covering shall remain in place until the concrete has developed a compressive strength of not less than 3,000 pounds per square inch (21 MPa) or for a minimum period of 14 days or as approved by ENGINEER.

H. The protective covering shall be placed around and over the forms and it shall extend beyond the edge of the pavement for a distance at least equal to the depth of covering required.

I. When removing forms, the protective covering should be removed for as short a time as possible and should be replaced promptly to prevent loss of heat.

J. The mixing and placing of concrete shall stop in sufficient time each day to permit finishing of the concrete and the placing of the required protective covering during daylight hours.

K. The requirements specified herein for the curing and protection of concrete in cold weather are minimum requirements, and CONTRACTOR shall be responsible for the quality and strength of the concrete placed. Concrete damaged by frost action shall be removed and replaced at CONTRACTOR's expense.

L. Between October 15 and May 15, when the predicted low temperature is to be below 35 degrees Fahrenheit (2° Celsius) at any time within 72 hours after placing the pavement, the pavement shall be protected and such protective covering shall remain in place until the concrete has developed a compressive strength of not less than 3,000 psi. (21 MPa), or for a minimum period of 14 days, unless otherwise authorized by ENGINEER.

M. Special Protection:

1. No pavement may be placed between October 15 and May 15, unless it is specifically provided for in the Contract Documents, or authorized by ENGINEER, except that in no case shall concrete be placed when the predicted high temperature is to be below 35 degrees Fahrenheit (2° Celsius), without written permission of ENGINEER. When paving is permitted during the period, the following requirements shall apply:

2. The temperature of the concrete at the time it is placed on the subgrade shall be not less than 50 degrees Fahrenheit (10° Celsius), nor more than 85 degrees Fahrenheit (30° Celsius).

3. In order to maintain a mix temperature between 50 degrees Fahrenheit (10° Celsius) and 85 degrees Fahrenheit (30° Celsius) the mixing water or the aggregates, or both, shall be heated as required by ENGINEER. The water and the aggregates shall be heated to a temperature of not more than 150 degrees Fahrenheit (65° Celsius). The heating of aggregates shall be done by the use of steam pipe under the aggregate piles, or by free steam discharged into the aggregate piles, or by steam pipe in the batching bins. The heating of the water and the aggregates shall be controlled so that there will not be any large differences in temperature from batch-to-batch.

4. When there is any danger of the predicted low temperature dropping below 35 degrees Fahrenheit (2° Celsius) all the necessary materials for covering and protecting the concrete, equipment for heating the water and aggregates, when required, and calcium chloride shall be on the Project and available for immediate use for the required method of curing and cold weather protection before any pavement is placed.

5. For predicted low temperatures from 35 to 25 degrees Fahrenheit (2 to -4° C) either 1-layer of waterproof paper blankets or 1-foot (300 mm) of loose dry straw or hay shall be placed.

6. For predicted low temperatures of 20 to 25 degrees Fahrenheit (-7 to -4° Celsius) 1-layer of waterproof paper blankets and 1-foot (300 mm) of loose dry straw or hay shall be placed.

7. For predicted low temperatures less than 20 degrees Fahrenheit (-7° Celsius) the minimum requirement for cold weather protection will be 1-layer of waterproof paper blankets and 1-foot (300 mm) of loose dry straw or hay overlayed with a waterproof protective covering consisting of tarpaulins, paper blankets, polyethylene sheeting or other approved material.

N. When temperature are such that special protection is required as specified above, all concrete placed within the proceeding 72 hours shall be similarly protected.

O. When special protection is started, it shall be continued until design strength is reached in accordance with the above requirements unless warmer temperatures prevail for a period of at least 48 hours. Permission to eliminate special protection for such a period shall be as approved by ENGINEER.

P. Protection of the new concrete against cold weather including ordinary and special protection shall be at CONTRACTOR's expense.

3.22 Concrete Temperature Limitations

A. Concrete shall not be placed when the temperature of the concrete at the point of placement is above 90 degrees Fahrenheit (32°Celsius).

3.23 Curb Drop

A. Curb drops shall be provided for existing and future sidewalk ramps, for approaches for existing driveways and at other locations as determined by ENGINEER.

B. Curb drops for sidewalks shall be in accordance with the current rules and regulations of Act 8, Michigan PA 1973, as amended. Curb drops for drive approaches shall be centered with the existing driveway at the property line.

C. Width of the residential curb drop shall be equal to the width of the driveway determined at the property line plus four feet. Unless otherwise approved by ENGINEER, the minimum width of the residential curb drop shall be 14 feet (4.5 m).

3.24 Shoulders

A. Shoulders shall be constructed according to the lines, grades, and cross section shown on the Plans and as specified for the particular type of shoulder material required. Shoulders shall be done in such sequence with the surfacing operations that they will be completed not more than seven (7) days after the expiration of the curing period, unless otherwise directed by ENGINEER.

B. Aggregate shoulders, when called for, shall be constructed according to the requirements specified under Section 32 1123, Aggregate Base Courses.

3.25 Cleanup

A. After the concrete has gained sufficient strength, but no sooner than within 12 hours, the fixed forms shall be removed and the spaces on both sides shall be immediately backfilled with sound earth of topsoil quality.

B. Backfill shall be compacted, leveled and left in a neat, workmanlike condition.

C. At a seasonally correct time approved by ENGINEER, the disturbed area shall be raked, have topsoil placed thereon, fertilized and seeded per the requirements of Section 32 9219, Seeding, or sodded in accordance with Section 329223, Sodding.

3.26 Opening Pavement

A. ENGINEER reserves the right to require that curing operations be discontinued when the concrete has reached 85% of the design strength, and to require that the shoulders be completed and the slab be opened to traffic.

3.27 Monument Boxes

A. Government, plat, and street intersection monuments within existing or proposed pavement shall be preserved by enclosing in standard monument boxes. Monument box castings shall be furnishing and installed by CONTRACTOR.

B. Existing monument boxes shall be adjusted to meet the proposed pavement elevation by removing the castings and resetting to the required elevation.

C. Support for the monument box shall be concrete bedding, so constructed as to hold them firmly in place.

D. The adjacent pavement, curb, or curb and gutter shall be replaced to the new elevation, condition and kind of construction, unless otherwise provided.

3.28 Testing

A. During the course of the Work, ENGINEER may require the taking of standard test scores and cylinders, by a testing laboratory acceptable to OWNER and approved by ENGINEER. Cost of testing and coring shall be at the expense of OWNER.

B. For each lane of Work:

1. A minimum of one (1) cylinder for testing compressive strength shall be made for each 500 linear feet (150 m), or fraction thereof, or as determined by ENGINEER.

2. A minimum of two (2) cores for testing compressive strength and for checking thickness shall be drilled each 500 feet (150 m), or fraction thereof.

3. The making of cylinders, the drilling of cores and testing shall be at the expense of OWNER.

C. Slump tests for consistency of Portland cement concrete shall be made in accordance with ASTM C143 and C172.

D. In the event the test results on a core indicates a deficiency in either thickness or compressive strength or in the event the test results on a cylinder indicates a deficiency in compressive strength, the following adjustments in the unit price for concrete shall be made based on the average of 3 cores:

Thickness	
Under Required Thickness	**Percent of Reduction in Unit Price**
0" to 1/4"	None
by more than a 1/4", but not exceeding a ½"	20
by more than a 1/2", but not exceeding 1"	50
by more than 1"	Remove & Replace

Comprehensive Strength	
Under Required Compressive Strength	**Percent of Reduction in Unit Price**
0 to 150 psi (0 to 1 MPa)	None
by more than 150 psi, but not exceeding 300 psi (1 MPa to 2 MPa)	20
by more than 300 psi, but not exceeding 500 psi (2 MPa to 3.5 MPa)	50
by more than 500 psi (Greater than 3.5 MPa)	Remove & Replace

E. Reduction in the unit price are additive, that is if an area is deficient by 3/8 of an inch (9 mm) and is under strength by 200 psi (1.4 MPa), the total reduction is 20% plus 20% or a reduction of 40%.

F. The area of a deficient core shall be determined by the drilling and testing of two (2) additional cores, one (1) on each side of the deficient core and 20 feet (6 m) from it, when possible.

G. The extra core drilling and testing shall be at CONTRACTOR's expense.

End of Section

Section 32 1500
Aggregate Surfacing

Part 1 General

1.01 Scope of Work

A. This section includes the requirements for constructing aggregate surfacing.

1.02 Related Work Specified Elsewhere

A. Section 01 2200: Unit Prices
B. Section 01 8900: Site Construction Performance Requirements
C. Section 31 2313: Subgrade Preparation
D. Section 32 1313: Concrete Paving
E. Section 32 9219: Seeding

1.03 Reference Standards

A. Unless otherwise specified, the Work for this Section shall conform to the applicable portions of the following Standard Specifications:

1. ASTM – American Society of Testing and Materials

2. AASHTO – American Association of State Highways and Transportation Officials

3. MDOT – Michigan Department of Transportation, Standard Specifications for Construction, latest edition

1.04 Allowable Tolerances

A. The finished surface shall be shaped to conform to plan grade and cross section within a tolerance of 3/4 inch in 10 feet (30 mm per 5 m).

1.05 Test Reports

A. Testing lab shall provide ENGINEER with 2 certified copies of the test results of the thickness of the compacted aggregate. Core drilling, testing for thickness and certification of the test results shall be performed by a testing laboratory approved by ENGINEER.

1.06 Stockpiling Aggregate

A. Aggregate shall be deposited in stockpiles in such a manner that the material may be removed from the stockpile by methods which will provide aggregate having a uniform gradation.

B. Stockpiling of aggregate, in excess of 4 feet (1.2 m) in depth, on the completed subbase or aggregate surface will not be permitted, except with the approval of ENGINEER.

1.07 Environmental Requirements

A. Comply with the requirements for aggregate base or surfacing installations due to outside ambient air temperatures specified under Article 3.10 of this Section.

Part 2 Products

2.01 Dense-Graded Aggregate

A. The dense-graded aggregate gradation shall conform to dense-graded aggregate, Series 22 and 23 as specified in MDOT Section 902.

2.02 Calcium Chloride Additives

A. The calcium chloride additives shall conform to ASTM D98 and as specified in MDOT Section 903.

2.03 Water

A. Water used for compaction and dust control shall be reasonably clean and free from substances injurious to the finished product. Water from sources approved by the Michigan State Department of Public Health as potable may be used.

Part 3 Execution

3.01 Excavation Verification

A. Prior to the placing of any aggregate material, examine the excavation for the grades, lines, and levels required to receive the new Work. Ascertain that excavation and compacted subgrades or subbases are adequate to receive the new Work. Correct defects and deficiencies before proceeding with the Work.

3.02 Subgrade Conditions

A. Prior to the placing of any aggregate material, examine the subgrade or subbase to ascertain that it is adequate to receive the aggregate to be placed. If the subgrade or subbase remains wet after all surface water has been removed, ENGINEER may require the installation of edge drain.

3.03 Existing Base

A. Prior to the placing of any aggregate material for surfacing, examine the existing base for grade and condition to receive the new Work. Ascertain that the base is adequately compacted to receive the aggregate surfacing to be installed. Correct defects and deficiencies before proceeding with the Work.

3.04 Existing Improvements

A. Investigate and verify locations of existing improvements, including structures, to which the new Work will be in contact.

B. Necessary adjustments in line and grade, to align the new Work with the existing improvements must be approved by ENGINEER, prior to any changes.

3.05 Preparation of Subgrade or Subbase

A. Subgrade or subbase shall be fine graded to the cross section indicated on the Plans, and shall be thoroughly compacted prior to the placing of the aggregate material.

3.06 Installation - General

A. Width, thickness, and type of aggregate materials shall be indicated on the Plans or as directed by ENGINEER.

B. No aggregate material shall be placed until the subgrade, or subbase, or existing aggregate surface has been approved by ENGINEER.

3.07 Aggregate Surface Course

A. Where the base for the new aggregate surface course is an existing aggregate surface, the existing surfacing, shall be either graded or scarified and graded to remove irregularities and to provide a bond between the old and new surfaces.

B. Aggregate surface course shall be placed by a mechanical spreader or other approved means, in uniform layers to such a depth that when compacted, the course will have the thickness shown on the Plans.

C. Depth of the surface course, when compacted, shall not exceed 6 inches (150 mm), unless otherwise specified on the Plans or directed by ENGINEER. Aggregate shall be of a uniform mixture when placed on the prepared base. It shall be uniformly spread and then trimmed with a road grader, trimmer or other approved means until the surface is free from waves and irregularities. Trimming shall be alternated by rolling with a pneumatic-tired or tamping type roller. The entire operation shall continue until the surface course is compacted to at least 95% of maximum unit weight.

D. When the operation is completed, the surface course shall conform to the required lines, grades and cross sections.

E. Optimum moisture content shall be maintained until the prescribed unit weight is obtained and each layer shall be compacted until the maximum unit weight is attained before placing the succeeding layer.

F. When approved by ENGINEER, additional water may be applied by an approved means, to the aggregate to aid in the compaction and shaping of the material.

G. With the approval of ENGINEER, chloride additives may be used by CONTRACTOR to facilitate his compaction and maintenance of the aggregate surface. Amount and method of combining the chloride additives are at the option of CONTRACTOR and are at his expense.

3.08 Aggregate Shoulders and Approaches

A. Construction of shoulders and approaches shall be of the material, width and depth as shown on the Plans.

B. When shoulders and approaches are specified by class, they shall conform to MDOT Section 307 for shoulders and approaches specified as: Class I, Class II, Class III or Class IV.

C. The subgrade for the shoulders and approaches shall be graded to an elevation below the finished surface that will permit the placing of the specified thickness of materials.

D. The subgrade of shoulders and approaches shall be approved by ENGINEER prior to the placing of aggregate.

E. The aggregate shall be placed on the prepared subgrade by a mechanical spreader or other approved means, to a depth of not more than 5 inches (125 mm). If the specified thickness exceeds 5 inches (125 mm), the shoulder or approach shall be constructed in two or more courses.

F. Dumping the aggregate on the road surface and grading it onto the shoulder or approach will not be permitted.

G. The aggregate shall be compacted to not less than 100% of the maximum unit weight for the first 5 feet (1.5 m) outside of the pavement edge and 98% of the maximum unit weight for the remainder of the area. When the operation is completed, the surface course shall conform to the required lines, grades and cross sections.

H. On resurfacing projects, the existing aggregate shoulder or approach shall be scarified prior to the placing of new aggregate materials. The placement of aggregate shall proceed the placing of the top course of bituminous mixture on the adjoining pavement. Final shaping and compaction of the shoulder or approach shall follow the placement of the top course of bituminous mixture unless otherwise directed by ENGINEER.

I. The optimum moisture content shall be maintained until the prescribed unit weight is obtained and each layer shall be compacted until the maximum unit weight is attained before placing the succeeding layer.

J. When approved by ENGINEER, additional water may be applied by an approved means, to the aggregate to aid in the compaction and shaping of the material.

K. With the approval of ENGINEER, chloride additives may be used by CONTRACTOR to facilitate his compaction and maintenance of the aggregate surface. Amount and method of combining the chloride additives are at the option of CONTRACTOR and are at his expense.

3.09 Maintenance During Construction

A. Aggregate surface shall be continuously maintained in a smooth and firm condition during all phases of the construction operation.

B. CONTRACTOR, at his expense, shall provide additional materials needed to fill depressions or bind the aggregate.

3.10 Temperature Limitations

A. Aggregate materials shall not be placed when there are indications that the mixtures may become frozen before the maximum unit weight is obtained.

B. In no case shall the aggregate be placed on a frozen subgrade or base course unless otherwise directed by ENGINEER.

3.11 Cleanup

A. Immediately following the compacting of the surface course, the voids on both sides of the aggregate course shall be backfilled with sound earth of topsoil quality.

B. The backfill shall be compacted, leveled and left in a neat, workmanlike condition.

C. At a seasonally correct time approved by NGINEER, the disturbed area shall be raked, have topsoil placed thereon, fertilized and seeded per the requirements of Section 32 9219, Seeding or sodded in accordance with Section 32 9223, Sodding.

3.12 Opening Aggregate Surfaced Roads

A. ENGINEER reserves the right to open the aggregate surfacing to traffic at any time during construction.

3.13 Monument Boxes

A. All government, plat, and street intersection monuments within existing or proposed pavement shall be preserved by enclosing in standard monument boxes. Monument box castings shall be furnished and installed by CONTRACTOR and shall be East Jordan Iron Works No. 1570, or approved equal.

B. Existing monument boxes shall be adjusted to meet the proposed pavement elevation by removing the castings and resetting to the required elevation. Support for the monument box shall be concrete bedding, so constructed as to hold them firmly in place. Adjacent pavement, curb, or curb and gutter shall be replaced to the new elevation, condition, and kind of construction, unless otherwise provided.

3.14 Testing

A. During the course of the Work, the ENGINEER may require testing for compaction or density and for thickness of material. Testing and coring required shall be performed by a testing laboratory acceptable to OWNER and approved by ENGINEER. The cost for testing and coring shall be at the expense of OWNER.

B. When thickness tests are done, a minimum of one depth (thickness) measurement will be made every 400 linear feet (120 m) per traffic lane. The lane width shall be as indicated on the Plans or as determined by ENGINEER. If 2 lanes are constructed simultaneously, only one test is necessary to represent both lanes. For areas such as intersections, entrances, cross-overs, ramps, widening strips, acceleration and deceleration lane, at least one depth measurement will be taken for each 1,200 square yards (1000 m^2) of such areas or fraction thereof. The location of the depth measurement will be at the discretion of ENGINEER.

C. The maximum unit weight when used as a measure of compaction or density of soils shall be understood to mean the maximum unit weight per cubic foot (or cubic meter) as determined by ASTM D1557, Method D.

3.15 Defective Work

A. Thickness:

1. Measurements of aggregate base and/or surface course thickness will be made to the nearest 1/4 inch (5 mm). Depths may be 1/2 inch (10 mm) less than the thickness indicated on the Plans provided that the average of all measurements taken at regular intervals shall be equal to or greater than the specified thickness. In determining the average in place thickness, measurements which are more than 1/2 inch (10 mm) in excess of the thickness indicated on the Plans will be considered as the specified thickness plus 1/2 inch (10 mm).

2. Locations of the depth measurements will be as specified herein unless otherwise directed by ENGINEER. Sections found to be deficient in depth shall be corrected by CONTRACTOR using methods approved by ENGINEER.

B. Weight:

1. When the aggregate material is measured by weight in Tons (or metric tons), the pay weights for aggregates will be the scale weight of the material, including admixtures, unless the moisture content is more than 6 percent.

2. Moisture tests will be made at the start of weighing operations and at any time thereafter when construction operations, weather conditions or any other cause may result in a change in the moisture content of the material.

3. If the tests indicate a moisture content in excess of 6 percent, the excess over 6 percent will be deducted from the scale weight of the aggregate until such time as moisture tests indicate that the moisture content of the material is not more than 6 percent.

End of Section

Section 32 9219
Seeding

Part 1 General

1.01 Scope of Work

A. This Section includes seeding complete with earth bed preparation, providing and placing topsoil, preparation and fertilizing topsoil, sowing of seed for lawns and other ground cover, protection of seeded areas, watering of seeded areas, mowing of seeded areas, protection and cleanup.

1.02 Related Work Specified Elsewhere

A. Section 01 2200: Unit Prices
B. Section 01 8900: Site Construction Preparation Requirements
C. Section 31 2200: Grading

1.03 Requirements of Regulatory Agencies

A. Comply with the applicable requirements of the Michigan Department of Agriculture, Pesticide and Plant Pest Management Division, Michigan Seed Law, Act 329, PA of 1965, as amended.

B. Comply with the applicable requirements of the Proceedings of the Association of Official Seed Analysts, Rules for Testing Seeds.

C. Chemical fertilizer shall be supplied in suitable bags with the net weight of the contents and guaranteed analysis shown on the container. Bulk shipments shall be accompanied by an analysis and net weight certification of the shipment. Custom mixed fertilizers shall be accompanied by a certification of the weight of each commercial fertilizer used in the mixture and a guaranteed analysis of each shipment expressed in percentages of total Nitrogen (N), total available Phosphoric Acid (P_2O_5) and total available Potash (K_2O) included.

1.04 Source Quality Control

A. A seed mixture proposed for use in the Work shall have been tested for purity and germination by the Seed Producer within nine (9) months of sowing.

1.05 Reference Standards

A. ASTM - American Society for Testing and Materials

B. MDOT - Michigan Department of Transportation, Standard Specifications for Construction, latest edition

1.06 Submittals

A. Submit Seed Producers Certification that seed meets the requirements of these Specifications and conform to the State of Michigan Seed Act referenced above under Article 1.03 of this Section.

B. Where required, submit test reports for all seed proposed for use in the Work to ENGINEER, showing results of purity and germination tests, compliance with regulatory agencies, dates and location of tests.

1.07 Product Delivery, Storage, and Handling

A. Material shall be delivered to the Project site in their original, unopened containers. Containers shall be clearly marked showing, name of manufacturer, brand name, trade name or generic name of material, warranty of analysis, net weight of contents and date of packaging, where applicable.

B. Seed shall be delivered to the site in durable bags, tagged or labeled to show date of tests, warranty of purity and germination analysis, name, lot number and net weight of contents.

C. Commercial fertilizers shall be delivered to the site of the Work in the original unopened bags. Bags shall not exceed 100 pounds (45 kg) net weight each and shall be clearly marked with guaranteed analysis in a conspicuous location on each bag.

D. Material shall be stored at the Project site, under shelter, off the ground and shall be protected from damage by moisture, temperature, exposure to elements, vandalism or other action which might otherwise impair their use.

E. Materials proposed for use in the Work shall be handled in a manner that will protect the material and the personnel involved in the Work. Handle seed in a manner which will protect the mixture from contamination or deterioration.

1.08 Environmental Requirements

A. Seeding is limited to the periods between April 20 and June 1, August 10 to October 1 and after November 20 for as long as weather permits preparation of the seed bed without irrigation and/or mulch. With the use of irrigation and/or mulch, seeding can be done from April 20 thru October 1 inclusively.

B. Comply with the limitations placed on the use of certain soil protection materials because of prevailing temperatures as described in this Section.

C. Comply with the limitation placed on seeding applications because of wind velocity as described-in this Section.

1.09 Protection

A. Provide suitably approved warning signs and barricades for protection of seeded areas from pedestrian or vehicular traffic. Protect all newly seeded areas during the progress of the Work and until completion of the turf establishment period.

B. Protect all adjacent construction from topsoil spills and perform such cleanup of affected surfaces before it becomes compacted by traffic.

1.10 Final Acceptance

A. CONTRACTOR shall establish a dense cover of seeded grass on disturbed areas.

B. These areas shall be maintained until final acceptance of the Work by ENGINEER.

C. ENGINEER will inspect the turf to insure that the grass seed is well established, weed free, in a growing and vigorous condition.

D. Areas that do not meet the approval of ENGINEER shall be re-seeded at CONTRACTOR's expense.

Part 2 Products

2.01 Seed

A. Seed and seeding mixtures shall be certified, mature, clean, dry, new crop seed products suitable for the specified applications and having the percentages of purity, germination and proportions, by weight, indicated in Table 1.

Table 1 - Seeding Mixtures

	Seeds		Mixture Proportions (%)			
Kind	Purity	Germination	TDS	TUF	TGM	THM
Kentucky Blue Grass	98%	80%	5	10	10	30
Perennial Rye Grass	96%	85%	25	20	20	20
Hard Fescue	97%	85%	25	20	30	
Creeping Red Fescue	97%	85%	45	40	40	50
Fults Salt Grass	98%	85%*		10		

Table 2 – Soil Types and Location of Seeding

Symbol for Turf Seed Mixture	Soil Type	General Location	Rate of Seeding lbs/ac (kg/ha)
TDS	Dry Sandy to Sand Loam	Rural or Urban	250 (280)
TUF	All Types	Freeway, Blvds, Streets	250 (280)
TGM	Medium to Heavy	All	250 (280)
THM	Loamy to Heavy	Home and Business Turf	250 (280)

B. The specific mixture to be used shall be for the type of soil on the Project and the location of the seeding unless otherwise indicated on the Plans or as designated by ENGINEER.

C. Hydroseeding shall consist of a blend of seed, fertilizer and hydromulch.

2.02 Mulching Material

A. Straw:

1. Small grain straw or grass or marsh hay acceptable to ENGINEER.

B. Wood Excelsior:

1. Green wood fibers, baled or blanket of type and manufacture acceptable to ENGINEER.

2. Wood excelsior shall be made of green timber fiber baled so that the bales weigh 80 to 90 pounds at the time of manufacture.

3. Wood excelsior blankets shall be made of a uniform web of interlocking fibers with a backing of fabric netting on one (1) side only. The fabric net shall have a mesh size not exceeding 1-1/2" x 3" (40 mm x 75 mm) and shall be a woven of either cotton cord, twisted paper cord or a synthetic, biodegradable fiber. Blankets shall be produced in the form of a tightly compressed roll 36 inches ± 1-inch (900m m ± 25 mm) wide and approximately 120 feet (36 m) long. Blanket shall have a fiber net on the outside of the fiber mat. Blanket roll weight, when manufactured, shall average 85 pounds (38 kg) ± 10%. Each roll shall have separator sheets of 40 pound Kraft paper placed at the beginning and at the end of each roll to facilitate unrolling and handling at the job site. The Kraft paper sheet at the end of each roll shall also form a wrapper for the roll.

C. Netting:

1. Twisted Kraft paper or synthetic fiber, biodegradable woven mesh net material suitable for the application and acceptable to ENGINEER.

2. The net shall consist of a biodegradable mesh with openings not to exceed 1-1/2" x 3" (40 x 75 mm)

3. The net shall be furnished in widths of not less than 35 inches (900 mm).

D. Proprietary Mulch Material:

1. Biodegradable natural and/or synthetic materials suitably fabricated and acceptable to ENGINEER.

2.03 Mulch Anchoring Material

A. Emulsified Asphalt:

1. ASTM D977, Rapid Setting (R.S. 1 or 2), Medium Setting (M.S. 2 or 2h) or Slow Setting (S.S. 1).

B. Mulch Anchoring Tool:

1. Suitable unit having a series of flat, notched discs for punching and anchoring mulch in soil, or a regular farm disc weighted and set nearly straight as a substitute.

C. Latex Base Adhesive:

1. Latex base adhesive mixed with water at a ratio of 25 gallon of water to 1 gallon adhesive with 25 pounds of recycled newsprint as a tracer (14 L of adhesive with 0.35 kL of water with 28 kg of newsprint).

D. Recycled Newsprint:

1. Mix 7 pounds of newsprint with 7 gallons of water (60 kg of newsprint with 1000 L of water).

E. Guar Gum:

1. Mix 1 pound of dry adhesive with 26.5 gallons of water with 5 pounds of recycled newsprint as a tracer (55 kg adhesive / 12 200 L water / 280 kg newsprint).

2.04 Fertilizer

A. Fertilizer shall be a standard commercial grade fertilizer, conforming to state regulations, of the type recommended for grasses. The fertilizer shall contain slow release nitrogen amounting to 75% of the nitrogen available. Fertilizer shall be uniform in composition, free flowing and suitable for application with method selected. Fertilizer for hydraulic seeding shall be soluble or ground to a fineness that will permit complete suspension of all insoluble particles in the slurry.

2.05 Agricultural Liming Materials

A. Burnt lime (quick lime), hydrated lime, limestone (calcite and dolomite), marble shells and by-products shall conform to the requirements of ASTM C602.

2.06 Water

A. Free of matter harmful to plant growth.

2.07 Staples

A. Wire staples for holding mulching materials in place shall be not less than six (6) inches (150 mm) long No. 11 (U.S. Steel Gage) steel wire or longer.

2.08 Topsoil

A. Topsoil shall be fertile, friable, sandy clay loam without admixture of subsoil. Topsoil is to be free of glass, stones greater than one (1) inch (25 mm) in any dimension, weeds, undesirable grasses and other extraneous materials. Topsoil shall have the following range of values:

1.	Soil pH	5.0 to 7.5
2.	Soluble Salts	500 ppm max
3.	Organic Content	5 to 30 %
4.	Silt Content	35% to 50%
5.	Clay Content	5% to 10%
6.	Deleterious Material*	5% max

*rock, gravel, stone, sticks, roots, sod, etc.

B. Compost may be mixed with topsoil to obtain the desired content. Topsoil is to be final screened thru a 5/8-inch (15 mm) maximum mesh screen prior to delivery to the Project site. ENGINEER shall review source and final screen results prior to release of topsoil. CONTRACTOR shall submit a certified analysis of the topsoil from each source to ENGINEER. Topsoil shall be placed in 3-inch (75 mm) minimum thickness throughout, or as specified in the plans or Specifications.

C. CONTRACTOR shall obtain his own topsoil borrow pit source and shall obtain all necessary permits and agreements for the use of such borrow pits at his own expense.

2.09 Improved Topsoil

A. Improved topsoil shall consist of a mixture of 2/3 topsoil and 1/3 compost. Compost shall be mature/stabilized, humus-like material derived from the aerobic decomposition of yard waste (i.e., grass clippings and leaves) or other materials as designated compostable as defined in P.A. 641 as amended and shall be in compliance with all federal and state law.

B. The improved topsoil mixture shall have a dark brown or black color, be capable of supporting plant growth without ongoing addition of fertilizers or other soil amendments and shall not have objectionable odor. The mixture shall be free of glass, plastic, metal, and other contaminants, as well as viable weed seeds and other plant parts capable of reproducing. The mixture shall be such that no visible water or dust is produced when handling it.

C. The manufacturer of the compost shall maintain annually on file with the Michigan Department of Agriculture, Pesticide and Plant Pest Management Division, test data and a statement to show that the following criteria are being met by the compost provided for the project.

D. The composition of the compost shall be within the following range of values:

	Quality Parameter	Range of Value
1.	Soil pH	6 to 7.5
2.	Soluble Salts	2 to 5 mmho/cm
3.	Carbon/Nitrogen Ratio	13 to 20 parts C to 1 part N
4.	Inerts	< 1%
5.	Organic Matter	35 to 55 %
6.	Nitrogen	1 to 2 %
7.	Phosphorus	0.2 to 0.8 %
8.	Potassium	0.5 to 1.5 %
9.	Unit Weight	535 to 775 Kg/m3
10.	Moisture Content	40 to 50 %
11.	Particle Size	< 20 mm maximum
12.	Water Holding Capacity	> 100%
13.	Heavy Metals	None

E. Maturity/Stabilization: An acceptable test that can demonstrate Maturity/Stability.

F. Temperature: The compost material must have undergone the procedure to significantly reduce the pathogen level as referenced in EPA 40 CFR, Part 257 Regulations, Federal Register Vol. 58, No. 32, dated 2/19/93; Rules and Regulations. The temperature must be maintained at 40° C for 5 days with a temperature exceeding 55° C for at least 4 hours.

G. Pathogens and Trace Elements: Shall meet the requirements of EPA 40 CFR; Part 503 Regulations, Federal Register Vol. 58, No. 32, dated 2/19/93; Rules and Regulations.

H. To comply with the annual filing requirements with the Michigan Department of Agriculture, Pesticide and Plant Management Division, the supplier of the compost shall certify that the compost meets Michigan P.A. 641 as amended and EPA 40 CFR, Part 257 and 503 Regulations, Federal Register Vol. 58, No. 32; dated 2/19/93; Rules and Regulations.

I. A data sheet shall accompany the certification.

J. The data sheet shall show the following:

1. Standard compost total nutrient test results, including N, P, K, Ca, Mg, Mn, Cu, Fe total carbon, pH, as provided by an acceptable testing laboratory
2. Organic content
3. Inert contamination
4. Soluble salts

5. Carbon/Nitrogen ratio

6. Proof of maturity/stability acceptable to the Michigan Department of Agriculture

K. The certification and data sheets shall be mailed annually to the Michigan Department of Agriculture, Agriculture Environment Coordinator. The date shall be included on which the compost test results were mailed to the Michigan Department of Agriculture.

Part 3 Execution

3.01 Preparation of Subgrade

A. Complete all fine grading within the areas to be covered with topsoil necessary to bring the surface of the proposed subgrade to the elevations indicated on the Plans and parallel to the proposed finished grade. The surface of the subgrade immediately prior to being covered with topsoil shall be raked or otherwise loosened to a minimum depth of two (2) inches (50 mm) to facilitate making a bond between the subsoil and the topsoil.

3.02 Preparation of Soil

A. After the areas to be seeded have been brought to the required grade and properly trimmed and cleaned up, the existing soil shall be brought to a friable condition by harrowing or otherwise loosening and mixing to a depth of at least four (4) inches (100 mm). Lumps and clods shall be thoroughly broken. When the area to be seeded has been prepared and covered with a layer of topsoil as specified under Article 3.01 of this section, this operation will not be required.

3.03 Preparation of Mulch Material

A. When seed is to be sown through mulch which has been in place for a period of more than two (2) weeks or which is being held in place by a surface-applied coating of asphalt emulsion or other adhesive, the mulched area shall be prepared for seeding by discing, a spike-toothed harrow, or by other means acceptable to ENGINEER.

3.04 Placing and Spreading Topsoil

A. Topsoil shall be placed and spread over the area designated on the Plans, or as determined by ENGINEER, to a depth of four (4) inches, ± 1-inch (100 mm ± 25 mm) or to such depth as specified on the plans.

B. In all cases, topsoil shall be placed to a depth sufficiently greater than that shown on the Plans or specified so that, after natural settlement or rolling, the completed Work will conform to the lines, grades and elevations shown on the Plans.

C. Spreading of topsoil shall be completed in such a manner that seeding as specified can proceed without additional moving of topsoil. Topsoil furnished and placed shall be considered incidental to seeding unless otherwise specified in the Proposal.

D. After topsoil is spread, all large earth lumps, rocks, roots, debris, or other foreign matter shall be raked and removed from the topsoiled area and legally disposed of by CONTRACTOR.

3.05 Fertilizing

A. Chemical fertilizer shall be applied on the prepared soil surfaces at a minimum rate of 1/3 ton per acre (666 lbs/ac.) (750 kg/ha) of 12-12-12 fertilizer, or such other rate of another fertilizer mixture that yield 240 lbs/acre (270 kg/ha) of nutrient. Dry fertilizers shall be thoroughly disced, harrowed or raked into the soil to a minimum depth of not less than 1-inch (25 mm). Where hydraulic seeders are used for sowing seed, one half the recommended rate of fertilizer may be spread in combination with such sowing with the balance incorporated into the soil prior to seeding. In all other cases, fertilizer shall be incorporated into the soil before any seeding is started.

3.06 Seeding

A. Seed of the kind required shall be sown at the rate as specified in Table 2. Seed shall be sown in the presence of an inspector by mechanical spreader, hydraulic seeder or broadcasting. The broadcasting method shall be used for sowing seed only in areas inaccessible to mechanical spreading equipment. Seeding during winds above 15 miles per hour (25 km/hr) shall not be permitted.

B. Prior to placing seed materials, water topsoil to a depth of four (4) inches (100 mm) at least 48 hours prior to seeding operations to obtain a loose friable seed bed. Time and depth of watering operations shall be varied at the direction of ENGINEER for varying conditions at the site of the Work.

C. Broadcasting methods for sowing seed materials shall be accomplished by spreading one-half of the specified amount of seed in one direction and then broadcasting the remaining one-half of the seed at right angles to the first seeding pattern using the same broadcast method. Rate of broadcast shall be as specified herein or per the written recommendations of the Producer of the seed material used. Roll seeded area with roller weighing a maximum of 150 pounds/foot (225 kg/m) of width.

D. Hydroseeding shall be performed using suitably acceptable hydraulic seeding equipment and a homogeneous slurry solution of water, seed, fertilizer and suitable mulch material as approved by ENGINEER. Seed slurry mixture shall be distributed uniformly at a rate approved by ENGINEER for the seed materials, fertilizer and/or mulch materials used to suit the seed application rate. Seed application rate shall be 300 lbs/acre (340 kg/ha).

3.07 Mulching

A. Mulching shall consist of placing a mulch material on areas that have been or are to be seeded. Mulch shall be placed in a loose enough condition so as to allow penetration of sunlight and circulation of air, but thick enough to shade the ground, reduce rate of water evaporation and prevent or reduce erosion by wind or water. Mulch shall be secured with suitably acceptable anchoring material.

B. For surfaces and slopes on which power equipment can be operated, satisfactory mulching materials include the following:

C. Small grain wheat straw or grass hay applied at 1-1/2 to two (2) tons per acre (3.5 to 4.5 metric ton/ha) with disc packer, asphalt or netting tie-down.

D. Wood chips applied at six (6) to nine (9) tons per acre (13.5 to 20.0 metric tons/ha).

E. Asphalt emulsion alone at 600 to 1,200 gallons per acre (5.5 to 11. kl/ha). (This application is suitable for limited periods of time and where trampling by either people or animals will not occur.)

F. For surfaces and slopes where power equipment cannot be operated, satisfactory mulching materials include the following:

G. Straw or grass hay applied at 1-1/2 to two (2) tons per acre (3.5 to 4.5 metric tons/ha), anchored with asphalt or netting tie-down.

H. Asphalt emulsion alone at 600 to 1,200 gallons per acre (5.5 to 11.0 kl/ha). (Limited to areas where tracking is not a problem.)

I. Commercially available erosion control netting of jute, paper or biodegradable synthetics.

J. Continuous filament fiberglass at 1,000 pounds per acre (1100 kg/ha) anchored with 150 gallons (1400 l/ha) of asphalt emulsion.

K. Anchor straw or hay mulch by the methods as specified herein.

L. Wood chips will not need anchoring when used on workable slopes.

M. Commercially manufactured netting and/or fiberglass materials shall be anchored in accordance with the manufacturer's printed instructions for the material used.

N. Punch and anchor mulch material into soil using mulch anchoring tool. Soil must be moist, free of stones and loose enough to permit disc penetration to a depth of three (3) inches (75 mm).

O. Blow on liquid or emulsified asphalt materials with the straw or hay mulch or spray or sprinkle asphalt tie-down materials immediately after mulch is spread.

P. Apply emulsified asphalt at 0.04 gallons per square yard 0.2 l/m^2). Do not apply emulsified asphalt during freezing weather since it contains approximately 50% water. Apply liquid (cut back) asphalt at approximately 0.10 gallons per square yard (0.45 l/m^2). Liquid asphalt may be applied during freezing weather since it is cut back with kerosene.

3.08 Conversion from Soil Protection to Permanent Vegetation

A. Following straw or hay mulching, grass seeding can be made in early spring by broadcasting seed directly into the mulch. Fertilizer or lime, where needed, should be incorporated into the soil before mulching.

B. Asphalt emulsion alone can be readily incorporated into the soil by ordinary tillage before seeding.

C. Wood chip mulch may be removed before seeding or incorporated deeply into the soil. If wood chips are incorporated into the soil, the addition of extra nitrogen fertilizer to the soil will be required to provide nitrogen in the new seeding.

D. Fiberglass mulch shall be removed before seeding because of its permanence. Care shall be taken to prevent fiberglass filaments left in place from becoming entwined or wound around shafts of power mowers or other power equipment.

E. Acceptable proprietary netting and erosion control materials shall be disposed of in accordance with the manufacturer's printed instructions for the material used prior to any seeding operations.

3.09 Turf Establishment

A. Seeded areas shall be watered whenever excessive drying is evident during the period set for establishment. Watering shall be done in a manner that will prevent erosion due to the application of excessive quantities and the watering equipment shall be of a type that will prevent damage to the cultivated surfaces. CONTRACTOR shall be responsible for the proper care of the seeded areas until final acceptance of the entire Work covered by the Contract.

B. The seeded areas shall be mowed with mowing equipment acceptable to ENGINEER to a height of two (2) inches (50 mm) whenever the average height of grass establishment reaches four (4) inches (100 mm). When the amount of cut grass is heavy, cut grass shall be removed to prevent destruction of the underlying grass. If weeds or other undesirable vegetation threaten to smother the planted species, such vegetation shall be mowed, or in the case of rank growths, shall be uprooted, raked and legally disposed of from the area.

C. Reseed and mulch areas larger than four (4) square inches (25 cm^2) not having a dense, uniform, vigorous stand of grass acceptable to ENGINEER.

D. The establishment period shall extend for a period from the time of seeding until the seeded area has a uniform stand of grass acceptable to ENGINEER. The minimum period shall be 30 days.

E. If after 60 days from the initial seeding a dense, uniform, vigorous stand of grass has not been established by CONTRACTOR, OWNER may reseed the defective areas and all costs will be deducted from CONTRACTOR’s payments.

End of Section

Division 33
Utilities

Section 33 0130
Water Utility Leak Testing & Disinfection

Part 1 General

1.01 Scope of Work

A. Work specified in this section consists of testing for signs of leakage in pipelines and structures to ensure they are watertight. CONTRACTOR shall furnish labor, equipment, air, water and other materials, including meters, gauges, blowers, pumps, compressors, fuel, bulkheads and accessory equipment for the complete and proper testing of specified utilities.

1. Test gravity sewers and drain lines by low pressure air testing.
2. Test all other pipelines with water under the specified pressures.

B. This section also includes disinfection and bacteriological testing of all potable water pipelines and appurtenant piping, including labor, equipment, water and other materials to complete the disinfection and testing and subsequent disposal of flushing water.

1.02 Related Work Specified Elsewhere

A. Section 33 1100: Water Utility Distribution Piping
B. Section 33 3000: Sanitary Sewerage Utilities

1.03 Reference Standards

A. ANSI/AWWA B300 Hypochlorites
B. ANSI/AWWA B301 Liquid Chlorine
C. ANSI/AWWA C651 Disinfecting Water Mains
D. APHA, AWWA, and WEF Standard methods for the Examination of Water and Wastewater

1.04 Submittals

A. The following shall be submitted in accordance with Section 01 33 00, Submittal Procedures, for leakage testing:

1. Pre-Testing Report: Prior to placing the sewer system in service, CONTRACTOR shall submit to ENGINEER a detailed bound report summarizing the leakage test data, describing the test procedure and showing the calculations on which the leakage test data is based.

2. Post Resting Report: Following leakage testing, CONTRACTOR shall submit to ENGINEER a detailed bound report summarizing the leakage test data, including:

a. Length and diameter of the section of line tested (manhole to manhole) including any laterals;

b. Type of plugs used and where;

c. Depth of sewer, and ground water pressure over sewer pipe;

d. Stabilization time period and air pressure;

e. Actual air test pressures used if ground water is present;

f. Allowed time by specifications versus the actual test time;

g. Air pressure at beginning and end of test;

h. Name of the person performing the testing;

i. Date(s) and time(s) of testing, including any retesting; and

j. Description of any repairs made following testing.

B. The following shall be submitted in accordance with Section 01 3300 for disinfection and bacteriological sampling:

1. A written plan for proper installation, flushing and testing of new water mains must be submitted to the Superintendent of Water Production and Distribution or their designee for approval prior to start of work. The plan will address how CONTRACTOR will meet the requirements of this specification. At a minimum, it will include:

a. Schematic map of the project showing sampling points, points of connection and flushing points.

b. Make and model number of backflow prevention device(s) and flow meter used to connect to the water system for flushing and testing.

c. Calculations for sizing of source water connection(s), flushing velocities and total quantity, chlorine dosing, and de-chlorination.

d. A detailed work schedule listing the approximate dates for each activity covered in this specification.

e. A detailed work plan listing procedures and approximate dates for each activity covered in the specification.

f. Detailed procedures for each activity.

g. NPDES permit and compliance procedures for initial flushing and flushing during dechlorination of pipelines.

h. The appropriate certifications of the laboratory and the disinfection subcontractor.

i. Emergency contact information.

2. The written plan for installation, flushing, shutdowns, tie-ins, and activation will be submitted to OWNER/ENGINEER two weeks prior and returned to CONTRACTOR one week prior to the activity.

Part 2 Products (Not Used)

Part 3 Execution

3.01 General

A. New sewer and water pipelines installed shall be tested for leakage using Hydrostatic Testing for pressure lines and Low Pressure Air Testing for gravity lines. Tests to be performed shall be witnessed by the Engineer.

3.02 Flushing

A. Mains shall be flushed to remove all sand and other foreign matter.

B. Velocity of the flushing water shall be at least 4 feet per second (fps).

C. Flushing shall be terminated at the direction of the Engineer.

D. Dispose of the flushing water without causing a nuisance or property damage.

E. Temporary flush out connections shall be installed on all dead end water mains at the locations shown on the Drawings.

3.03 Restrain Against Movement

A. Before applying pressure, all piping and all components in the test section must be restrained. This means that if piping or parts move or separate during the test, it will not result in damage or injury. Never conduct leak tests on unrestrained piping.

1. Heat fusion joints must be properly cooled before testing.

2. Mechanical connections must be completely installed and tightened per manufacturer's instructions.

3. If backfill provides restraint, it must be properly placed and compacted. Joints and connections may be exposed for inspection.

4. End closures must be suitable for pressure service and pressure-rated for the test pressure.

5. Ensure that all connections to test equipment are secure. Disconnect or isolate all low pressure filling lines and all other parts that are not to be subjected to test pressure. Restrain, isolate or remove expansion joints before leak testing.

3.04 Test Section

A. Testing may be conducted on the full system or in sections of no greater than 1-mile in length. Test section length is determined by the capacity of the testing equipment. Lower capacity pressurizing or filling equipment may not be capable of completing the test within permissible time limits. If so, use higher capacity test equipment or select a shorter test section.

B. Before applying test pressure, allow time for the test fluid and the test section to equalize to a common temperature.

C. Maximum allowable leakage for the entire section(s) being tested shall not exceed the leakage calculations for the shortest section between valves within the test section.

3.05 Test Pressure

A. For pressure piping systems that include polyethylene pipe or fittings:

1. The maximum permissible test pressure is measured at the lowest elevation in the test section.

2. The maximum permissible test pressure is the lower of (a) 150% of the system design operating pressure provided that all components in the test section are rated for the test pressure, or (b) the pressure rating of the lowest pressure rated component in the test section.

B. For leak testing purposes, the maximum allowable test pressure in polyethylene pipe is 150% of the pipe's design pressure rating for the application and the application service temperature.

C. Do not subject lower pressure rated, non-polyethylene parts or devices to pressures above their pressure rating. Lower pressure rated parts may be removed or isolated from the test section to avoid damage or failure. Vent isolated parts or equipment to atmosphere.

D. Thermoplastic pipes have reduced strength at elevated temperature. Test pressure must be reduced when the test section is at elevated temperature either from service conditions or from environmental conditions such as being warmed by the sun. Multiply the test pressure by the Table 1 multiplier to determine the allowable elevated temperature test pressure.

Table 1. Elevated Temperature Multiplier

Test Section Temperature °F (°C)	< 80 (< 27)[1]	< 90 (< 32)	<100 (< 38)	<110 (< 43)	< 120 (< 49)	< 130 (< 54)	< 140 (< 60)[2]
Multiplier	1.00	0.90	0.80	0.75	0.65	0.60	0.50

[1] Use the 80°F (27°C) multiplier for 80°F (27°C) and lower temperatures.
[2] The maximum service temperature for polyethylene pressure piping is 140°F (60°C).

3.06 Test Duration

A. When testing at pressures above system design pressure up to 150% of the system design pressure, the maximum test duration is eight (8) hours including time to pressurize, time for initial expansion, time at test pressure, and time to depressurize the test section.

1. If the test is not completed due to leakage, equipment failure, or for any other reason, depressurize the test section completely, and allow it to relax for at least eight (8) hours before pressurizing the test section again.

B. Testing at excessive pressure or for excessive time may damage the piping system.

C. When testing at system design pressure or less, test duration including time to pressurize, time for initial expansion, time at test pressure and time to depressurize should be limited to a practical time period given that the test section is not to be left unsupervised at any time during leak testing.

3.07 Hydrostatic Leak Testing

A. General:

1. Prior to hydrostatic testing, pipelines shall be flushed or blown out as appropriate.

2. CONTRACTOR shall test pipelines in sections and in accordance with the approved disinfection plan.

    a. No section of the pipeline shall be tested until all field-placed concrete or mortar has attained an age of 14 days.

3. The test shall be made by closing valves when available, or by placing temporary bulkheads in the pipe and filling the line slowly with water.

    a. CONTRACTOR shall be responsible for ascertaining that test bulkheads are suitably restrained to resist the thrust of the test pressure without damage to, or movement of, the adjacent pipe.

4. Unharnessed sleeve-type couplings, expansion joints, or other sliding joints shall be restrained or suitably anchored prior to the test, to avoid movement and damage to piping and equipment.

5. CONTRACTOR shall provide sufficient temporary air tappings in the pipelines to allow for evacuation of all entrapped air in each pipe segment to be tested.

    a. After completion of the tests, such taps shall be permanently plugged.
    b. Care shall be taken to see that air vents are open during filling.

6. Pipeline shall be filled at a rate which will not cause any surges or exceed the rate at which the air can be released through the air valves at a reasonable velocity and all the air within the pipeline shall be properly purged.

    a. After the pipeline or section thereof has been filled, it shall be allowed to stand under a slight pressure for at least 24 hours to allow the concrete or mortar lining, as applicable, to absorb water and to allow the escape of air from any air pockets.

    b. During this period, bulkheads, valves, and connections shall be examined for leaks. If leaks are found, corrective measures satisfactory to OWNER shall be taken.

7. The hydrostatic test shall consist of holding the test pressure on the pipeline for a period of 2 hours (minimum).

    a. The test pressure for distribution and transmission pipelines shall be 150 pounds per square inch (1 MPa) gage, minimum.

    b. No pressure test will be required for a reservoir overflow line.

    c. Visible leaks shall be repaired in a manner acceptable to OWNER/ ENGINEER.

8. The maximum allowable leakage measured by water meter from the section of main tested shall not exceed a rate of 10 US gallons per inch diameter of the main being tested, per mile of pipe, in a 24-hour period while under pressure. If more than one section of pipe is being tested at a given time, the maximum allowable leakage will be based on the shortest section.

   a. No pipe installation will be accepted if the leakage is greater than the allowable leakage calculated in accordance with the following formula:

$$L = \frac{S * D * (P)^{1/2}}{148{,}000}$$

Where: L = allowable leakage, in gallons per hour
S = length of pipe tested, in feet
D = nominal diameter of the pipe, in inches
P = average test pressure during the leakage test, in pounds per square inch (gauge)

Table 2. Allowable Leakage per 1000 Feet of Pipeline Tested

Average Pressure (psi)	Nominal Pipe Diameter in Inches											
	3	4	6	8	10	12	14	16	18	20	24	30
175	0.27	0.36	0.54	0.72	0.89	1.07	1.25	1.43	1.61	1.79	2.15	2.68
150	0.25	0.33	0.50	0.66	0.83	0.99	1.16	1.32	1.49	1.66	1.99	2.48
125	0.23	0.30	0.45	0.60	0.76	0.91	1.06	1.21	1.36	1.51	1.81	2.27

3.08 Disinfecting Pipelines

A. General:

1. Potable water pipelines except those appurtenant to hydraulic structures shall be disinfected in accordance with the requirements of ANSI/AWWA C651 using the Continuous-Feed Method as modified herein.

2. Preliminary and final flushing shall be done at the ends of mains, which have been hydrostatically tested.

B. Chlorination:

1. A chlorine-water mixture shall be uniformly introduced into the pipeline by means of a solution-feed chlorinating device.

2. The chlorine solution shall be introduced at one end of the pipeline through a tap in such a manner that as the pipeline is filled with water, the dosage applied to the water entering the pipe shall be approximately 50 mg/l. Free chlorine concentration at initial chlorination shall be a minimum of 25 mg/l.

3. Care shall be taken to prevent the strong chlorine solution in the line being disinfected from flowing back into the line supplying the water.

C. Chlorine Residual Test:

1. CONTRACTOR shall make 24-hour chlorine residual tests. CONTRACTOR shall notify OWNER of the chlorine test result.

2. Chlorinated water shall be retained in the pipeline for at least 24 hours.

3. After the chlorine-treated water has been retained for the required time, the free chlorine residual at the pipeline extremities and at other representative points shall be at least 10 mg/l. Before a bacteriological analysis can be performed the system shall be flushed down to existing system residual.

D. Repetition of Test:

1. The disinfection testing procedure shall be repeated if the initial tests fail to produce satisfactory results.

2. Two consecutive satisfactory test results shall be required after any unsatisfactory test.

3. The tablet method shall not be used for repeated disinfection.

E. Chlorinating Valves:

1. During the process of chlorinating the pipelines, all valves and other appurtenances shall be operated while the pipeline is filled with the heavily-chlorinated water.

F. Final Flushing:

1. CONTRACTOR shall be responsible for the safe disposal of chlorinated water flushed from water mains following disinfection procedures. CONTRACTOR shall be responsible for disposing of disinfecting solution in a manner in accordance one of the following approved manners:

a. Discharge chlorinated water directly into a nearby sanitary sewer provided that the water will receive subsequent treatment and disposal by a properly permitted wastewater treatment plant.

b. Dechlorination may be required by the wastewater treatment plant prior to receiving the discharge water.

(1) CONTRACTOR must obtain written permission from the wastewater treatment plant prior to discharge and shall verify whether or not dechlorination is necessary prior to disposal.

(2) CONTRACTOR shall submit a copy of the written authorization from the wastewater treatment plant to ENGINEER and the OWNER prior to disposal.

c. Discharge chlorinated water to a surface water body, either directly or indirectly (i.e., through a storm sewer).

(1) Prior to discharging, CONTRACTOR shall obtain a National Pollutant Discharge Elimination System (NPDES) general discharge permit, and shall comply with the associated monitoring and reporting requirements of the issuing agency, including dechlorination.

(2) CONTRACTOR shall submit a copy of the NPDES permit to the ENGINEER and the OWNER prior to disposal.

d. Discharge chlorinated water to the ground under Act 451 of the Part 31 Rules.

(1) Prior to discharging, CONTRACTOR shall dechlorinate the water to below four (4) milligrams per liter (mg/L).

(2) Following dechlorination, CONTRACTOR shall discharge to an area large enough, and with suitable soils, to prevent site runoff.

e. CONTRACTOR must obtain written permission from the landowner where the discharge is to take place and written verification that dechlorination is or is not necessary prior to disposal and that a value of less than 4 mg/L of chlorine is present within the water.

(1) CONTRACTOR shall submit a written copy both the ENGINEER and the OWNER prior to disposal.

3.09 Bacteriological Testing of Disinfected Pipelines

A. General:

1. CONTRACTOR shall collect a minimum of 2 sets of samples at least 24 hours apart after completion of final flushing as indicated above.

2. Samples will be taken at locations indicated in ANSI/AWWA C651 and will be tested for coliform organisms and heterotrophic plate count according to the latest edition of the *Standard Methods for the Examination of Water and Wastewater*.

3. Laboratory costs of testing will be CONTRACTOR's responsibility.

4. Satisfactory bacteriological results will be absent of total and fecal coliform, a heterotrophic plate count less than 100 CFU and chlorine Residual

5. If disinfection fails to produce satisfactory bacteriological counts, the pipe shall be reflushed and will be resampled and retested.

a. If counts from analysis of the second samples exceed the criteria in Standard methods, the pipe shall be re-disinfected and will be resampled and retested until satisfactory results are obtained.

b. CONTRACTOR shall be responsible for all repeat bacteriological testing costs.

B. Sampling:

1. Per AWWA Standards, no sampling stations shall be at a distance greater than 1,200 feet.

2. Mains shall be flushed at an adequate velocity prior to sampling to remove any debris remaining in the pipe.

3. Sampling must be accomplished by a certified treatment/distribution operator or an employee of a certified laboratory. This certification will be evidenced in the approved plan.

4. At OWNER's discretion, the source water will be sampled or the nearest water quality sample station's most recent results will be used to determine the baseline water quality.

5. Samples must be collected from extreme ends, all branches of the new main and at a minimum 300-foot interval. The sample points will also be part of the approved plan.

6. The temperature and total chlorine residual will be measured with a field test kit and recorded by the sampler on the "chain of custody" form.

7. After another 24-hour period, a second set of samples will be collected from the same sample points.

8. Both sets will be analyzed for total and fecal coliform presence/absence and heterotrophic plate count.

9. OWNER reserves the right to sample for bacteria at its own discretion with notice.

C. Laboratory Report:

1. General:

a. Lab results will be reported on a chain of custody, lab work sheet, or summary letter imprinted with the laboratory's name, address, and phone number.

(1) The report will include the field tests and laboratory analysis.
(2) The report will be signed by the laboratory director.

b. The laboratory report will be submitted for approval through the assigned Public Works Inspector to the Superintendent of Water Production and Distribution or their designee.

c. It will be OWNER's right, and responsibility to reject the report if any data is missing or suspect due to conflicting indications.

End of Section

Section 33 1100
Water Utility Distribution Piping

Part 1 General

1.01 Scope of Work

A. This Section includes water main Work complete with water main piping, valves, hydrants, thrust blocks, valve wells, structures, fittings, joints, joint materials, nuts, bolts, glands, gaskets, plugs and accessories as shown and required. This Section also includes bedding and laying of water main piping, hydrostatic testing of new water main piping systems, and flushing and chlorination of water main piping systems.

1.02 Related Work Specified Elsewhere

A. Section 01 2200: Unit Prices
B. Section 04 0511: Mortaring and Grouting
C. Section 31 2316: Structural Excavation and Backfill
D. Section 31 2333: Trenching and Backfilling
E. Section 33 0130: Water Utility Leak Testing & Disinfection

1.03 Requirements of Regulatory Agencies

A. Conform to the applicable requirements of State and local health authorities having jurisdiction for disinfection and testing of water mains.

1.04 Reference Standards

A. Unless otherwise specified, the Work of this Section shall conform to the applicable portions of the following Standard Specifications:

1. ANSI - American National Standards Institute

2. ASTM - ASTM International

3. AWWA - American Water Works Association

4. MDOT - Michigan Department of Transportation, Standard Specifications for Construction, latest edition

5. NSF - National Sanitation Foundation

1.05 Submittals

A. Tabulated Laying Schedule:

1. Tabulated Laying Schedule, showing stationing, deflection, elevation, slope and description of pieces (i.e., pipe size and material; fitting type, size and material; valve type and size, etc.) shall be submitted to ENGINEER. Pipe manufacture shall not be started until the laying schedule has been reviewed by ENGINEER.

B. Product Data:

1. Submit catalog data showing pipe sizes, and manufacturing standards, as well as design calculations for internal pressure, vacuum and external load conditions, for both non-restrained and restrained joints.

C. Schedule of Corporation Stops (Tapping Outlets):

1. A complete schedule of tapping outlets installed in water main piping shall be kept by CONTRACTOR and submitted to ENGINEER at the end of each water main piping section of the Project or on the last day of each week, whichever occurs first.

D. Quality Assurance Materials:

1. Quality assurance test procedures, test reports for pipes, specials and fittings shall be submitted to ENGINEER.

E. Affidavits:

1. Affidavits of compliance with the Contract Documents shall be submitted to ENGINEER and shall include the following, where applicable:

a. Pipes, specials and fittings (AWWA C200).

b. Cement-mortar protective lining (AWWA C205 and AWWA C602).

c. Tape coating for the exterior (AWWA C214 and AWWA C209).

d. Shrink wrap for exterior (AWWA C216).

e. Paint system for the exterior (AWWA C210, C218 or C222).

f. Manufacturer's standard repair procedures.

g. Manufacturer's written quality control procedures.

h. Manufacturer's Installation Instructions: Indicate special installation requirements.

i. Manufacturer's Certificate: Certify that Products meet or exceed specified requirements.

2. Affidavits for items a through e shall be signed by an authorized professional.

1.06 Closeout Submittals

A. The following shall be submitted in accordance with Section 01 7700, Closeout Procedures:

1. Manufacturer's field reports.

2. Project record documents:

a. Accurately record actual locations of piping mains, valves, connections, and invert elevations.

b. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

3. Provide a final record laying schedule.

4. Submit certified copies of hydrostatic test results of completed force main sections as specified in Article 3.15.

1.07 Storage of Materials

A. Pipe shall be stored in a manner to minimize infiltration of dirt, debris and other extraneous materials.

B. Piping materials shall not be stacked higher than four (4) feet (1.2 m). Suitable racks, chairs and other supports shall be provided to protect preformed pipe mating surfaces from damage. Store bottom tiers off the ground, alternate tiers and chock tier ends.

C. Store hydrants, valves, wells and prefabricated structures off the ground, drained and kept free of water to protect against damage from freezing. Hydrants, valves, wells, their accessories and appurtenances shall be kept in their original containers until ready for installation.

D. Gaskets, glands, joint and sealing materials subject to ultra-violet or ozone attack shall be protected from the sunlight, atmosphere and weather; and stored in suitable enclosures until ready for installation.

1.08 Handling of Materials

A. Load and unload piping using suitably approved hoists and skidding. Piping shall not be dropped, bumped or allowed to impact against itself. Damaged piping shall be rejected by CONTRACTOR.

B. Lifting devices shall be suited to the Work and shall protect surfaces from damage.

Part 2 Products

2.01 General

A. It is the intent of the Articles in Part 2 of this specification section is to specify in detail the various types of pipe, joints, and fittings which have been indicated throughout the Plans and Specifications.

B. These Articles shall not be construed as allowing any alternate type of material to that which is indicated on the Plans or elsewhere in the Specifications.

2.02 Ductile Iron Pipe System

A. Ductile Iron Pipe shall be ANSI/AWWA C151/A21.51, with cement mortar lining inside, and 1-mil (25 µm) minimum thickness asphaltic coating outside. Pipe shall have a minimum wall thickness class for the pipe nominal inside diameter as indicated on the Plans or specified in the Proposal.

B. Mechanical joints for ductile iron pipe shall be compression gasket type, conforming to ANSI/AWWA C111/A21.11 except that slots with the same width as the diameter of the bolt holes in mechanical joints shall not be allowed in the bell flange.

C. Push-on, compression gasket type joints shall conform to ANSI/AWWA C111/A21.11 with spigot of pipe marked to visually determine when the spigot is fully seated in the bell of the adjoining section.

D. Fittings and plugs shall be ductile iron compact fittings, mechanical joint, pressure rating of 350 psi (2.4 MPa), conforming to ANSI/AWWA C153/A21.53, and rubber gasket joints conforming to ANSI/AWWA C111/A21.11, with double thickness cement mortar lining and coal tar enamel coating on the outside of fittings.

E. Flexible ball and retainer type joints shall be ball and retainer type, boltless, locking, and capable of being deflected up to 15□.

F. Cement mortar linings for ductile iron pipe shall conform to the requirements of ANSI/AWWA C104/A21.4 of the thickness specified and shall be permanently set prior to the application of any additional pipe coating.

2.03 Prestressed Concrete Pressure Pipe Systems

A. Concrete piping shall be prestressed concrete, embedded cylinder type, 175 psi (1.2 MPa) plus d-load design pressure conforming to AWWA C301. Seal coat in accordance with ANSI/AWWA C104/A21.4 as applicable.

B. Joints for concrete pipe shall be push-on, steel ring, gasket type conforming to AWWA C300 or AWWA C301.

C. Fittings shall be AWWA C300, Type A, concrete or mortar lined with reinforced concrete or mortar exterior covering. AWWA C300, Type B, cut and welded steel plate, mortar coated on interior and exterior.

D. Seal coat concrete pipe with bitumastic concrete penetrant conforming to ANSI/AWWA C104/A21.4. Apply after pipe has cured.

2.04 Polyvinyl Chloride (PVC) Piping Systems

A. Rigid polyvinyl chloride bell and spigot type pressure pipe and couplings, size four (4) inches (100 mm) and larger, shall conform to AWWA C900, pressure class 235, DR 18 unless otherwise indicated in the Contract Documents. Rigid polyvinyl chloride bell and spigot type pressure pipe and couplings, smaller than four (4) inches shall be ASTM D2241, SDR 21, pressure class 200.

B. Molecularly oriented polyvinyl chloride (PVCO) pipe sizes 4-iches through 24-inches shall be AWWA C909, pressure class 200 unless otherwise indicated in the Contract Documents. PVCO pipe will only be allowed when specifically called for in the Contract Documents.

C. Compounds used for production of PVC pipe and components shall be suitable for potable water products as required in NSF 14 and ANSI/NSF 61. Spigot end of pipe shall be marked to visually determine when the spigot is fully seated in the bell of the adjoining pipe.

D. Joints for PVC pipe shall be push-on or mechanical elastomeric gasket type, conforming to ASTM D3139.

E. PVC fittings shall only be allowed when called for on the Plans. When allowed, 4-inch and larger PVC fittings and plugs shall be 200-pound (1380 kPa) Pressure Class conforming to AWWA C900 of types and sizes indicated on the Plans. PVC fittings smaller than 4-inches, when allowed, shall be ASTM D2241.

F. Fittings and plugs for PVC pipe, unless specified otherwise, shall be ductile iron and as specified in Article 2.02.

G. Gaskets for PVC pipe shall be elastomeric seal type conforming to ASTM F477.

H. Pipe joint lubricants shall be manufacturers standard nontoxic conforming to AWWA C900.

2.05 Restrained Joints

A. Where the Plans or Specifications call for restrained joints they shall be per the following:

1. Restrained joints for ductile iron pipe and fittings shall be designed for a working pressure of 350 psi (2.4 MPa). Joints shall be capable of being deflected after assembly. Restraints shall be by one of the following methods:

a. A positive axial lock between the bell interior surface and a retainer welded on the spigot end of the pipe.

b. A thrust restraint wedge which embeds in the pipe with twist off nuts to control wedge setting.

2. Restrained joints for PVC water main pipe shall be designed for a working pressure of 200 psi (1.4 MPa). Where the restrained portion of the pipe is connected to fittings, restraint shall be provided across the joint by a clamping ring and anchored to the fitting with T-head bolts or stainless steel rods.

3. Restraining devices for PVC water main pipe shall incorporate clamping rings with serrations on the inside surface to provide positive restraint on the outside surface of the pipe and shall provide full support around the circumference of the pipe to maintain roundness.

2.06 Polyethylene Encasement

A. Polyethylene material for encasement shall be either 4 mil high density, cross-laminated polyethylene film or 8 mil linear low-density polyethylene film per AWWA C105.

2.07 Hydrants

A. Fire hydrants shall equal or exceed AWWA C502 Specifications and shall be in compliance with OWNER's standards.

B. Hydrants shall have a main valve opening of 5-1/4" and a 6" inlet connection. Each hydrant shall have two (2) 2-1/2" national standard hose connections and one (1) 4 1/2" national standard pumper connection.

C. Each hydrant shall be furnished complete with one 6" auxiliary gate valve and box.

D. The hydrant inlet joints and auxiliary valve joints shall be push-on type or mechanical joint for standard hydrants and mechanical type for Type P hydrants.

E. Standard hydrant leads shall consist of pipe material as used for water main construction:

1. Type P hydrant leads shall consist of anchoring couplings (F-1215) and anchoring pipe with one end solid gland and the other Roto-Right gland (F-1218) by Clow, and standard mechanical fittings where applicable.

2. TCIW-MJ hydrant tee with fittings, clamps and rods, or equal may be substituted.

2.08 Valves

A. General:

1. Valves, operation, accessories, and specific notes are specified on the drawings. Valve materials and workmanship shall conform to applicable ANSI, ASTM, and AWWA standards. Valve bodies shall have an arrow to indicate direction of turning to open.

B. Swing Check Valve (2-1/2-inch and larger):

1. General:

a. Swing check valves shall be the rubber flapper type with a heavily constructed cast iron body and cover in accordance with ASTM A296.

b. The body shall be long pattern design (not wafer), with integrally cast-on end flanges.

c. Check valves to have full pipe size flow area.

d. Seating surface to be on a 45-degree angle requiring the flapper to travel only 35 degrees from closed to full open position, for minimum head loss and non-slam closure.

e. The valve shall be designed to also function in the vertical position.

2. Flapper:

a. The flapper shall be Buna-N having an "O" ring seating edge and be internally reinforced with steel.

b. Flapper to be captured between the body and the body cover in a manner to permit the flapper to flex from closed to full open position during flow through the valve.

c. Flapper shall be easily removed without need to remove valve from line.

d. Flapper shall have an elastic spring, molded internally, to assist the flapper to close against a slight head to prevent slamming.

3. Exterior Paint: Phenolic Primer Red Oxide (NSF Approved)

4. Manufacturer: Valve shall be Crispin, Val-Matic, Clow, or equal.

C. Wafer Style Check Valves:

1. General:

a. Silent or double door spring loaded check valves shall be compact wafer style, designed to fit between ANSI flanges.

b. Valves shall be sized as shown on Drawing for low pressure air, with a working pressure of 150 psi

c. Check valve shall be spring loaded, normally closed by means of one or more heavy duty stainless steel torsion springs.

d. Flow from the blowers shall cause the valve to open and upon blower shut down, the torsion spring will shut the valve before reverse flow starts and at a point of zero velocity of non-slam closure.

2. Materials:

a. The sealing element shall be BUNA-N molded to body.

b. Valve body shall be fabricated of cast iron.

c. Torsion spring, hinge shaft and stop pin shall be constructed of stainless steel.

d. Silent plug or doors shall be bronze, ASTM B584.

3. Manufacturer: Valves shall be Val-Matic, Mission, or equal.

D. Ball Check Valves:

1. Provide PVC Ball Check Valve with socket union connections, true union design, ball check type, Viton O-rings and seat, rated for 150 psi at 73°F.

2. Manufacturer: Valves shall be NIBCO, Inc., Hayward Industrial Products, Inc, or approved equal.

E. Ball Valves:

1. Manufacturer: Valves shall be Apollo Conbroco, Jamesbury Series 500 Chemtrol, Howard, or equal.

2. Ball valves have a working pressure of 200 psig, except PVC which is 150 psig, drop tight shut off, full port material bronze body, hard chrome plated ball teflon or viton seats and/or 316 stainless steel body and ball, teflon seats and/or PVC body and ball teflon seats depending on the service, with stops at full open and full closed.

F. Plug Valves:

1. General:

a. Plug valves shall be of the non-lubricated eccentric type with resilient faced plugs and shall be furnished with end connection as shown on the plans. Flanged valve shall be faced and drilled to the ANSI125/150 lb. standard.

2. Bodies:

a. Valve bodies shall be of ASTM A126 Class B cast iron. Bodied in 4" (100mm) and larger valves shall be furnished with a 1/8" welded overlay seat of not less than 90% pure nickel. Seat areas shall be raised, with raised surface completely covered with weld to insure that the plug face contacts only nickel. Screwed in seats are not acceptable.

3. Plugs:

a. Plugs shall be of ASTM A126 Class B cast iron. The plugs shall have a cylindrical seating surface eccentrically offset from the center of the plug shaft. The interface between the plug face and body seat, with the plug in the closed position, shall be externally adjusted in the field with the valve in line under pressure. Plug valves shall be chloroprene (CR) or resilient facing suitable for application.

4. Bearings:

a. Bearings shall have sleeves type metal bearings and shall be of sintered, oil impregnated permanently lubricated type 316 ASTM A743 Grade CFB ½" – 36" sizes. Non-metallic bearings shall not be acceptable.

5. Shaft seals:

a. Shaft seals shall be of the multiple V-ring type and shall be externally adjustable and re-packable without removing the actuator or bonnet from the valve under pressure. Valves utilizing O-rings or non-adjustable packing shall not be acceptable.

6. Pressure Rating:

a. Pressure rating shall be 175 psi on sizes ½" – 12" and 150 psi for 14" – 72". Every valve shall be given a hydrostatic and seat test, with test results being certified.

b. Manual valves shall have lever or gear actuators and tee wrenches, extension stems, floor stand, etc., as indicated on the plans. All 6" valve and larger shall be equipped with gear actuators.

c. Gearing shall be enclosed in a cast iron housing and be suitable for running in a lubricant with seals provided on all shaft to prevent entry of dirt and water into the actuator.

d. The actuator shaft and the quadrant shall be supported on permanently lubricated bronze bearings. Actuators shall clearly indicate valve position and adjustable stop shall be provided to set closing torque and to provide adjustment to compensate for change in pressure differential or flow direction change.

e. Exposed nuts, bolts and washers shall be zinc plated.

f. Power actuated valves shall be furnished with electric motor actuators as indicated on the plans.

7. Manufacturers: Valves shall be the product of DeZurik or engineer approved equal.

G. Butterfly Valves (Cast Iron):

1. Butterfly valves shall be rubber-seated tight closing and shall conform to AWWA Standard C504 latest revision.

2. Class 150 Valves (Non-Cyclic Applications)

3. Valves shall be of the flangeless wafer body style. All valves shall be suitable for use with ANSI 150-pound flanges. Bodies shall be cast iron. Valves shall be rated at 175 psi. Bodies of all flangeless wafer valves shall have bolt guides to center the body in the pipeline.

4. Valves shall be furnished with self-lubricated bearings of TFE coated stainless steel. Shaft seals shall be provided to prevent leakage and to protect bearings from internal or external corrosion.

5. Valve seats shall be of the reinforced resilient type and shall be field replaceable. Seats shall also act as a body liner to prevent flow from contacting the body casting. Seats shall have flange sealing to provide a positive seal without use of flange gaskets. Seats shall be of Buna-N or EPDM suitable for use with potable water. Shafts shall be one piece and shall be 316 stainless steel. Shaft diameter shall be suitable for the service conditions specified.

6. Shafts shall be finish ground to minimize bearing and shaft seal wear. Shafts of 12-inch and larger shall have a non-adjustable thrust collar. Shaft seals shall have a stuffing box and pull-down packing gland. Packing shall be furnished with self-adjusting "V" type packing.

7. Discs shall be aluminum bronze. The disc-to-shaft connections shall be Type 316 stainless steel.

8. Pins, shaft, and disc of all valves shall be individually machined and completely interchangeable.

9. Valves shall be available with field interchangeable manual or powered actuators as required. The actuator-to-shaft connection shall be designed to shear and prevent internal valve damage if the disc closes on foreign material in the pipeline.

10. Factory Testing: Test shall be conducted on each valve in accordance with Manufacturer's Quality Control procedures.

11. Butterfly valves shall be marked with the valve size, manufacturer's mark, year of manufacture, and class.

12. Manufacturer: Valves shall be DeZurik, Val-Matic, Clow or equal

H. Gate Valves:

1. Gate valves two inches (2") in diameter or larger shall be iron-body, bronze mounted, inside-screw, hand-operated resilient seat, and shall be equipped with rubber O-Ring Seals at the top of the stems unless otherwise shown on the plans. Valves shall conform to the requirements of AWWA Specification C500, except as such specifications are herein modified. Gate valves shall be designed for minimum working pressure of 200 psi.

2. Valves smaller than three inches (3") in diameter shall have threaded connections, unless shown otherwise on the plans. Valves three inches (3") in size and larger, shall have mechanical joints for use underground and shall have flanged joints if they are to be installed in structures. Flanges for pressure ratings shall be faced and drilled to comply with ANSI Specifications A21.15.

3. Wedge shall be of cast iron completely encapsulated with rubber. The sealing rubber shall be permanently bonded to the cast iron wedge to meet ASTM tests for rubber metal bond ASTM D-249.

4. Valves shall be supplied with O-Ring Seals at all pressure retaining joints. No flat gaskets allowed.

5. Gate valves shall be hand operated and designed to turn left or counter-clockwise to open with 2" square operating nut or handwheel with the word "Open" and an arrow cast in the metal to indicate direction of opening.

6. Suitable extension stems or operating keys shall be furnished to properly operate all valves installed with valve boxes, and all necessary guides and supports for valve stems shall be furnished and installed where required.

7. Gate valves installed underground shall be equipped with standard cast iron valve boxes unless otherwise shown on the plans. Where valves are shown to be of smaller diameter than the connecting piping the two reducers required shall be included as fittings.

8. CONTRACTOR shall submit to ENGINEER complete catalog information showing principal dimensions, weights, and specifications and operating data for all valves he proposes to finish.

9. Body and bonnet shall be coated with fusion bonded epoxy both interior and exterior, complying with AWWA C-550 and be NSF 14 and NSF 61 approved.

10. Each valve shall have maker's name, pressure rating, and year in which manufactured cast on the body. Prior to shipment from factory, each valve shall be tested by hydrostatic pressure equal to requirement for both AWWA requirements. Bolting shall either be regular plated or stainless steel type 304/316, as required.

11. Valves shall be as manufactured by Mueller Company, Clow Valve Company, or ENGINEER-approved equal. Valves shall be backed by manufacturer's five-year limited warranty.

I. Altitude Valves:

1. Altitude level control valve shall be cast iron, ASTM A 126-CLB, globe body design, and fully bronze mounted. Valve shall be ANSI B16.1, Class 125 flanged ends, and shall be constructed with complete bronze lining, bronze valve seat and piston. Furnish with external controls, including piping and regulating valves.

2. Valve shall be designed for installation in the influent piping to a water storage tank to prevent tank overflow and to maintain the water level within the tank within a variation of six inches of depth.

3. Altitude valves shall be one of the following types:

a. Type 1: Closes at the high water level, and opens for return flow when pressure at the valve inlet is less than the storage tank pressure.

b. Type 2: Closes at the high water level, and/or return flow, delays on opening until pressure at the valve inlet lowers to a selected pressure.

c. Type 3: Closes at the high water level, water is withdrawn from the storage tank through a separate line. The valve opens to refill the tank when the water level lowers approximately six inches below shutoff point. The valve shall not allow loss or return of storage water through the valve.

d. Type 4: Closes at the high water level, water is withdrawn from the storage tank through a separate line. The valve delays on opening until water in the reservoir lowers to a desired low level. Low level shall be adjustable 1 to 15 feet from high water shutoff point. The valve shall not allow loss or return of storage water through the valve.

4. Acceptable manufacturers include Cla-Val, Golden Anderson, OCV Control Valves, Ross Valve, Singer, or approved equal.

J. Air Release Valves:

1. Air Release valves shall have an ASTM A126 Class B cast iron body and cover with a threaded inlet connection of the size shown on the plans or listed in the schedule and a 1/2-inch NPT outlet connection. Valve body shall have a 2-inch NPT plugged port near the base to facilitate cleanout of large solids as well as a ½-inch NPT connection near the top and 1-inch NPT port near the bottom to permit the installation of flushing attachments.

2. Valves shall have an 18-8 stainless steel float and a replaceable seat of Buna-N or other suitable material. Internal linkage mechanism shall be 18-8 stainless steel, plastic or bronze is not acceptable. The linkage mechanism shall be capable of being removed from the cover without disassembly of the mechanism. Valves shall have 3/16 in. diameter stainless steel orifice for working pressures up to 150 PSI. Valve shall close drop tight.

3. The valve shall automatically exhaust accumulated air from a fluid system while the system is pressurized and operational.

4. For valves installed below grade, each valve shall be equipped with a flood safe kit to prevent inflow into the valve during submerged conditions.

a. Cover, and upper/lower chamber shall be constructed of ductile iron and conform to ASTM A536, Grade 65-45-12 with internal and external FBE coating.

b. Upper and lower seats shall be resilient in accordance with ASTM D2000.

c. Float checks shall be constructed of Type 316 stainless steel in accordance with ASTM A240.

d. Nuts and bolts shall be constructed of Type 316 stainless steel in accordance with ASTM F593.

e. Basket retainer shall be Type 304 stainless steel in accordance with ASTM F879; basket shall be Type 304 stainless steel in accordance with ASTM A240.

5. Air release valves shall be Golden Anderson, Val-Matic or equal.

K. Insertion Valves (4-inch to 12-inch):

1. General:

a. Insertion valves shall be an all stainless steel body Resilient Wedge Gate and designed for permanent use in potable water, raw water, reclaimed water, irrigation and backflow control systems. The design will allow the valve to be installed into an existing pressurized pipeline while maintaining constant pressure and service without system shutdown. No restraining devices, restraining fasteners, or transition gaskets shall be required for the installation or operation of the valve.

2. Valve Body and Bonnet:

a. Valves shall have a stainless steel body, carbon steel epoxy coated bonnet and a reinforced composite polymer valve cartridge to provide superior corrosion resistance, strength and a pressure rating that meets or exceeds the requirements of resilient seated gate valves. The insertion valve shall be stainless steel construction for corrosion resistance, maximum toughness and strength.

b. Valves must be capable of working on Cast/Grey Iron or Ductile Iron Class A, B, C and D, IPS PVC, C900 and C909 PVC, Steel and AC pipe diameters without changing either top or bottom portion of split valve body or using a transition gasket.

c. Valves must provide a solid support of the host pipe through the entire laying length of the valve body. No gaps or space between the valve body and host pipe shall be accepted.

d. Valves shall be rated for 250 psig maximum working pressure. The pressure rating must be permanently marked into the body.

e. Valves must be hydrostatically pressure tested to 1.25 times of the system operating pressure (minimum) or 1.5 times of the Insertion Valves 250 psig maximum pressure rating. The test shall be sustained for a minimum of 15 minutes. Once the pressure test is affectively achieved the insertion valve body must not be moved in accordance with AWWA Standards. If the insertion valve body is moved the pressure test must be completed again. Any movement, repositioning, loosening and/or re-tightening must be retested before the pipe is tapped.

3. Resilient Wedge Gate Assembly:

a. Valves shall have an EPDM molded resilient wedge seal. The resilient wedge seal will be affixed into a reinforced nylon composite polymer valve cartridge. The entire assembly shall be inert and impervious to corrosion.

b. Nylon composite polymer valve cartridge shall be engineered to come into contact with the interior of the host pipe and an engineered sealing surface in the valve body to create a seal. The resilient wedge shall be reinforced to resist abrasion thus extending the life and quality of the shutdown where the wedge contacts the host pipe.

c. Pressure equalization on the down or upstream side of the closed wedge shall not be necessary to open the valve.

d. Wedge shall be symmetrical and seal equally well with flow in either direction.

e. Resilient wedge must ride inside a minimum of four body channels to maintain wedge alignment throughout its travel and to achieve maximum fluid control regardless of high or low flow pressure or velocity.

f. Valves shall have a full size, full port flow way that is unobstructed, and free of depressions to provide optimum flow and sealing and not trap tuberculation or debris.

4. Fusion-Bonded Epoxy / E Coating:

a. Valves shall have all stainless steel bodies, fasteners and epoxy coated carbon steel valve bonnet. The use of epoxy coatings for protection against corrosion is deemed insufficient for any component other than the valve bonnet.

5. Gaskets and Stem Seals:

a. Insertion valves shall utilize four O-Ring's to seal between valve body to valve bonnet and valve stem. These O-rings shall be located in such a fashion as to ensure the 250 psig pressure worthiness and prevent ground water and/or foreign materials from entering the valve.

6. Valve Stem:

a. Valves shall be NRS (non-rising stem) and operate with standard turns 3 turns per diameter inch to open and close.

(1) NRS stem must have an integral stem collar manufactured of no lead bronze. Two-piece stem collars are not acceptable. The stem shall be affixed into the valve cartridge to maintain stem alignment, low torque and continuous operation of the valve.

b. Valves shall be operated by a 2" square wrench nut – open left or open right.

c. Valve stem shall be made of stainless steel and shall be able to withstand torque of 700 ft. lbs. of torque without compromising operation.

7. Hardware:

a. Bonnet and valve body fastener hardware shall be stainless steel.

b. Valve cartridge locking pins shall be made of grade 8 zinc coated carbon steel to prevent galling with stainless steel pin plugs coated to prevent galling.

8. Split Restraint Devices & Fasteners:

a. Valves that require the use of external or integral split restraint devices and or restraint fasteners are prohibited.

2.09 Tapping Sleeves

A. Tapping Sleeves shall be cast iron or ductile iron, pressure rating of 250 psi (1.7 MPa), mechanical joint sleeves conforming to AWWA C153, furnished complete with valve, stops, caps, plugs and joint accessories as indicated on the Plan. The sleeve shall be of a 2-section type.

2.10 Valve Boxes

A. Valve boxes shall be 3-piece, 5-1/4-inch (135 mm) diameter, screw type, gray iron castings consisting of base section, bottom section, and top section with lid conforming to ASTM A48, Class 20. Overall length shall be adjustable to meet grade.

2.11 Corporation Stops

A. Corporation stops, couplings and plugs shall be water service bronze of type and size detailed on the Plans.

2.12 Service Saddles

A. Water service saddles shall be compatible with the main and service lead, with straps of a ductile material to avoid crushing the main out-of-round. A molded gasket of rubber or neoprene shall completely encircle the tapped opening to insure a watertight connection. The use of lead gaskets is not allowed. Water service saddles shall be bronze with AWWA tapped threads.

B. Service saddles used with PVC water main shall be double strap, full circular and provide uniform bearing around the circumference. U-bolt type straps are not allowed.

2.13 Curb Stops

A. Water service bronze of types and sizes detailed on the Plans. Curb stops shall include an extension type, 3-piece curb box with extension type base, foot piece, one piece lid and a 3-foot stationary rod, unless otherwise specified.

2.14 Threaded Fittings

A. Where indicated on the Plans, threads for water main service fittings shall conform to the requirements of AWWA C800 and AWWA C800 "Appendix for Materials."

2.15 Water Service Pipe

A. Soft Copper shall be Type "K" conforming to ASTM B-88, with flared fittings.
B. Polyvinyl Chloride shall conform to ASTM D2241 or D1785 Schedule 40.

2.16 Restraints, Clamps, Rods, and Ties

A. High strength low alloy steel or stainless steel conforming to ANSI/AWWA C111/A21.11. Balls and fittings shall be bronze alloy or corrosion protected steel.

2.17 Structures

A. Material for water main structures shall conform to the details on the plans and the requirements listed below:

B. Concrete brick shall be ASTM C55, Grade S-II, solid units of nominal 3-inch (75 mm) thickness.

C. Concrete block shall be ASTM C139 shape and scored as detailed and as approved.

D. Precast concrete structures shall conform to ASTM C478, circular with circular reinforcement as detailed. Provide lifting holes in precast units where indicated.

2.18 Manhole Steps

A. Cast iron manhole steps shall be ASTM A48, Class 30, with a minimum cross section dimension of 1-inch (25 mm) in any direction.

B. Steel reinforced plastic manhole steps shall be suitably approved co-polymer polypropylene conforming to ASTM D4101, PP0344B33534Z02 with 1/2 inch (12 mm) minimum diameter deformed reinforcing bar conforming to ASTM A615, Grade 60.

C. Manhole steps shall be of types and sizes indicated on the Plans and shall comply with applicable state and federal occupational and safety standards.

2.19 Covers and Frames

A. Structure frame and covers shall be of the types and sizes as detailed on the Plans. Covers shall be Class 30, ASTM A48 gray iron castings. Castings shall be neatly made and free from cracks, cold sheets, holes and other defects. Surfaces of castings shall be ground to assure proper fit and to prevent rocking. Units shall be frost proof and shall be provided with tapping screws and anchors where indicated on the Plans.

2.20 Bolts, Studs, and Nuts

A. Bolts, studs, and nuts shall be as specified on the Plans and shall conform to the requirements of ANSI/AWWA C111/A21.11 and the ASTM standards listed below:

1. Bronze: ASTM B98
2. Steel: ASTM A307, Grade B
3. Cadmium Plating: ASTM B766, Grade NS
4. Zinc Coating: ASTM A153 or B633, Type GS

B. Tee head bolts and nuts shall be high strength, low alloy steel conforming to ANSI/AWWA C111/A 21.11.

2.21 Flowable Fill

A. Materials:

1. Cement: Cement shall conform to ASTM C150 or ASTM C595

2. Fly Ash: Fly ash shall have a maximum loss on ignition of 12 percent and meeting the other requirements of ASTM C618 (Class F)

3. Water: The water shall meet the requirements of ASTM C94

B. Mixture (Strength 50-100 psi) (345 to 690 kPa):

1. Fly Ash: 2,000 lbs/cyd (1190 kg/m^3) (min)

2. Cement: 100 lbs/cyd (60 kg/m^3)(minimum)

3. Water: Sufficient water to produce the desired flowability (approximately 700 lbs/cyd)(415 kg/m^3)

C. Temperature of the flowable fill mixture as manufactured and delivered shall be at least 50°Fahrenheit (10° Celsius).

D. Flowable fill can be mixed by pugmill, central concrete mixer, ready mix truck, turbine mixer, or other acceptable equipment or method for filling abandoned Water Mains.

E. CONTRACTOR shall submit a history of the mix design for 7-day and 28-day strengths, together with any other technical information. The design mix shall also be included as part of CONTRACTOR's submittals for project.

2.22 Tracer Wire

A. Copper clad steel wire with 30 mil High Density Polyethylene insulation. Concentric copper cladding metallurgically bonded to a steel core through a continuous solid cladding process.

B. Copper cladding to measure 3% minimum of the overall wire diameter. Wire to be 12 AWG, 0.0808 in. diameter, 0.00242-inch nominal copper thickness, 9.5270 ohms nominal resistance per 1,000 feet, 675 pounds breaking strength. Wire to be Copperweld ® or equal.

2.23 Acceptable Manufacturers

A. Flexible Joint Pipe: Acceptable manufacturers include "F141," Clow, "Usiflex," U.S. Pipe, or equal.

B. Restrained Joints: Acceptable manufacturers for restrained joints for ductile iron pipe include Griffin Pipe Products Company, "Snap-Lok" or "Bolt-Lok"; American Cast Iron Pipe Company, "Lok-Ring" or "Lok-Fast"; United States Pipe and Foundry Company, "TR Flex"; EBAA Iron "Megalug" or ENGINEER-approved equal.

1. Manufactured in accordance with ANSI/AWWA C111.

2. A tightly adherent, corrosion resistant coating shall be used on all exposed metal components of the restrained joint system.

a. Wedges, actuating hardware or other exposed threaded components shall be coated with a minimum of two (2) coats of fluoropolymer epoxy coating that has been heat cured.

b. Primary restraint castings shall be coated with a polyester coating, electrostatically applied and fusion bonded.

c. Bolts, nuts, and washers shall be manufactured of low-allow steel conforming with the material characteristics listed in ANSI/AWWA C11 and shall have a minimum of two (2) coats of fluoropolymer epoxy coating that has been heat cured.

C. Valve Boxes: Acceptable manufacturers include: "A-295 Three Piece Screw Type," Traverse City Iron Works; "F2450," Clow, "Series 6860, Tyler," or equal.

D. Corporation Stops: Acceptable manufacturers include: Hays; Crane; Mueller; Ford; or equal.

E. Service Saddles: Acceptable manufacturers include: "Twin Seal," Clow, "Hays Seal," Hays, "Service Saddles," Mueller, or equal.

F. Curb Stops: Acceptable manufacturers include: Hays, Ford, Mueller, or equal.

Part 3 Execution

3.01 CONTRACTOR's Verification

A. Prior to the installation of any water main piping or materials, examine all trenches and other excavations for the proper grades, lines, levels and clearances required to receive the new Work. Ascertain that all excavation bottoms, compacted subgrades and pipe bedding are adequate to receive water main materials to be installed. Correct defects and deficiencies before proceeding with the work.

B. Expose the existing water main piping and structures to which the new Work is to be connected and notify ENGINEER of the same. ENGINEER will verify the vertical and horizontal locations of the existing system and shall inform CONTRACTOR as to the necessary adjustments required to align the new water main work with the existing system.

3.02 Preparation

A. Remove lumps, blisters and excess coatings from the socket and plain ends of pipe. Wire brush and wipe clean the outside surfaces of plain ends and the inside surfaces of socket ends before installation. Any pipe or fitting which has acquired a coating of mud or other foreign material shall be scrubbed clean with heavily chlorinated water.

B. Pipe fittings, valves, hydrants, accessories and appurtenances shall be examined carefully for damage and other defects immediately before installation. Defective or damaged materials shall be rejected and removed from the Project by CONTRACTOR.

3.03 Installation - General

A. Foreign matter shall be prevented from entering the pipe while it is being placed in the trench. During and after laying operations, no debris, clothing or other materials shall be placed in the pipe.

B. During the progress of water main Work, watertight plugs shall be carried along and inserted in the end of each pipe as it is laid to prevent foreign matter or rodents from entering the pipe. This watertight plug shall be fastened in the end of the water main in such a manner as to prevent it from floating or being otherwise displaced whenever construction operations are temporarily halted, such as at noon or at the end of the day's Work.

C. Each section of pipe, when placed to grade and line, shall have firm bearing on the trench bedding throughout its length between bell holes.

D. Cutting of pipe shall be done with approved tools and by approved methods suitable for the pipe material. Pipe cutting methods that produce a smooth, square-cut end without damage to the pipe and that minimize airborne particles, shall be employed. Pipe cutting shall be performed using the recommendations of the manufacturer for the type of pipe materials being cut and according to the best trade practices.

E. When cutting pipe or fittings, care shall be taken to prevent damage to linings and coatings. Damage to linings shall be cause for rejection of the complete Section. Damage to exterior coatings shall be corrected to original Specifications.

F. Where pipe using a resilient gasket to affect the seal is cut, the cut pipe end shall be tapered at a 30-degree angle with the centerline of the pipe, and ground smooth, on the outside end to remove any sharp edges or burrs which might damage the gasket.

G. Unless otherwise specified, pipe shall be laid with bell ends facing in the direction of laying. After a length of pipe is placed in the trench, the spigot shall be centered in the bell end of the adjacent pipe section, the pipe shoved into position and brought to true alignment and secured with sand tamped under and on both sides of the pipe except at bell holes. Adequate support shall be provided for all water main pipe.

H. After the bottom of trench has been excavated the pipe bedding material will be installed in accordance with Section 31 2333, Trenching and Backfilling. The pipe shall then be installed strictly in accordance with the manufacturer's recommendations. After the pipe is laid, the bedding shall be continued above the pipe as specified in Section 31 2333, Trenching and Backfilling. Particular care shall be taken to assure filling and tamping all spaces under, around and above the top of the pipe.

I. A continuous and uniform bedding as specified in Section 31 2333, Trenching and Backfilling, shall be provided in the trench for all buried pipe.

J. Backfill shall be as indicated on the Plans and as specified in Section 31 2333, Trenching and Backfilling.

K. Install bolts, studs, and nuts of the type specified per the manufacturer's installation and torquing requirements. All steel bolts, studs, and nuts shall be painted with bituminous paint after installation.

3.04 Installation of Ductile Iron Pipe

A. Push-on-joints shall be made by means of a compression type push-on resilient gasket. Gasket shall be prelubricated before installation using a lubricant recommended by the pipe manufacturer. The seated joint shall be identified by the visible mark on the spigot of the installed pipe section.

B. Mechanical joints shall be made with bolts, molded resilient gasket and cast iron follower gland. Nuts shall be screwed up finger tight before using a wrench. The gland and rubber gasket shall be brought up evenly at all points around the bell flange and then torqued per the manufacturer's recommendations.

C. Exposed portions of bolts shall be covered with mastic.

D. Flexible joint pipe shall be assembled, handled and installed in accordance with the printed recommendations which accompanies the pipe and is provided by the manufacturer of the piping materials being installed. Methods of handling and installation shall be acceptable to ENGINEER.

3.05 Installation of Concrete Pipe

A. Pipe and fittings shall be jointed by means of a resilient gasket and steel spigot ring. Resilient gasket shall be lubricated and installed to form a watertight joint between the bell and spigot of the pipe.

B. Pipe shall be laid in accordance with the accepted tabulated laying schedule and the Plans. Short lengths of pipe (ten (10) feet or less) (3 m) specified under Article 1.06 of this Section shall be installed and evenly distributed along the line of the Work, if required.

C. Bell of the pipe in place shall be cleaned and properly lubricated and pipe section installed. After the spigot is well entered into the bell and the gasket is fully compressed and brought to final shape, prior to driving the pipe home, check each gasket for proper position around the full circumference of the joint and complete installation.

D. Provide cloth bands wired around each joint outside diameter and grout with Portland cement mortar grout. Completely fill the annular recess between the adjoining bell and spigot pipe ends. Annular spaces between pipe ends on the inside of joints of pipe 24 inches (600 mm) or more in diameter shall be filled with Portland cement mortar grout.

3.06 Installation of Polyvinyl Chloride Pipe

A. Polyvinyl chloride pipe shall be laid with gasketed joints in complete accordance with AWWA C605 and the pipe manufacturers published instructions. Joints shall be sufficiently lubricated using the pipe manufacturers recommended lubricant.

B. Gaskets for pipe joints shall be inserted with the painted edge facing the end of the bell. Each length of pipe shall be pushed home individually. Pipe shall be positioned so that the reference mark on the spigot end is in line with the bell end.

C. Tracer wire is to be installed along with PVC water mains. Tracer wire is to be continuous from end to end and terminate at each structure in such a way and with a sufficient length of wire to allow for easy connection to utility tracing equipment. Wire shall be continuity tested after installation. Any wire which fails the continuity test shall be replaced.

3.07 Installation of Restrained Joints

A. Restrained joints shall be provided where indicated on the plans. Joints shall be assembled in strict accordance with manufacturer's directions. Joints shall be fully extended after assembly.

3.08 Fittings, Strapping, and Lugged Pipe

A. Install all fittings to the lines, levels and locations indicated on the Plans. Fittings shall be provided with restraints as specified herein, as indicated on the Plans, or as required for a functional installation.

B. Where indicated on the Plans or as determined by ENGINEER, bends in water main piping and piping runs subject to impact reaction shall be secured by means of metal strapping. Install all necessary bands, tie rods, nuts, and washers required. No metal strapping shall be used in direct contact with polyvinyl chloride pipe.

C. Where lugged pipe and special fittings are indicated on the Plans, furnish and install all necessary tie rods, nuts, and washers.

3.09 Polyethylene Encasement

A. Where called for on the plans, ductile iron water main, fittings and hydrants shall be encased in a polyethylene film tube.

1. Service taps, bends, tees and other connections shall be made to polyethylene encased pipe in accordance with section 4.4.6 of AWWA C105.

B. Polyethylene film tube shall be installed in accordance with ANSI/AWWA C105/A21.5, Method A.

1. Method A consists of cutting the polyethylene tube two feet longer than the pipe to provide an overlap at the joints.

C. The cost of the polyethylene encasement shall be incidental to the water main.

3.10 Valves

A. Valves shall be installed to the grade, lines, levels and locations indicated on the Plans.

B. Valve connections shall be as specified for the piping materials used. Valves shall be set with the stem plumb on permanent, firm foundations as indicated on the Plans.

C. Where required, valves shall be supported with special supports as indicated on the Plans and as approved by ENGINEER. Valves shall be installed so as not to receive support from the connecting pipe. In no case shall valve installation be used to bring misaligned pipe into alignment.

3.11 Line Tapping

A. Traditional line tapping methods shall be used for the installation of all insertion valves to allow removal of a single coupon for system evaluation. Reaming the pipe, complete removal of a section of pipe (top and bottom) or milling a slot in the pipe shall be prohibited.

B. Insertion valves must be installed by companies trained and authorized by the approved valve manufacturer. This will ensure high quality installation and guarantee the warranty of the product.

C. Tapping shall be accomplished without interruption of service.

3.12 Water Main Structures

A. Construct water main valve wells and structures to the grades, lines and levels indicated on the Plans and as specified. Structures shall be complete with concrete bases, reinforcing, frames, covers, adjustment rings, etc. as shown and as required for a complete installation. Construction of water main structures shall conform to the type of construction and dimensions indicated on the Plans and as described below.

B. Block Structures:

1. Construct concrete block structures in the locations and according to the details on the Plans. The first course of concrete blocks shall be placed on the prepared base or footings in a full bed of mortar.

2. Mortar joints shall be full and close in courses. Courses shall be level throughout. Stagger joints in adjoining courses by one-half the length of the block as nearly as practicable.

3. Joints shall be uniform in thickness throughout the structures. Strike joints and properly point to provide true, smooth surfaces.

C. Precast Concrete Structures:

1. Construct precast concrete structures as detailed on the Plans. Provide mortar joints struck smooth. Provide two (2) to four (4) courses of 8-inch (200 mm) brick at top of structure for future adjustment.

D. Cement mortar plaster coat shall be applied to the exterior surfaces of all brick or block gate wells and other water main structures indicated on the Plans. Plaster coat shall be 1/2 inch (10 mm) thick and shall be applied to the outer surfaces of the structures.

E. Provide and install to the elevations shown cast iron covers, frames, adjusting rings, anchors, etc., indicated on the Plans and as required. Castings shall be set in a full bed of cement mortar 1/2 inch (10 mm) thick minimum. Mortar joints shall be struck smooth.

F. Install steps for structures of types and in locations indicated on the Plans. Steps shall be installed on 16-inch (400 mm) centers minimum, unless shown otherwise on the plans.

G. Pipe placed in structures for inlet or outlet connections shall extend through the walls and beyond the outside wall surfaces a sufficient distance to allow for complete connections. Openings between pipes and walls shall be sealed with a full bed of cement mortar. Pipe shall be supported by concrete supports.

3.13 Valve Boxes

A. Install valve boxes to the grade, lines, levels and locations indicated on the Plans. Valve boxes shall not transmit shock or stress to the valve and shall be set plumb with covers centered over operating nuts and flush with the indicated surface elevations. Valve boxes that shift or fill during backfilling shall be uncovered and reset.

3.14 Hydrants

A. Hydrants shall be installed plumb to the lines, levels, grades and locations indicated on the Plans. Hydrants shall be set to the established grade, shall have their nozzles parallel to or at right angles to and facing the grade or curb.

B. Where necessary to adjust for proper hydrant location, CONTRACTOR shall install additional pipe between the water main and road box. Hydrant extensions shall be installed to adjust hydrant to proper grade.

C. CONTRACTOR shall plumb hydrants at the time they are set with a plumb line or other means acceptable to ENGINEER.

D. Upon substantial completion of cleanup, CONTRACTOR shall recheck hydrants for plumb and grade and shall make adjustments as necessary at this time.

E. The Work of constructing fire hydrants shall not be considered complete until these final adjustments for plumb and grade have been made.

3.15 Fire Hydrant Approaches

A. Fire hydrant approaches shall consist of culvert pipe with end protection and a gravel approach.

B. Culvert pipe shall be of the size and type shown on the Plans. Pipe shall be installed to the existing or proposed grade of the drain or ditch with pipe bedding and backfill from a point 4 inches (100 mm) below the pipe to a point 12 inches (300 mm) above the top of the pipe, consisting of bank run sand meeting the requirements of MDOT Class II granular material and compacted to 95% of maximum unit weight. Each end of the culvert pipe shall be protected against erosion, as shown on the Plans.

C. Gravel approach shall extend from the edge of the traveled portion of the road to the fire hydrant and shall be a minimum of ten feet (3 m) wide. Approach shall consist of a minimum of six (6) inches (150 mm) of compacted 22A or 23A aggregate, with calcium chloride applied at a rate of six (6) pounds per Ton (3 kg per metric ton) of aggregate.

3.16 Air Release Assembly

A. Provide materials and construct air release assemblies where indicated on the Plans. Install valves, fittings, caps, plugs and piping as required. Fittings and joint materials used for air release assemblies shall be as specified herein for the water main piping materials used.

3.17 Blow-off Assembly

A. Provide materials and construct blow-off assemblies where indicated on the Plans.

B. Blow-off assemblies and pipe shall be installed to the lines, levels and elevations shown. Install valves, fittings, reducers, piping, plugs, joints, etc., as detailed.

C. Blow-off assemblies shall be installed on stable, undisturbed earth materials with changes in directions and returns provided with bedding and restraints as indicated on the Plans, as specified herein and as required for a complete installation.

D. Blow-off assemblies shall include valve boxes as detailed.

3.18 Tapping Valve Assembly

A. Install tapping valve assemblies of sizes and to the lines, elevations, locations and details indicated on the Plans.

B. Tapping sleeve shall be assembled around the main, and the tapping performed in strict accordance with the manufacturer's recommendations.

C. Tapping shall be accomplished without interruption of service.

3.19 Anchors, Encasements, and Restraints

A. Plugs, tees, sleeves, bends, caps, straps and lug piping shall be provided with suitable anchors, encasements and restraints as indicated on the Plans. Anchoring, encasement and restraint methods shall be as detailed. Bearings shall be as shown. Anchors, encasements and restraints shall rest on firm, stable, compacted subgrade and shall be provided for all standard and special fittings.

3.20 Water Service Lines

A. When so indicated in the Proposal, or on the Plans, CONTRACTOR shall provide water service lines in accordance with this Section. Otherwise, water service lines are not required.

B. Water service lines shall be installed after the water main has been successfully tested and put into service, including the installation of fire hydrants.

C. Service lines shall be of the type indicated on the Plans, and shall be 3/4 inch (20mm) diameter unless otherwise indicated on the Plans or Proposal.

D. Water service lines shall be provided for all lots or parcels at the locations indicated on the Plans, within these Contract Documents or as designated by ENGINEER. Service lines shall extend from the water main to within 1-foot (300 mm) of the limits of a right-of-way or easement at a minimum 5-foot (1.5 m) depth terminating with a curb stop and curb box as specified herein.

E. Water service lines under concrete or asphalt pavements shall be installed by boring or tunneling, unless otherwise indicated on the Plans or approved by ENGINEER.

F. Backfilling of open cut construction for water services shall be in accordance with Section 31 2333, Trenching and Backfilling, after the service line, including curb stop, has been laid and approved by ENGINEER. Prior to backfilling the service line CONTRACTOR shall request an inspection by ENGINEER and obtain approval of the service line.

G. Alternative methods such as hydraulic jacking; air jetting; piston mole; etc, may be used to install water service lines if approved by ENGINEER.

1. Proposed method must be approved by the governmental agency having jurisdiction over the work area and CONTRACTOR must demonstrate that, in the opinion of ENGINEER, the method is suitable for local soil and ground conditions.

2. To be found suitable for local conditions, the method must be demonstrated to perform within acceptable horizontal and vertical accuracy limits, must not compress soil beyond acceptable limits, and must not leave voids in the soil. Water jetting shall not be permitted.

3. Final installation of the service pipe must be in accordance with manufacturer's recommendations and no joints or fittings shall be allowed under roadway surfaces.

H. Existing water mains shall be kept in service until all water services have been connected to the new mains. CONTRACTOR shall repair all water services damaged during the installation of the new water mains. Only after the new mains have been accepted and put into service, will service connections be made to the new mains.

I. Reconnection of Water Services:

1. Connection of existing service lines to the new mains shall be made within the street rights-of-way or within the easements, utilizing the existing curb stops.

2. Existing lead water service lines shall be abandoned and new water service lines installed from the new water main to the existing curb stops.

J. Backfill, method of construction under pavements, and new water service lines shall be as specified in this Section.

3.21 Corporation Stops

A. Corporation stops shall be located on water main piping where indicated on the Plans, or as determined by ENGINEER.

B. Corporation stops on PVC water mains shall be made with service saddles.

C. Install a minimum of two (2) corporation stops in each valve well.

D. One-inch (25 mm) tapping outlets shall be installed at approximately 20-foot (6 m) intervals along the entire length of the concrete water main. Tapping outlets shall be constructed as detailed on the plans and shall be positioned 45 degrees off vertical. Location of the tapping outlets shall be marked by means of No. 4 (No. 13M) reinforcing rod. The rod shall be placed in a vertical position immediately adjacent to, but not touching, the water main and the top, six (6) inches (150 mm) below finished grade.

3.22 Service Saddles

A. Where service saddles are to be installed, the entire circumference of the main shall be free of loose material. Installation of the saddle and tapping of the main shall be in accordance with manufacturer's recommendations.

3.23 Curb Stops

A. Install curb stops of the types and sizes indicated on the Plans. Curb stops shall include furnishing and installing a curb box.

3.24 Abandoning Water Main

A. Install cap with a minimum 2-inch (50 mm) diameter threaded opening at one end of water main to be abandoned and solid cap at opposite end.

B. Install a minimum 2-inch (50 mm) diameter stand pipe no farther than 1-foot (0.3 m) from the end with the solid cap in the top of the water main to be abandoned. The stand pipe should be installed such that it can be removed after use and the hole sealed.

C. Install a minimum 2-inch (50 mm) diameter drain pipe in threaded opening. Pipe shall be installed in the opposite end of the water main from the stand pipe. Pipe should bend up to a 90 degree angle with the end of the pipe being a minimum of six (6) inches (150 mm) above the top of the water main.

D. Using the stand pipe, fill the water main to be abandoned with flowable fill material. Material shall be placed in the water main until free water flows from the drain pipe at the opposite end.

E. Continue filling water main until the material released at the drain pipe is representative of the flowable fill being introduced at the fill end of the water main, at which time the drain pipe will be sealed with a threaded cap and the filling terminated.

F. Remove the stand pipe and cap the filling hole.

3.25 Relocate Water Main

A. Relocate water main shall consist of removing and relaying and existing water main to go under or over a proposed utility. Existing pipe shall be removed and disposed of. Bends and vertical anchors shall be installed as shown on the plans. Verticals anchors and thrust blocks shall be sufficient to resist thrust forces.

3.26 Abandon Existing Gate Valve and Well

A. Gate valve and well, and other water main structures on the existing water main, shall be abandoned and the structures shall be abandoned in accordance with the following:

1. Abandonment of existing structures shall consist of removing and salvaging the existing frame and cover.

2. The valve shall be opened.

3. Masonry shall be broken down to an elevation at least 3-feet (1 m) below the subgrade.

4. Abandoned structure shall be backfilled with flowable fill to 1-foot (300 mm) above the pipes and the remainder of the structure with sand-cement mixture at a 10 to 1 ratio to subgrade elevation or to 1-foot (300 mm) below finished grade.

3.27 Remove Gate Valve and Well

A. Gate valve and well, and other water main structures on the existing water main, shall be removed in accordance with the following:

1. Removal of existing structures shall consist of removing and salvaging the existing frame and cover, and valve.

2. Ends of the existing water main shall be plugged and braced.

3. Complete structure shall be removed entirely and disposed of.

4. Excavation shall be backfilled with sand and compacted to 95 percent of its maximum unit weight.

3.28 Remove Existing Fire Hydrants

A. Fire hydrants on the existing water main shall be removed by excavating and removing the existing fire hydrant, gate valve, and valve box.

1. Existing hydrant lead shall be capped and blocked.

2. Fire hydrant, valve, and box shall be salvaged and delivered to a location as designated by OWNER.

3. Excavation shall be backfilled with sand and compacted to 95 percent of its maximum unit weight.

3.29 Relocation of Fire Hydrants

A. Relocation of hydrants shall include the provision of new hydrant shoes, frost jacket and restraints.

B. Provide new materials required for hydrant relocation.

C. Reinstall hydrants at the new locations to the lines and levels shown.

D. Make joint connections to new or existing water mains, joints, couplings, etc., as shown and as required.

E. Provide anchorage and restraint for a complete installation.

3.30 Hydrostatic Testing

A. General:

1. After the pipe has been laid and backfilled, the pipe shall be hydrostatically tested for leakage. CONTRACTOR shall furnish the pump, pipe connection, hydrants, valves and any other necessary apparatus including gages and meters and all personnel necessary for conducting the test. Before applying the test pressure, all air shall be expelled from the pipe. If necessary to accomplish this, taps shall be made at points of higher elevation and afterwards plugged.

2. Test sections shall not exceed 1 mile (1.6 km) and in the event more than 1 mile (1.6 km) of water main is tested, the permissible leakage will remain at the amount determined for 1 mile (1.6 km) of pipe.
3. Hydrostatic testing shall conform to AWWA C600.

B. Testing Ductile Iron Water Main:

1. The test shall be made at a pressure of 150 pounds per square inch (1 MPa) gage minimum. Full pressure shall be held for at least 2 hours.

2. Any faulty pipe fitting, gate valves or other accessories which permit leaks during testing shall be replaced by CONTRACTOR with sound material and the test shall be repeated until specified requirements are met.

C. Testing PVC Water Main:

1. The test shall be made at a pressure of 150 pounds per square inch (1 MPa) gage minimum. Full pressure shall be held for at least 2 hours.

2. Any faulty pipe fitting, gate valves or other accessories which permit leaks during testing shall be replaced by CONTRACTOR with sound material and the test shall be repeated until specified requirements are met.

D. Allowable Leakage:

1. The maximum allowable leakage measured by water meter from the section of main tested shall not exceed a rate of 10 US gallons per inch diameter of the main being tested, per mile of pipe, in a 24-hour period while under pressure. If more than one section of pipe is being tested at a given time, the maximum allowable leakage will be based on the shortest section.

a. No pipe installation will be accepted if the leakage is greater than the allowable leakage calculated in accordance with the following formula:

$$L = \frac{S * D * (P)^{1/2}}{148{,}000}$$

Where: L = allowable leakage, in gallons per hour
S = length of pipe tested, in feet
D = nominal diameter of the pipe, in inches
P = average test pressure during the leakage test, in pounds per square inch (gauge)

Allowable Leakage per 1000 Feet of Pipeline Tested

Average Pressure (psi)	Nominal Pipe Diameter in Inches											
	3	4	6	8	10	12	14	16	18	20	24	30
175	0.27	0.36	0.54	0.72	0.89	1.07	1.25	1.43	1.61	1.79	2.15	2.68
150	0.25	0.33	0.50	0.66	0.83	0.99	1.16	1.32	1.49	1.66	1.99	2.48
125	0.23	0.30	0.45	0.60	0.76	0.91	1.06	1.21	1.36	1.51	1.81	2.27

3.31 Flushing

A. After completion of water main installation, flush the new mains, valves, hydrants and appurtenances completely and as acceptable to ENGINEER.

B. Heavily chlorinated water discharged from a disinfected system shall be controlled adequately to protect any surface water resource or adjacent property from potential environmental damage, or from creation of a hazard to traffic.

C. Remove and dispose of all temporary installations at completion of the flushing operation.

D. After flushing, and prior to final approval of the system, CONTRACTOR shall pump down all fire hydrants and verify that the hydrant valve is properly seated to prevent the hydrant standpipe from filling with water.

3.32 Disinfection

A. General:

1. Potable water pipelines, except those appurtenant to hydraulic structures, shall be disinfected in accordance with the requirements of ANSI/AWWA C651 using the Continuous-Feed Method as modified herein.

B. Chlorination:

1. The liquid mixture shall be applied by means of a solution-feed chlorinating device.

2. CONTRACTOR shall install corporation stop and feed chlorine solution through the corporation stop at the beginning of the main or valved section.

2. The chlorine solution shall be introduced at one end of the pipeline through a tap in such a manner that as the pipeline is filled with water, the dosage applied to the water entering the pipe shall be approximately 50 mg/l. Free chlorine concentration at initial chlorination shall be a minimum of 25 mg/l.

3. An open discharge shall be maintained at the far end of the section of main being chlorinated, and the introduction of chlorine solution and water shall continue until the water discharging at the far end shall carry the required dosage of chlorine.

4. As the main is filled with chlorinated water, each outlet from the main shall be opened and sufficient water drawn off to assure that the full dosage of chlorine reaches each outlet.

5. Back pressure causing a reversal of flow in the main being chlorinated shall be prevented, and pressure in the main shall be held down to a point which will make it impossible for chlorinated water to be forced into other sections of the main or water system.

6. The chlorine treated water shall remain in the main at least 24 hours, and at the end of that time the chlorine residual at pipe extremities and other representative points shall be at least 10 mg/l. If the chlorine residual shall be less than 25 ppm at the end of 24 hours, further application of chlorine shall be made and the retention period repeated until the required 10 mg/l residual is obtained.

C. Repetition of Test:

1. The disinfection testing procedure shall be repeated if the initial tests fail to produce satisfactory results.

2. Two consecutive satisfactory test results shall be required after any unsatisfactory test.

3. The tablet method shall not be used for repeated disinfection.

3.33 Water for Cleaning, Testing and Disinfection

A. Water for cleaning, testing and disinfection shall be obtained from a potable water supply. CONTRACTOR shall provide all water required at his own expense and shall make all necessary arrangements with the authority which controls the source of water system and shall be governed in his use of water by all rules and regulations imposed thereon by said authority.

B. CONTRACTOR shall provide and remove temporary connections between the source water system and the mains constructed under this contract. All temporary connections shall meet the approval of the ENGINEER, the authority controlling the source water system, and Public Health authorities having jurisdiction.

C. CONTRACTOR shall be responsible for the safe disposal of chlorinated water flushed from water mains following disinfection procedures. CONTRACTOR shall be responsible for disposing of disinfecting solution in a manner in accordance one of the following approved manners:

1. Discharge chlorinated water directly into a nearby sanitary sewer provided that the water will receive subsequent treatment and disposal by a properly permitted wastewater treatment plant.

2. Dechlorination may be required by the wastewater treatment plant prior to receiving the discharge water.

a. CONTRACTOR must obtain written permission from the wastewater treatment plant prior to discharge and shall verify whether or not dechlorination is necessary prior to disposal.

b. CONTRACTOR shall submit a copy of the written authorization from the wastewater treatment plant to ENGINEER and the OWNER prior to disposal.

3. Discharge chlorinated water to a surface water body, either directly or indirectly (i.e., through a storm sewer).

   a. Prior to discharging, CONTRACTOR shall obtain a National Pollutant Discharge Elimination System (NPDES) general discharge permit, and shall comply with the associated monitoring and reporting requirements of the issuing agency, including dechlorination.

   b. CONTRACTOR shall submit a copy of the NPDES permit to the ENGINEER and the OWNER prior to disposal.

4. Discharge chlorinated water to the ground under Act 451 of the Part 31 Rules.

   a. Prior to discharging, CONTRACTOR shall dechlorinate the water to below four (4) milligrams per liter (mg/L).

   b. Following dechlorination, CONTRACTOR shall discharge to an area large enough, and with suitable soils, to prevent site runoff.

5. CONTRACTOR must obtain written permission from the landowner where the discharge is to take place and written verification that dechlorination is or is not necessary prior to disposal and that a value of less than 4 mg/L of chlorine is present within the water.

   a. CONTRACTOR shall submit a written copy both the ENGINEER and the OWNER prior to disposal.

3.34 Bacteriological Analysis

A. General:

1. Prior to placing a water main in service, not less than two (2) consecutive water samples taken 24 hours apart for bacteriological analysis shall be collected and each analysis shall show results meeting state and local drinking water standards.

2. Samples will be taken at locations indicated in ANSI/AWWA C651 and will be tested for coliform organisms and heterotrophic plate count according to the latest edition of the *Standard Methods for the Examination of Water and Wastewater*.

3. CONTRACTOR shall collect water samples and cause analyses to be made at his own expense. Samples shall be collected in accordance with AWWA C651. Testing laboratory and sample collection shall meet the approval of public agency having jurisdiction.

4. If disinfection fails to produce satisfactory bacteriological counts, the pipe shall be re-flushed and will be resampled and retested.

   a. If counts from analysis of the second samples exceed the criteria in Standard methods, the pipe shall be re-disinfected and will be resampled and retested until satisfactory results are obtained.

b. CONTRACTOR shall be responsible for all repeat bacteriological testing costs.

B. Sampling:

1. Per AWWA Standards, no sampling stations shall be at a distance greater than 1,200 feet.

2. Mains shall be flushed at an adequate velocity prior to sampling to remove any debris remaining in the pipe.

3. Sampling must be accomplished by a certified treatment/distribution operator or an employee of a certified laboratory. This certification will be evidenced in the approved plan.

4. At OWNER's discretion, the source water will be sampled, or the nearest water quality sample station's most recent results will be used to determine the baseline water quality.

5. Samples must be collected from extreme ends, all branches of the new main and at a minimum 300-foot interval. The sample points will also be part of the approved plan.

6. The temperature and total chlorine residual will be measured with a field test kit and recorded by the sampler on the "chain of custody" form.

7. After another 24-hour period, a second set of samples will be collected from the same sample points.

8. Both sets will be analyzed for total and fecal coliform presence/absence and heterotrophic plate count.

9. OWNER reserves the right to sample for bacteria at its own discretion with notice.

C. Laboratory Report:

1. General:

a. Lab results will be reported on a chain of custody, lab work sheet, or summary letter imprinted with the laboratory's name, address, and phone number.

(1) The report will include the field tests and laboratory analysis.
(2) The report will be signed by the laboratory director.

b. It will be OWNER's right, and responsibility to reject the report if any data is missing or suspect due to conflicting indications.

3.35 Cleaning (Pigging)

A. When required in the plans or specifications, water main shall be mechanically cleaned. Cleaning shall be with a metal bodied, mandrel type solid plug (pig) with scrapers. The pig shall be pulled or otherwise propelled through the entire line prior to testing or connecting to any existing water main.

End of Section

Section 33 3000
Sanitary Utility Sewerage Piping

Part 1 General

1.01 Scope of Work

A. This Section includes sanitary sewer Work indicated on the Plans complete with pipe, joints, structures, pipe bedding, installation, television inspection, and testing.

1.02 Related Work Specified Elsewhere

A. Section 01 2200: Unit Prices
B. Section 04 0511: Mortaring and Grouting
C. Section 31 2316: Structural Excavation and Backfill:
D. Section 31 2333: Trenching and Backfilling

1.03 Requirements of Regulatory Agencies

A. Testing shall conform to the applicable requirements of State and local authorities having jurisdiction, and shall include such tests as: deflection, air, exfiltration and infiltration.

1.04 Reference Standards

A. Unless otherwise specified, the Work for this Section shall conform to the applicable portions of the following Standard Specifications:

1. ANSI - American National Standard Institute

2. ASTM - American Society for Testing and Materials

3. MDOT - Michigan Department of Transportation, Standard Specifications for Construction, latest edition

4. NCPI - National Clay Pipe Institute

1.05 Source Quality Control

A. Laboratory test not less than 1 percent, with a minimum of 3 pieces, each size, material and class of gravity pipe required in the Work.

1.06 Tolerances

A. The actual grade of the invert of the sewer shall not deviate from plan grade by more than 0.1 feet/100 feet (0.03 m/30 m), and not more than 0.2 ft. (60 mm) in total for a sewer run from manhole to manhole.

B. Alignment of sewer shall be within 0.2 feet/100 feet (0.06 m/30 m) and within 0.5 feet (150 mm) in total for a sewer run from manhole to manhole.

1.07 Submittals

A. Submit independent grade checks in accordance with Article 3.06 of this section.

B. Submit manufacturer's data for pipe bulkheading devices in accordance with Article 3.13 of this Section.

C. A complete field report of the location of wyes, risers and building leads shall be submitted to ENGINEER at the end of each sewer section of the Project or on the last day of each week, whichever occurs first.

1. Complete field report shall include witnessing by CONTRACTOR of the ends of building leads placed. Witnessing shall consist of recording 3 horizontal distances to the nearest foot (0.3 m) with the lines of measurement at minimum angles of 45 degrees with respect to one another. Witnessing shall also include recording of the depth to nearest 1/2 foot (0.1 m) from the invert at the end of the lead to the finish ground above the end of the lead.

2. No payment will be made for un-witnessed installation or for improperly witnessed installations.

D. As part of the television inspection, a wye location report shall be submitted to ENGINEER. The report shall contain the precise location of each wye, notes, photographs, and other pertinent information.

E. Submit 2 copies of the laboratory test reports required per Article 1.05 of this Section to ENGINEER.

F. Shop Drawings shall be provided of all manhole tees.

1.08 Storage of Materials

A. Piping material shall not be stacked higher than 4 feet (1.2 m). Suitable racks, chairs, and other supports shall be provided to protect preformed pipe mating surfaces from damage. Store bottom tiers off the ground, alternate tiers and chock tier ends.

B. Joint and sealing materials used in the sanitary sewer system shall be protected from sunlight and stored in cool and clean place until ready for installation.

1.09 Handling of Material

A. Load and unload piping using suitably approved hoists, skids, etc. Piping shall not be dropped, bumped or allowed to impact against itself. Damaged piping not be used by CONTRACTOR.

B. Lifting devices shall be suited to the Work and shall protect surfaces from damage.

Part 2 Products

2.01 General

A. It is the intent of the Articles in Part 2 of this specification section to specify in detail the various types of sewer pipe, joints, manholes, etc. which have been indicated throughout the Plans and specifications. These Articles shall not be construed as allowing any alternate type of material to that which is indicated on the Plans or elsewhere in the specifications.

2.02 Clay Pipe Systems

A. Pipe shall conform to ASTM C700, extra strength vitrified clay pipe.

B. Joints for clay pipe shall meet the requirements of ASTM C425. Joints for house leads shall be limited to approved compression type joints with the sealing element bonded to the bearing surfaces.

C. Only lubricant as supplied by the pipe manufacturer shall be used on the bell and spigot in making up joints and the joints shall be coupled in accordance with the pipe manufacturer's requirements.

D. Wyes and tees shall be manufactured to the same standards as the pipe. Wye and tee fittings shall be furnished with the spurs securely fastened by the manufacturer to the barrel of the pipe. There shall be no projection on the inner surface of the pipe.

2.03 Precast Concrete Pipe Systems

A. Non-reinforced Concrete Pipe:

1. Pipe shall conform to ASTM C14 Class III nonreinforced concrete sewer pipe.
2. See Article 2.03.C for requirements for joints.

B. Reinforced Precast Concrete Pipe System:

1. Pipe shall be ASTM C76. 10-inch (250 mm) diameter pipe shall have steel and concrete as specified for 12-inch (300 mm) diameter pipe, ASTM C76, Class II through Class V, Wall B or Wall C, circular reinforced.

2. Twelve (12) -inch through 30-inch diameter (300 mm through 750 mm) pipes shall be ASTM C76, Class II through V, Wall B or Wall C, circular reinforced.

3. Thirty-six (36) -inch through 108-inch (900 mm through 2700 mm) diameter pipes shall be ASTM C76, Class I through V, Wall B or Wall C, circular or elliptical reinforced.

4. When elliptical reinforcement is used, the following method of indexing the steel and the pipe barrel shall be used:

5. A dummy lift pin form shall be set in the outer pipe wall form projecting into the pipe wall a minimum 1-3/4 inches (45 mm) and a maximum of 2-1/4 inches (55 mm). An additional spacer chair shall be welded to the elliptical steel cage at the proper location so as to engage the dummy lift pin form during the pipe casting operation.

6. It is the intent of the spacer chair and dummy lift pin arrangement to provide a means of assuring the final position of the elliptical steel cage within the barrel of the pipe and, for providing a means of indexing the pipe in the field to assure proper placement of the pipe.

7. Prior to shipment of the pipe, they shall be striped along the inside top with a minimum 1-inch (25 mm) wide indelible marker so that final inspection of the pipe orientation can be made following completion of the installation.

8. For pipe 114 inches (2850 mm) or larger in diameter, the design information in accordance with Section 6 of ASTM C76, shall be submitted to ENGINEER for approval, prior to fabrication. The design of pipes shall meet the D-load requirements for the class of pipe indicated on the Plans.

C. Joints for Concrete Pipe:

1. Premium joints for concrete pipe shall be ASTM C443 limited as follows: Section 6.1 of C443, "Physical Requirements for Gaskets," shall be replaced with Section 6.9 of C361, "Rubber Gaskets." Also, Section 5 of C443 shall be limited to a modified grooved tongue to receive an "O" ring rubber gasket.

2. For concrete pipe sizes 10-inch to 24-inch (250 mm to 600 mm), the modified grooved tongue and bell ends of the pipe shall be made smooth and shall not have over a 3-1/2-degree slope formed to fit the rubber gasket to tolerances as determined by the manufacturer. Pipe tongue shall not be out of round by more than ± 1/16 inch (1 mm).

3. For pipe sizes 27 inches to 108 inches (675 mm to 2700 mm), the modified groove and bell ends of the pipe shall be smooth and shall not have over a 2-degree slope, formed to fit the rubber gasket to tolerances as determined by the manufacturer.

4. For pipe sizes 36 inches (900 mm) and larger, the tongue shall be reinforced with an amount of circular steel equivalent in area to the inner steel cage specified for the pipe barrel and the bell shall be reinforced with an amount of circular steel equivalent in area to the outer steel cage specified for the pipe barrel.

5. For pipe sizes under 36 inches (900 mm) in diameter, including C14-XM5 extra strength, the bell or tongue shall be reinforced. Where the reinforcing steel for the tongue, barrel and bell is not continuous, the steel shall be lapped a minimum of two (2) inches (50 mm).

6. Only lubricant, as supplied by the pipe manufacturer, shall be used on the groove and on the tongue in making up joints, and the joints shall be coupled in accordance with the pipe manufacturer's requirements.

7. Joints in concrete pipe 36 inches (900 mm) in diameter and larger shall have the inside annular space filled with cement mortar and troweled flush. Mortar shall consist of 1-part Portland Cement and two (2) parts of plaster sand. Mortar for inside joints shall be mixed with only enough water for dry packing.

D. Wyes and Tees:

1. Wyes and tees shall be manufactured to the same standards as the pipe. Spurs shall be of the same size and type as the house lead/riser pipe. Wye and tee fittings shall be furnished with the spurs securely fastened by the manufacturer to the barrel of the pipe. There shall be no projection on the inner surface of the pipe.

2.04 ABS Pipe

A. Acrylonitrile-Butadiene-Styrene (ABS) Truss pipe shall be constructed in accordance with ASTM D2680. Pipe shall be of a double wall construction, braced with a truss-type structure with all three (3) formed in one (1) extrusion. Truss voids shall be filled with lightweight concrete to provide additional compressive strength and bracing.

B. Solid wall pipe shall conform to ASTM D2751, SDR 23.5.

C. Joints for Acrylonitrile-Butadiene-Styrene (ABS) composite pipe shall be ASTM D2680, Type S.C., a solvent-cemented joint in which pipe solvent cements into a coupling socket to form the joint closure. Installation of the solvent cement shall be in strict accord with the manufacturer's recommendations.

D. Wyes and tees shall be manufactured to the same standard as the pipe. Spurs shall be of the same size and type as the house lead/riser pipe. Wye and tee fittings shall be furnished with the spurs securely fastened by the manufacturer to the barrel of the pipe. There shall be no projection on the inner surface of the pipe.

2.05 PVC Truss Pipe

A. Polyvinyl Chloride (PVC) truss pipe shall be ASTM D2680. The pipe shall be of a double wall construction, braced with a truss-type structure with all three (3) formed in one (1) extrusion. The truss voids are filled with lightweight concrete to provide additional compressive strength and bracing.

B. Joints for Polyvinyl Chloride (PVC) pipe shall be elastomeric gasketed conforming to ASTM D3212, push on type joint.

C. Wyes or tees shall be a molded wye or tee fitting per ASTM D2680, with gasketed joints on each end suitable for directly inserting in the mainline pipe. Wye and tee fittings shall be furnished with the spurs securely fastened by the manufacturer to the barrel of the pipe. There shall be no projection on the inner surface of the pipe. Branch connection fitting shall be a gasketed joint suitable for the house lead pipe specified. Saddle connections are not allowed.

2.06 PVC Solid Wall Pipe

A. PVC Solid Wall Pipe in sizes 6-inch through 15-inch (150 mm through 375 mm) shall be ASTM D3034, SDR 35, and in sizes 18-inch through 27-inch (450 mm through 675 mm) shall be ASTM F679 SDR35, polyvinyl chloride pipe (PVC).

B. Joints for polyvinyl chloride pipe (PVC) shall be ASTM D3212, push-on type. A joint in which an elastomeric ring gasket is compressed in the annular space between a bell end or socket and a spigot end of pipe.

C. Wyes or tees shall be a molded wye or tee fitting per ASTM D2680, with gasketed joints on each end suitable for directly inserting in the mainline pipe. Wye and tee fittings shall be furnished with the spurs securely fastened by the manufacturer to the barrel of the pipe. There shall be no projection on the inner surface of the pipe. Branch connection fitting shall be a gasketed joint suitable for the house lead pipe specified. Saddle connections are not allowed.

2.07 Dual Wall Corrugated PVC Pipe – Smooth Interior

A. Pipe shall be a single extrusion of PVC with a smooth interior and corrugated outer walls. Corrugated outer profile shall be annular and seamless.

B. Pipe and fittings shall be in accordance with ASTM F949. Joints shall be bell and spigot type with an elastomeric gasket meeting the requirements of ASTM F477 and be suitable for sanitary sewer service and the testing requirements of this section.

C. Wyes or tees shall be a molded wye or tee fitting per ASTM F949, with gasketed joints on each end suitable for directly inserting in the mainline pipe. Branch connection fitting shall be a gasketed joint suitable for the house lead pipe specified. Saddle connections are not allowed.

D. Connections to manholes that utilize a rubber boot (Kor-N-Seal) shall be accomplished by sealing the rubber boot to a rubber gasket installed on the outside of the pipe with the stainless-steel band and clamp assemblies on the outside of the rubber boot. For sizes 21-inch and larger use two stainless band assemblies (with two screw clamp assemblies per band assembly) on the outside of the rubber boot, with the screw clamps staggered around the pipe so that the take-up pressure is equalized.

E. Connections to manholes with an A-Lok type connection shall use a manhole sleeve designed for connection to an A-Lok assembly with the recommended A-Lok ring number.

F. Acceptable manufacturers of Dual wall corrugated PVC pipe include Contech A2000, Uponor ETI Ultra-Corr or ENGINEER approved equal.

2.08 Structures

A. General:

1. Material for sanitary sewer structures shall conform to the requirements as indicated on the plans and as specified below. Precast concrete structures are required except when constructing a structure over an existing sewer may require limited use of concrete block or brick as approved by ENGINEER.

B. Concrete Brick:

1. Concrete brick shall be ASTM C55, Grade S-II, solid units of nominal 3-inch (75 mm) thickness.

C. Concrete Block:

1. Block shall conform to ASTM C139, Portland cement conforming to ASTM C150, Type II. Blocks shall be solid curved blocks with the inside and outside surfaces parallel and curved to the required radii. The blocks shall have a groove or other approved type of joint at the ends.

D. Precast Concrete:

1. Precast concrete manhole, flat top slabs, risers, cone, transition sections and bottom sections shall conform to ASTM C478, and shall be circular with circular reinforcement. For depths greater than 32-feet, manhole shall be designed for

the earth loading at the design depth of bury with a factor of safety of 1.5. Base slab shall be 8 inches (200 mm) thick for depths up to 25 feet (7.5 m) and 12 inches (300 mm) thick for depths greater than 25 feet (7.5 m).

2. Transition sections, reducers and flat top slabs shall be designed for the earth loading at the design depth of bury with a factor of safety of 1.5.

3. Precast doghouse sections shall be used for connections to existing sewer 15 inches (375 mm) and smaller on straight through runs for a depth up to 20 feet (6 m) and on right angle runs, with a maximum of four cutouts for depths up to 12 feet (3.5 m).

    a. Openings in precast doghouse sections shall be cast in the pipe before curing and no breaking or chipping of sections will be allowed after the manhole section has cured.

    b. The size of the opening shall be cast as indicated on the Plans.

4. Precast bottom sections shall be cast with the bottom end flat to provide bearing of the full wall thickness. Openings for sewer pipe shall be cast in the manhole and the bottom section by the manufacturer.

5. Six (6) -inch through 24-inch (150 mm through 600 mm) connections to manholes shall use a mechanically compressible flexible joint, as indicated on the Plans.

6. Twenty-seven (27) -inch (675 mm) and larger connections to manholes shall be grouted, as indicated on the Plans.

7. Riser sections of a manhole shall have modified grooved tongue joints with "O" ring gaskets or a tongue and groove joint with a Butyl Rubber based gasket type sealant meeting the requirements of AASHTO M-198 and having a nominal size of 1-inch (25 mm).

8. Eccentric cone sections of a manhole shall have modified grooved tongue joints with "O" ring gaskets and be provided with 4-stud inserts cast in the top. The top shall have a smooth finished surface.

9. Concrete grade rings shall have smooth finished top and bottom surfaces. Grade rings shall be provided with "O" ring gaskets.

10. Precast manhole tees will be allowed on straight through runs with no angle at the manhole and where stubs or openings in manhole are above the tee section.

11. Precast concrete manhole tee units shall conform to ASTM C76, Class IV and shall be circular with circular reinforcement. Precast tees must be a monolithic pour with wire cage inspection prior to concrete placement. Joints for tee shall be the same as the joints on the sanitary sewer.

E. Manhole Steps:

1. Cast iron manhole steps shall conform to ASTM A48, Class 30, gray iron with a minimum cross section dimension of 1-inch (25 mm) in any direction.

2. Steel reinforced plastic manhole steps shall be of suitably approved co-polymer polypropylene conforming to ASTM D4101, PP0344B33534Z02 with 1/2 inch (12 mm) minimum diameter deformed reinforcing bar conforming to ASTM A615, Grade 60 and shall be in accordance with ASTM C478.

3. Manhole steps shall be of the types and sizes indicated on the Plans and shall comply with applicable Michigan Occupational Safety and Health Standards (MIOSHA).

F. Manhole Frames and Covers:

1. Manhole frames and covers shall conform to ASTM A48, Class 30, gray iron and shall be of the types and sizes as indicated on the Plans. Castings shall be neatly made and free from cracks, cold sheets, holes and other defects. Surfaces of casting shall be ground to assure proper fit and to prevent rocking.

2. For manholes, use a bolted waterproof frame with a pressure tight cover. Bolted down frame and cover shall be installed as indicated on the Plans.

2.09 Steel Pipe

A. Pipe shall conform to ASTM A53, black and hot-dipped galvanized welded and seamless pipe of standard weight.

2.10 Bolt, Studs, Nuts

A. Bolt, studs, and nuts shall conform to the following ASTM Standards:
B. Cadmium Plating: ASTM B766, Grade N.S.
C. Zinc Coating: ASTM A153 or B663, Type G.S.

2.11 Concrete

A. In accordance with MDOT Section 701, use Grade S2; 3,500 psi (24 MPa) strength; Type IA cement; 6.0 sacks cement per cubic yard (355 kg/m^3); 6A coarse aggregate; 2NS fine aggregate; 6.5% ± 1.5% air content; 3-inch (75 mm) maximum slump; no admixtures without ENGINEER's approval.

2.12 Concrete Reinforcement

A. In accordance with MDOT Section 905, use ASTM A615, Grade 60 for bars and ASTM A185 for welded wire fabric.

2.13 Flowable Fill

A. Flowable Fill for Filling abandoned Sanitary Sewers:

1. Materials:

a. Cement: Cement shall conform to ASTM C150 or ASTM C595

b. Fly Ash: Fly ash shall have a maximum loss on ignition of 12 percent and meeting the other requirements of ASTM C618 (Class F)

c. Water: The water shall meet the requirements of ASTM C94

2. Mixture (Strength 50 to 100 psi) (345 to 690 kPa):

a. Fly Ash (Class F): 2,000 lbs/cyd (1185 kg/m^3) (minimum)

b. Cement: 100 lbs/cyd (60 kg/m^3) (minimum)

c. Water: Sufficient water to produce the desired flowability (approximately 700 lbs/cyd) (415 kg/m^3)

B. Temperature of the flowable fill mixture as manufactured and delivered shall be at least 50° Fahrenheit (10° Celsius).

C. Flowable fill can be mixed by pugmill, central concrete mixer, ready mix truck, turbine mixer, or other acceptable equipment or method.

D. CONTRACTOR shall submit a history of the mix design for seven day and 28 day strengths, together with any other technical information. The design mix shall also be included as part of CONTRACTOR's submittals for project.

Part 3 Execution

3.01 Verification of Excavation and Bedding

A. Prior to the installation of sanitary sewer piping, structures, or materials, examine trenches and other excavations for the proper grades, lines, levels and clearances required to receive the new Work. Ascertain that excavation bottoms, compacted subgrades and piping bedding are adequate to receive the sanitary sewer materials to be installed. Correct defects and deficiencies before proceeding with the Work.

3.02 Existing Sanitary Sewers

A. CONTRACTOR shall expose the existing sanitary sewer and structures to which the new Work is to be connected and notify ENGINEER of same. ENGINEER will verify the vertical and horizontal locations of the existing system and shall inform CONTRACTOR as to the necessary adjustments required to align the new sanitary sewer work with the existing system.

B. Connecting to an existing manhole requires removing the existing flow channel and constructing a new flow channel as necessary.

C. When connecting a new sewer to an existing sewer or a new building lead to an existing building lead, where the pipe joints are not compatible, use a "Fernco" rubber adapter. When connecting clay to clay, concrete to concrete or plastic to plastic, use stainless steel shear ring type couplers.

3.03 Verification of Pipe Class and Joints

A. Prior to the installation of any sanitary sewer piping, ascertain that the class of pipe, joint material and bedding are as specified herein and as indicated on the Plans.

3.04 Preparation of Pipe Ends

A. Outside surface of the spigot end and the inside surface of the bell end shall be cleaned and free of foreign material, other than sealant recommended by the manufacturer, prior to installation.

3.05 Examination of Material

A. Pipe, frames, covers, accessories, and appurtenances shall be examined carefully for damage and other defects immediately before installation. Defective or damaged material shall be rejected and removed from the Project by CONTRACTOR.

3.06 Installation - General

A. Each section of pipe, when placed to grade and line, shall have firm bearing on the trench bedding throughout its length.

B. Pipe shall be laid to the line and grade called for on the Plans. Each pipe as laid shall be checked by CONTRACTOR with line and grade pole or laser system to insure proper result is obtained. When employing a laser system, CONTRACTOR shall have an alternate and independent means of checking the line and grade. CONTRACTOR shall check line and grade every 100-feet minimum. The finished work shall be straight and shall be sighted through between manholes.

C. Construction shall begin at the outlet end and proceed upstream with spigot ends pointing in direction of flow. Bell holes shall be excavated so that the full length of the barrel will bear uniformly on the bedding.

D. Mechanical means shall be used for pulling home all pipe where manual means will not result in pushing and holding the pipe home. Mechanical means shall consist of a cable placed inside of the pipe with a suitable winch, jack, or come along for pulling the pipe home and holding the pipe in position.

E. After laying of pipe, care shall be taken so as not to disturb its line and grade. Any pipe found off grade or out of line shall be re-laid.

F. Cutting of pipe shall be done with approved tools and by approved methods suitable for the pipe material. Pipe cutting methods that produce a smooth, square-cut end without damage to the pipe and that minimize airborne particles shall be employed. Pipe cutting shall be performed using the recommendations of the manufacturer of the type of pipe materials being cut and according to the best trade practices. When cutting of pipe or fittings, care shall be taken to prevent damage to the lining and the exterior surface. Damage to either shall be cause for rejection of complete section.

G. During the preparation of the pipe bedding and until the trench has been satisfactorily backfilled, the trench shall be kept free of water and sewage. A dewatering system, in accordance with Section 31 2319, Dewatering, shall be provided and maintained by CONTRACTOR. The dewatering system shall remain in operation until the trench is backfilled.

H. Backfill shall be as indicated on the Plans and as specified in Section 31 2333, Trenching and Backfilling.

3.07 Pipe Laying

A. Rigid Pipe:

1. Installation of rigid pipe shall conform to ASTM C12. All pipe shall be jointed by means of a resilient gasket. The resilient gasket shall be lubricated and installed to form a watertight joint between the bell and spigot of the pipe. The bell of the pipe in place shall be cleaned and properly lubricated prior to the installation of

the next pipe spigot. The pipe shall be centered in the bell or groove. After the spigot is well entered into the bell and the gasket is fully compressed and brought to final shape, check the gasket for proper position around the full circumference of the joint. Complete installation by pushing the pipe tightly together to form a smooth and continuous invert.

2. Circular concrete pipe with elliptical reinforcement shall be installed with the lift holes on the top of the pipe. The manufacturer's marks designating the top and bottom of the pipe shall not be more than five (5) degrees from the vertical plane through the longitudinal axis of the pipe. After the pipe is installed, the lift holes shall be sealed with suitable concrete plugs and grouted.

3. When adapters are required to properly connect the new pipe to an existing pipe of other materials or manufacture, the nominal inside diameter of adapters shall be the same size as the nominal pipe diameter to which it is to be connected.

B. Flexible Pipe:

1. Installation of flexible pipe shall conform to ASTM D2321.

2. Except as otherwise specified herein, installation of ABS and PVC piping shall be made in complete accordance with the published installation guide of the pipe manufacturer.

3. Joints for ABS pipe shall be made by first applying a coat of primer to the inside of the socket and to the outside of the spigot end of the pipe.

   a. Without delay, apply a coating of cement to the same surfaces in sufficient quantity that when the spigot is fully inserted into the socket, a bead of excess cement will form around the complete circumference of the outside junction of the spigot and socket.

   b. Remove the excess cement and allow the assembly to cure 24 hours.

4. Joints for PVC pipe shall be made by using a lubricant immediately before joining.

   a. Apply lubricant on the bell and spigot, coating the entire circumference of the bell and spigot bevel plus 1-inch (25 mm) behind the taper. Insert lubricated spigot into the bell, and using normal force insert spigot until insertion stripe mark is flush with the bell entrance.

5. When jointing ABS or PVC pipe, rotate the pipe when inserting it approximately 1/4 to 1/2 turns.

6. Taps to previously installed ABS and PVC pipes, where in-line fittings are not provided, shall be made with chemically welded saddle fittings unless otherwise indicated on the Plans.

   a. Holes for saddle connections shall be by mechanical hole cutters, or by keyhole saw or saber saw.

b. Holes for saddles shall be laid out with a template and shall be deburred and beveled to provide a smooth hole shaped to conform precisely to the fitting.

c. After the cemented saddle has been fixed to the pipe surface, quickly install band clamps each side of the saddle and tighten.

3.08 Pipe Bedding

A. After the bottom of trench has been excavated the pipe bedding material will be installed in accordance with Section 31 2333, Trenching and Backfilling. The pipe shall then be installed strictly in accordance with the manufacturer's recommendations. After the pipe is laid, the bedding shall be continued above the pipe as specified in Section 31 2333, Trenching and Backfilling. Particular care shall be taken to assure filling and tamping all spaces under, around and above the top of the pipe.

B. A continuous and uniform bedding as specified in Section 31 2333, Trenching and Backfilling, shall be provided in the trench for all buried pipe.

3.09 Manhole Structures

A. General:

1. Construct sanitary sewer manhole and other sanitary structures to the grades, lines and levels indicated on the Plans, or as specified herein.

a. Structures shall be precast concrete, complete with concrete bases, reinforcing, frames, covers, and adjustment rings, as shown and as required for a complete installation.

b. Sanitary manholes as called for on the Plans shall carry a stub opening as specified herein.

c. Wye openings in manholes are prohibited unless indicated on Plans.

d. Sanitary sewer structures shall conform to the type of material and dimensions indicated on the Plans.

2. Manholes shall be completed and ready for final inspection either before 600 feet (180 m) of additional sewer construction is completed or within one (1) week after the manhole is constructed, whichever comes first.

B. Block Structures:

1. Sanitary manholes may only be constructed with block where specifically shown on the plans or where approved by ENGINEER. The first course of concrete block shall be placed on the prepared base in a full bed of mortar. Mortar joints shall be full and closed in all courses. Courses shall be level throughout. Stagger joints in adjoining courses by one-half the length of the block as nearly as practicable. Joints shall be uniform in thickness throughout the structure. Strike all joints and properly point to provide true, smooth surfaces.

2. Prior to applying plaster coat, block shall be thoroughly wetted with water and the surface allowed to dry sufficiently to effect proper bonding.

3. Construct as detailed on the Plans.

4. Where precast doghouse sections cannot be used, the manhole shall be brick or block to eight (8) inches (200 mm) above top of highest pipe. Above that point manholes shall be precast concrete as shown on the plans.

5. Cement mortar plaster coat shall be applied to the exterior surfaces of all brick and/or concrete block sections of all manholes. Plaster coat shall be 1/2 inch (10 mm) thick.

6. Provide and install all cast iron covers, frames, adjusting rings, and anchors to the elevation indicated on the Plans, or as specified herein. Castings shall be set on 1-inch (25 mm) diameter rubber "O" ring gasket, resting on adjustment rings. The casting shall be anchored to the precast concrete cone section as indicated on the Plans.

7. Steps are to be installed at the plant by the manufacturer of precast units. Field install steps in other than precast structures of the types and in the locations indicated on the Plans.

8. Pipe, 6-inch through 24-inch (150 mm through 600 mm) diameters, shall be connected to manholes using an approved mechanically compressible flexible joint as indicated on the Plans. The pipe shall be properly supported with compacted pipe bedding material from undisturbed ground so that any settlement will not disturb the connection.

9. Pipe, 27-inch through 42-inch (675 mm through 1050 mm) diameters, or pipe in brick or block manholes, shall be connected to manholes using a grouted joint as indicated on the Plans. The pipe shall be properly supported with 3,500 psi (24 MPa) concrete from undisturbed ground so that any settlement will not disturb the connection.

10. The joint for existing pipe, 6 inches (150mm) in diameter and larger, over which the sanitary manhole will be constructed, shall be a grouted joint as indicated on the Plans.

11. Pipe, 48 inches (1200 mm) in diameter or larger, shall be installed as an integral part of the manhole which shall be constructed of 3,500 psi (24 MPa) concrete placed in one continuous pour to 1-foot (300 mm) above the top of pipe as indicated on the Plans.

12. Concrete flow channels shall be constructed in each manhole, as indicated on the Plans. For manholes with outlet pipe diameter of 24 inches (600 mm) or less, construct concrete flow channel straight through a manhole to conform as closely as possible in shape, and slope to that of the connecting sewers. The channel walls shall be formed or shaped to the full height of the crown of the outlet sewer in such a manner to not obstruct maintenance, inspection or flow in the sewers. The concrete flow channel shall be constructed with a 3/4 inch to 1-1/4 inch (20 mm to 30 mm) gap provided at the pipe ends to maintain joint flexibility.

13. For manholes with outlet pipe diameters from 27 inches to 42 inches (675 mm to 1050 mm) or for manholes constructed over existing sewers to 42 inches (1050 mm) in diameter, the channel shall be constructed by filling around the pipe to the spring line and splitting the pipe at the spring line and removing the top half after the manhole is constructed.

3.10 Sanitary Sewer Stub Opening

A. Stub openings shall be at least 2 pipe lengths, with a minimum length of 10 feet (3 m) (unless otherwise indicated on the Plan), and the first joint located approximately 18 inches (450 mm) from the outside manhole wall. The end of the stub shall have a manufactured bell, which shall be plugged with a watertight manufacturer plug that is blocked to prevent movement.

3.11 Vent Assembly

A. Provide materials and construct vent assemblies where indicated on the Plans. Install piping, fittings, joints, vents, etc., as detailed. Vent assemblies shall be installed on undisturbed earth and provided with restraints as indicated on the Plans, and as required for a complete installation. Vent assemblies shall be connected to manholes as indicated on the Plans.

3.12 Drop Connection Assembly

A. Provide materials and construct drop connection assembly where indicated on the Plans. Install piping, fittings, joints, etc., as detailed.

B. Tapping of existing manholes for drop connections shall be made by drilling holes through the wall of the manhole at 4-inch (100 mm) centers along the periphery of the opening, to create a plane of weakness joint, before breaking out section. Nonshrink grout shall be used to seal the opening and a 3,500 psi (24 MPa) concrete collar 12 inches (300 mm) thick shall be poured around the pipe. Drop connections to existing or new manholes shall be made as indicated on the Plans.

3.13 Bulkheads

A. A solid masonry or approved water and airtight bulkhead shall be placed at each point of beginning and at each stub that is constructed or as indicated on the Plans.

B. At the completion of construction and testing, the bulkheads shall be removed, unless otherwise indicated on the Plans or as directed by ENGINEER.

3.14 Wyes

A. One 6-inch (150 mm) wye or tee branch shall be provided for each lot or parcel 100 feet (30 m) or less in width that is served by the sewer or every hundred feet (30 m) for lots or parcels in excess of 100 feet (30 m) in width that is served by the sewer, unless otherwise indicated on the Plans or specified.

B. In all cases, unless otherwise indicated, wyes shall be placed as near as practical to the lower 1/3 point of vacant lots or parcels to be served, and it shall be the responsibility of CONTRACTOR to see that the wyes are so placed. Wyes to developed lots or parcels shall be placed at the location nearest the existing sanitary service lead.

C. If CONTRACTOR fails to place any wyes as herein outlined he shall return to the site and place additional wyes, in an approved manner, at his expense.

D. If a concrete pipe with an inset opening is being used, a compression type joint shall be cast into bell end of the opening. Wye openings shall be closed with a 6-inch (150 mm) stopper, as recommended by the manufacturer, to make a watertight closure.

3.15 Risers

A. Risers shall be installed where the sewer is more than 12 feet (3.5 m) below the established grade or future grade, and carried to between nine (9) and ten (10) feet (2.5 m to 3.0 m) of the established grade or future grade, as indicated on the Plans. Six (6) inch (150 mm) pipe with approved compression type joints, shall be installed in the manner indicated on the Plans.

B. Riser openings shall be closed with a stopper, as recommended by the manufacturer, to make a watertight closure.

3.16 Building Leads

A. Building leads shall be 6-inch (150 mm) diameter pipe and shall be laid on a uniform slope of 1/8 inch per foot (10 millimeters per meter) unless greater slope will provide depth considered adequate by NGINEER.

B. Building leads shall be provided to within 1-foot (300 mm) of property line for all lots or parcels on both sides of the street, unless otherwise indicated on the Plans. If in an easement, the lead shall be provided to within 1-foot (300 mm) of the easement line.

C. Building lead depth, four-(4) feet (1.2 m) horizontal from property line or permanent easement line, shall be between eight (8) and nine (9) feet (2.5 m to 3.0 m). From this point, a 45-degree bend shall be placed and a short length of pipe such that the end depth will be between five (5) and six (6) feet (1.5 m to 1.8 m).

D. Building leads under or within five (5) feet (1.5 m) of concrete or asphalt pavements shall be installed by boring or tunneling.

E. Each building lead shall be closed with a stopper, as recommended by the manufacturer, to make a watertight closure.

3.17 Wye, Riser or Building Lead Marker

A. Unless otherwise indicated in the Plans or Specifications, prior to the backfilling of a wye, riser or building lead, a 2" x 2" (50 mm x 50 mm) (minimum cross section) wooden marker shall be placed from a point immediately in front of the service connection to 1-foot (0.3 m) below the finish ground surface. Do not rest the marker on any portion of the service connection or stopper.

3.18 Abandoning Sanitary Sewer with Flowable Fill

A. Install a bulkhead in each end of the sanitary sewer to be abandoned leaving a small opening in the very top of each bulkhead

B. Install a minimum 2-inch (50 mm) diameter stand pipe in the top of the bulkhead of the sanitary sewer to be abandoned. The stand pipe should be installed such that it can be removed after use and the hole sealed.

C. Install a minimum 2-inch (50 mm) air release pipe in the bulkhead in the opposite end of the sanitary sewer from the stand pipe. The air release pipe should bend up to a 90 degree angle with the end of the pipe being a minimum of six inches (150 mm) above the top of the sanitary sewer.

D. Using the stand pipe, pump flowable fill into the sanitary sewer to be abandoned. The flowable fill shall be pumped into the sanitary sewer until free water flows from the air release pipe at the opposite end.

1. Continue filling the sanitary sewer until the material released at the air release pipe is representative of the flowable fill being introduced at the fill end of the sanitary sewer.

E. Remove the stand pipe and air release pipe and plug the hole in both bulkheads.

3.19 Abandon Existing Manholes

A. Manholes on the existing sanitary sewer shall be abandoned and the structures shall be removed in accordance with the following:

1. Removal of existing structures shall consist of removing and salvaging the existing frame and cover.

2. Ends of the existing sanitary sewer shall be bulkheaded. Masonry shall be broken down to an elevation at least 30-inches (750 mm) below the proposed subgrade or finished grade.

3. Abandoned structure shall be backfilled with flowable fill to 1-foot (0.3 m) above the pipes and the remainder of the structure with sand-cement mixture at a 10 to 1 ratio to subgrade elevation.

3.20 Field Quality Control

A. General:

1. After pipe, structures, and leads have been laid, constructed and backfilled, the system shall be final inspected and tested. Inspection and testing shall consist of the following parts: first inspection, television inspection and testing.

2. The first inspection shall be completed and all repairs made in ample time so that the television inspection of the underground portion of the system, can be completed within 4 weeks of the completion of the construction. Television inspection shall be considered completed when the necessary construction repairs have been made and the installation re-televised when required, and the system is acceptable for the testing phase. When re-television is necessary, an additional 2 weeks will be allowed for completion. Testing of the system shall immediately follow the television inspection and shall be completed within a 2-week period.

3. Failure to maintain a schedule in compliance with this specification will automatically cause the stoppage of other work at the particular site in question until such time as the final inspection of the completed underground portion of the system has progressed to within acceptable limits.

B. First Inspection:

1. CONTRACTOR shall have the underground portion of the sewer system ready for the first inspection within 2 weeks after the completion of each 2,000-foot (600 m) section of sewer installed.

2. The first inspection shall consist of a visible and audible check of the sewers and manholes to ascertain that the manhole steps have been placed, lift holes jointed, the channeling of the manhole bottoms completed, visible or audible leaks stopped, pipe has been placed straight and true to the proper grades and elevation, the required adjusting rings and frame and cover properly installed, trenches and structures backfilled in a workmanlike manner and that the system has been thoroughly cleaned.

3. The first inspection shall be considered completed when all the repairs have been made and the system is ready for television inspection.

C. Television Inspection:

1. CONTRACTOR shall provide for television inspection of the various sanitary sewer lines installed under this Contract.

2. CONTRACTOR shall arrange for, engage and pay all expenses involved for the services of a competent company to perform this television inspection.

3. The television inspection shall observed by representatives of OWNER, ENGINEER, and CONTRACTOR. Any television viewing performed in the absence of ENGINEER will not be considered as a part of the final inspection.

4. The inspection shall involve the visual observation by closed-circuit television of all sanitary sewer, eight (8) inches (200 mm) in diameter to 30 inches (750 mm) in diameter inclusive, installed as a part of this Contract.

5. The inspection shall be performed at a maximum rate of speed of 30-feet per minute, which will allow examination of all points of infiltration, cracked or crushed pipe, defective joints, misalignment in line or grade, location of all wye openings and any defects or items of poor workmanship which may appear. Prior to television inspection, CONTRACTOR shall run water down the line to show any dips or high spots in the line. Water shall be run continuously during television inspection if necessary to determine changes in grade in the line.

6. Items which, in the opinion of ENGINEER, require repair shall be precisely located and photographed along with a detailed statement of the condition.

7. CONTRACTOR shall take immediate action to repair all such defects including excessive infiltration at any specific location, even though the infiltration limits as herein specified have not been exceeded for the entire length of sewer being inspected. Following completion of the repair, OWNER or ENGINEER, at their discretion, may require a second television inspection of any repaired areas. CONTRACTOR shall arrange for and pay all costs involved in performing this re-inspection.

8. As a part of the television inspection, the precise location of each wye shall be noted in relation to the downstream manhole.

a. These locations shall be entered on the Wye Location Sheet as supplied by ENGINEER and verified by comparison with the locations as established at the time of construction.

b. Discrepancies in location between the field location record and the television inspection record shall be reconciled and the proper location of the wye determined as a part of the television inspection.

c. Two (2) copies of all notes, photographs, wye locations and other pertinent information shall be made as a part of the television inspection.

(1) One set of this information shall be turned over to the representative of ENGINEER upon the completion of the inspection of each line.

(2) The second copy of the information shall be held by the television inspection company until completion of the project, at which time it shall be neatly assembled and turned over to ENGINEER as a complete, comprehensive report on the television inspection of the project.

9. Television inspection shall be recorded and shall be submitted in the format(s) as specified by ENGINEER.

a. DVD Disk:

(1) Audio/video route survey submission shall be on DVD media meeting the following specifications:

(a) Media: DVD-R or DVD+R, 4.7GB, single layer

(b) Format: DVD – Video

(c) Video Encoding: Highest available bit rate (6-9 Megabit), 60 fields per second interlaced video

(d) Audio Encoding: Uncompressed stereo wave or stereo Dolby Digital (256 kilobit or better)

(e) Aspect Ratio: 4x3 (720x480 pixels)

(f) No Macrovision or other copy protection encoding. No region code or region code 1.

10. Television inspection shall be considered completed when the necessary construction repairs have been made and the installation retelevised when required, and the system is acceptable for the testing phase.

D. Testing:

1. CONTRACTOR shall provide the necessary supervision, labor, tools, equipment and the materials necessary for the tests which shall be conducted in the presence of ENGINEER. ENGINEER shall be notified two (2) working days in advance of all testing. The following tests shall be performed and approved prior to placing any system in service:

a. Leakage tests shall be conducted on all new sewer lines and existing lines which have not been previously approved.

b. Sewers shall be subjected to air, exfiltration or infiltration tests, or a combination of same, prior to acceptance.

(1) Sewers over 24-inch (600 mm) diameter shall be subjected to infiltration tests.

(2) Sewers of 24-inch (600 mm) diameter or smaller, where the groundwater level above the top of the sewer is over 7 feet (2m), shall be subjected to infiltration tests.

(3) Sewers of 24-inch (600 mm) diameter or less, where the groundwater level above the top of the sewer is 7 feet (2 m) or less, shall be subjected to air tests or exfiltration tests.

2. Exfiltration/Infiltration Test:

a. Exfiltration and Infiltration testing will be performed in accordance with ASTM C1091 except as specified herein. If an exfiltration test is performed, the maximum exfiltration rate shall be the same as the permitted from infiltration. For the purposes of exfiltration testing, the internal water level shall be equal to the external water level plus 7feet (2 m) as measured from the top of pipe, and the elevation must be at least as high as the highest house service.

b. Maximum allowable infiltration shall not exceed 100 gallons per inch of diameter per mile of pipe between manholes per 24 hours (18.5 L/mm diameter/km length/24 hours) for any section of the system and shall include the infiltration from all manholes and other appurtenances.

3. Air Test:

a. The procedure for air testing of sewers shall be in accordance with ASTM C828 for Vitrified Clay Pipe, ASTM C924 for Concrete Pipe, and ASTM F1417 for Plastic Pipe except as follows:

b. House leads shall be properly plugged and blocked to withstand the air pressure. The sewer line shall be tested in increments between manholes. The line shall be cleaned and plugged at each manhole. Such plugs shall be designed to hold against the test pressure and shall provide an airtight seal. One (1) of the plugs shall have an orifice through which air can be introduced into the sewer. An air supply line shall be connected to the orifice. The air supply line shall be fitted with suitable control valves and a pressure gauge for continually measuring the air pressure in the sewer. The pressure gauge shall have a minimum diameter of 3-1/2 inches (90 mm) and range of 0 - 10 psig (0 to 70 kPa). The gauge shall have minimum divisions of 0.10 psig (0.5 kPa) and an accuracy of ± 0.04 psig (0.2 kPa).

c. The sewer shall be pressurized to an initial test pressure of 4.0 psig (27.5 kPa) greater than the greatest back pressure caused by groundwater over the top of the sewer pipe. At least 2 minutes shall be allowed for the air pressure to stabilize. If necessary, air shall be added to the sewer to maintain a pressure within 1.0 psig (7 kPa) of the initial test pressure.

d. After the stabilization period, the air supply control valve shall be closed so that no more air will enter the sewer. The sewer air pressure shall be noted and timing for the test begun. The test shall not begin if the air pressure is not within 1.0 psig (7 kPa) of the initial test pressure.

e. The time required for the air pressure to decrease 1.0 psig (7 kPa) during the Test shall not be less than the time calculated from Table 1 and the Appendices of the applicable ASTM standard as noted above.

f. Manholes on sewers to be subjected to air tests shall be equipped with a 1/2 inch (10 mm) diameter galvanized capped pipe nipple extending through the manhole wall, three (3) inches (75 mm) into the manhole and at an elevation equal to the top of the sewer pipe. Prior to the air test, the groundwater elevation shall be determined by blowing air through the pipe nipple to clear it and then connecting a clear plastic tube to the pipe nipple. The tube shall be suspended vertically in the manhole and the groundwater elevation determined by observing the water level in the tube. The air test pressure shall be adjusted to compensate for the maximum groundwater level above the top of the sewer pipe to be tested. After all tests are performed and the sewer is ready for final acceptance, the pipe nipple shall be removed and the hole in the manhole wall shall be plugged with hydraulic cement.

4. If a sewer fails to pass any of the previously described tests, CONTRACTOR shall determine the location of the leaks, repair them and retest the sewer. The tests shall be repeated until satisfactory results are obtained.

3.21 Deflection Test for Plastic Pipe

A. Plastic pipe shall be tested for deflection, but no sooner than 30 days following the backfilling of the pipe.

1. Maximum allowable deflection (reduction in vertical inside diameter) shall 5 percent.

2. Locations with excessive deflection shall be excavated and repaired by re-bedding and/or replacement of the pipe.

3. Optional devices for testing include a deflectometer, calibrated television or photography, or a properly sized "go, no-go" mandrel or sewer ball. Mandrel shall have a minimum of 9 legs.

End of Section

Division 40
Process Interconnections

Section 40 0513
Process Piping and Valves

Part 1 General

1.01 Scope of Work

A. This Section includes process piping systems complete with pipe, fittings, valves, connections, and accessories such as air compressor, hangers, supports and operators as indicated on the Plans or as required for a complete and functioning installation. This Section does not include domestic wastewater and potable water.

1.02 Reference Standards

A. Unless otherwise specified, the Work for this Section shall conform to the applicable portions of the following Standard Specifications:

1. ANSI - American National Standards Institute
2. ASME - American Society of Mechanical Engineers
3. ASTM - American Society for Testing and Materials
4. AWWA - American Water Works Association
5. NCPWB - National Certified Pipe Welding Bureau
6. NEMA - National Electrical Manufacturers' Association
7. UL - Underwriters Laboratories, Inc.

1.03 Qualifications

A. Welder Qualifications: Welders and/or welding processes shall be qualified by the NCPWB or similar ASME Boiler and Pressure Vessel Code.

B. Valve materials and workmanship shall conform to applicable ANSI, ASTM, and AWWA standards. Valve bodies shall have an arrow to indicate direction of turning to open.

1.04 Submittals

A. Copies of all materials required to establish compliance with the specifications shall be submitted in accordance with the provisions of Section 01 3000.

1. The submittal format shall be in the form of a booklet, suitably tabbed and divided to cover at least the areas noted below for each major equipment item.

2. The submittal booklet shall include adequate detail and sufficient information for ENGINEER to determine that all of the equipment proposed meets the detailed requirements of the Specifications.

3. Incomplete or partial submittals will not be reviewed.

B. Submittals shall include at least the following:

1. Certified shop and erection drawings showing all important details of construction, dimensions and anchor bolt locations.

2. Descriptive literature, bulletins and/or catalogs of the equipment.

3. CONTRACTOR shall verify in the field, the location, position, and size of all existing piping (including buried pipes), as indicated on the Contract Drawings and Specification to be reused, forming a part of the new process piping layout.

4. Process piping Shop Drawings submitted to ENGINEER for review shall clearly indicate the location, position (elevation), and size of all existing piping to be reused.

C. Complete operating and maintenance instructions shall be furnished for all equipment included under these specifications. The maintenance instructions shall include trouble shooting data and full preventative maintenance schedules and complete spare parts lists with ordering information.

D. Submit MANUFACTURER'S Certificate of Installation, Testing and Instruction.

E. In the event that it is impossible to conform with certain details of the specifications due to different manufacturing techniques, describe completely all non-conforming aspects.

1.05 Product Handling

A. Parts shall be properly protected so that no damage deterioration will occur during a prolonged delay from the time of shipment until installation is completed and the units and equipment are ready for operation.

B. Equipment and parts must be properly protected against any damage during a prolonged period at the site.

C. Factory assembled parts and components shall not be dismantled for shipment unless permission is received in writing from ENGINEER.

D. Finished surfaces of all exposed pump openings shall be protected by wooden blanks, strongly built and securely bolted thereto.

E. Finished iron or steel surfaces not painted shall be properly protected to prevent rust and corrosion.

F. After hydrostatic or other tests, all entrapped water shall be drained prior to shipment, and proper care shall be taken to protect parts from the entrance of water during shipment, storage and handling.

G. Each box or package shall be properly marked to show its net weight in addition to its contents.

1.06 Job Conditions

A. Drawings show general arrangement, direction, and sizes of pipes. Drawings are not intended to show every offset and fitting or every structural difficulty that may be encountered. Install the piping and appurtenances to suit, and to avoid interference with installation, operation, and maintenance of fixtures, equipment, or other piping. Verify measurements at job site.

B. Provide piping with necessary hangers, anchors, and supports as specified herein and as indicated. Piping supported by equipment to which it is connected is not acceptable.

Part 2 Products

2.01 Pipe System

A. General:

1. Pipe systems shall conform to the materials or component performance as specified herein and as shown on the drawings.

B. Ductile Iron Pipe Systems:

1. Pipe:

a. AWWA C151 with AWWA C104 cement mortar lined, Class 53. Provide asphalt coating for buried pipe, primer or epoxy-polyamide for above ground inside facilities pipe.

b. Pipe sizes indicated are inside diameter (I.D.).

c. Ductile iron pipe shall be manufactured by American Ductile Iron Pipe Company, United States Pipe and Foundry Company, or ENGINEER approved equal.

2. Connections:

a. Push-on, compression gasket type conforming to AWWA C111 with spigot of pipe marked to visually determine when the spigot is fully seated in the bell of the adjoining section. Push joints within 80 feet of an elbow or tee fitting including the fitting shall be use retainer type glands.

b. Flanges shall have full face neoprene gaskets, 1/8" thick and conform to ANSI B16.1. Carbon steel bolts shall conform to ASTM A449 with nuts conforming to ASTM A563 Grade B. Bolt head and nuts shall be hex type, zinc plated.

c. Mechanical couplings and split flanges for grooved pipe shall have housing with grips to secure onto the pipe ends and encase an elastomeric gasket seal. Housings shall be cast in two or more segments and secured together by no less than two steel oval head bolts. Conform to AWWA C606.

3. Fittings:

a. AWWA C110 and C111 with lining, coating, and pressure rating same as pipe.

b. Flanges shall conform to ANSI B16.1. Carbon steel bolts shall conform to ASTM A449 with nuts conforming to ASTM A563 Grade B. Stainless steel bolts and nuts shall conform to ASTM A320. Bolt head and nuts shall be hex.

C. Galvanized Steel Pipe Systems:

1. Pipe:

    a. ASTM A53, Schedule 40, Type S, Grade B, fabricated pipe in accordance with AWWA C200. Flanges shall be class D per AWWA C207.

2. Connections:

    a. Flanged joints in accordance with AWWA 207 or by mechanical coupling for grooved pipe as specified in Article 2.01.B.2. Screwed connections for fluid power piping shall not be made up using pipe joint compound, Teflon tape shall be allowed.

3. Fittings:

    a. Fittings shall be steel or cast iron conforming to C110, C111, or C208. Fittings shall conform to Article 2.01.B.3. Steel fittings interior coated per Article 2.01.C.1. Fabricated steel elbows shall be four piece except low lift elbows on pump discharge which shall be fabricated from three pieces of pipe.

D. Copper Pipe Systems:

1. Pipe: Conform to ASTM B88.
2. Connections: Copper Sweat, lead free solder.
3. Fittings: Conform to ASA B16.18.

E. Stainless Steel Pipe Systems:

1. Pipe: Stainless steel pipe greater than 3-inch diameter shall be ASTM A778, Type 304L, Schedule 5S, unless otherwise indicated on the plans. After all shop operations have been completed, all stainless steel material shall be full immersion pickled, rinsed with water, and passivated.

2. Fittings: Shall be ASTM A774, Type 304L. After all shop operations have been completed, all stainless steel material shall be full immersion pickled, rinsed with water, and passivated. Wall thickness shall equal that of pipe. Fittings shall be smooth standard fittings with dimensions conforming to ANSI B16.9

3. Joints: Butt-weld per American Welding Society Standards except where valves or equipment requires flanged connections. Flanged joints shall be fabricated from SS 304L per dimensions of AWWA C207 Class B ring flanges. Provide gaskets and bolts/nuts per pipe manufacturer recommendations for intended service.

F. Polyvinyl Chloride Pipe (PVC) Systems:

1. Polyvinyl Chloride Pipe (PVC) and fittings shall be in accordance with ASTM D-1784, D-1785, D-2464, and D-2467, Schedule 80 as indicated with socket welded or flanged joints. Provide unions or flanges at all valves and equipment. Pipe connections shall be made in conformance with the manufacturer's recommendations including supply of gaskets, where necessary.

2. Polyvinyl Chloride pipe and fittings shall be "Chemtrol" as manufactured by Celanese Piping Systems, Plastiline, Inc., R & G Sloane; or equal.

3. Provide Schedule 40, double wall containment piping with support discs on all chemical lines not in trays above grade. Slope piping to containment area.

G. Stainless Steel Tubing:

1. General working pressure 150 psi tubing shall be 304 or 316 stainless steel, seamless, ASTM A269, 18 gauge wall thickness. Connections shall be compression type 304 or 316 stainless steel fittings.

2. Fittings shall be as manufactured by Swazelok or equal.

H. Flexible Pipe:

1. Flexible pipe connections shall be steel flanged with convoluted neoprene molded to absorb piping shock and offsets up to 1/8-inch.

2. Flanges shall conform to ANSI B16.1 with built in the cables to prevent the joint from expanding past its limit.

3. The flexible control unit shall have a rated working pressure of 175 psig.

4. Flexible pipe shall be as manufactured by Metraflex or equal.

I. Cast Iron Pipe:

1. Cast iron pipe shall be, hub and spigot, service weight (SV), with bituminous coating inside and outside conforming to ASTM A74.

2. Fittings shall be cast iron soil pipe, hub and spigot, service weight (SV), bituminous coating inside and outside, conforming to ASTM A74 with molded rubber push on-on gaskets and/or neoprene rubber sleeves in conformance with ASTM D15 and Type 301 stainless steel clamps.

2.02 Wall Pipe and Sleeves

A. General:

1. Pipes and sleeves shall be as specified herein.

B. Wall Pipe:

1. AWWA C110 with lining, inside diameter and connections compatible to pipe system, shall be flanged, tapped bolt holes, water stop, push joint.

C. Sleeves:

1. Sleeves shall be schedule 40 pipe and be galvanized.

2.03 Link-Type Seals

A. Shall be interlocking expandable type of molded synthetic rubber segments with 304 stainless steel bolts and nuts and pressure plate.

B. Seals shall be as manufactured by Thunderline or equal.

2.04 Sleeve-Type Couplings

A. Pressure rating at least equal to that of related pipeline.

B. Manufactured by Dresser Mfg. Div., Bradford, PA; Rockwell International, Municipal & Utility Div., Pittsburgh, PA; R.H. Baker & Co., Inc., Los Angeles, CA; or equal.

C. Couplings for Buried Pipe:

1. Cast iron sleeve or steel sleeve and retainer with fusion bonded epoxy coating, Dresser Style 53 or 153, Rockwell Style 431, Baker Series 228, or equal. Couplings provided with type 304 or 316 stainless steel bolts and nuts.

D. Couplings for Exposed Pipe:

1. Steel; Dresser Style 38, 127 or 128 Rockwell Style 411, Baker Series 200, or equal. Couplings provided with type 304 or 316 stainless steel bolts and nuts. Provide tie rods across couplings as shown.

E. Furnished with pipe stop removed.

F. Provided with gaskets of composition suitable for exposure to liquid within pipe.

2.05 Flange Adapters

A. Cast iron adapters for transitioning from plain end ductile iron to flanged fittings, 125 # bolt pattern. (ANSI B16.1). Flange adapters shall have ductile iron set screws to securely grip the pipe end.

B. Flange adapters shall be as manufactured by EBAA Iron, inc. or ENGINEER-approved equal.

2.06 Swing Check Valve

A. Swing Check Valve (2-inch and smaller):

1. Swing check valves two inches and smaller shall have a bronze body and cap. Seats shall be integral with the valve body and shall provide leakproof closing with the disc.

2. Disc shall be bronze with composition face and bronze hinge.

3. Valves shall be rated for a working pressure of 125 psi, unless as otherwise indicated.

B. Swing Check Valve (2-1/2 inch and larger):

1. Swing check valves 2-1/2 inch and larger shall be the rubber flapper type with a heavily constructed cast iron body and cover.

2. Body shall be long pattern design (not wafer), with integrally cast-on end flanges.

3. Flapper shall be Buna-N having an “O” ring seating edge and be internally reinforced with steel.

4. Flapper to be captured between the body and the body cover in a manner to permit the flapper to flex from closed to full open position during flow through the valve.

5. Flapper shall be easily removed without need to remove valve from line.

6. Check valves to have full pipe size flow area.

7. Seating surface to be on a 45° angle requiring the flapper to travel only 35° from closed to full open position, for minimum head loss and non-slam closure.

C. Buna-N flapper to have an elastic spring, molded internally, to assist the flapper to close against a slight head to prevent slamming.

D. Materials of construction shall be certified in writing to conform to A.S.T.M. specifications as follows:

1. Body and Cover ..... Ductile Iron, ASTM A296
2. Flapper ..... Buna-N
3. Exterior Paint ..... Phenolic Primer Red Oxide, NSF Approved

E. Valve shall be Val-Matic, Clow, or ENGINEER approved equal.

2.07 PVC Swing Check Valve

A. Provide flanged Swing Check Valve constructed from PVC conforming to ASTM D1783 cell classification 12454 with Viton O-rings, seat, and gaskets.

B. Valve shall be of top entry bonnet design and O-ring sealed drain plug for maintenance servicing without the need to remove valve body from pipeline.

C. Valve shall be rated for 150 psi at 73°F. Provide external level and weight to assist disc in faster closing. Bolts, nuts and washers shall be resistant to sodium hypochlorite.

D. PVC Swing Check Valve shall be manufacture by Spears Manufacturing or ENGINEER approved equal.

2.08 Ball Check Valve

A. Provide PVC Ball Check Valve with socket union connections, true union design, ball check type, Viton O-rings and seat, rated for 150 psi at 73°F.

B. Manufacturer: NIBCO, Inc., Hayward Industrial Products, Inc, or ENGINEER approved equal.

2.09 Wafer Style Check Valve

A. Silent or double door check valves shall be compact wafer style designed for a working pressure of 150 psi and designed to fit between ANSI flanges

B. Check valve shall be spring loaded, normally closed by means of one or more heavy duty stainless steel torsion springs. Flow from the pumps shall cause the valve to open and upon pump shut down, the torsion spring will shut the valve before reverse flow starts and at a point of zero velocity of non-slam closure.

C. Seating shall be resilient and watertight with sealing element constructed of BUNA-N molded to body.

D. Valve body shall be fabricated of cast iron. Torsion spring, hinge shaft and stop pin shall be constructed of stainless steel. Silent plug or doors shall be bronze, ASTM B584.

E. Manufacturer shall be Val-Matic, Apco, Mission, or ENGINEER approved equal.

2.10 Gate Valve

A. Gate Valves 2 Inches and Smaller:

1. Valves shall have a bronze body and union bonnet. Seats shall be integral with the body and provide leakproof shut off with the disc. The disc shall be a solid bronze wedge. The stem shall be bronze and packed with corrosion resistant packing. Pressure class shall be 125 psi, unless as otherwise indicated.

B. Gate Valves, Sizes 4 Inches through 16 Inches:

1. Valves shall be Mueller 2360 Series; American Cast Iron Pipe Company, Waterous Series 2500; or Clow, F-6104, Resilient Wedge type, conforming to AWWA C509.

2. Valves shall be designed for 200 psi working pressure and 400 psi test pressure.

3. Valve body shall be cast iron, with a smooth, unobstructed waterway. Valve body, bonnet, and thrust collar shall be coated inside and out with fusion bonded epoxy.

4. Valves shall have a 2-inch square-operating nut with cast-in directional arrow, and shall open counterclockwise.

5. Gate valve shall have a cast bronze, non-rising stem with double “O” ring seals.

6. Two low torque thrust bearings shall be located above and below the thrust collar to reduce friction and minimize operating torques.

7. Stem nut shall be solid bronze and independent of the wedge. The wedge shall be cast iron, replaceable and completely encapsulated in permanently bonded urethane rubber per ASTM D429.

C. Gate valves may be Clow, U.S. Pipe Metroseal, Mueller, or ENGINEER approved equal.

2.11 Knife Gate Valve

A. Knife type valves 2 inches and larger shall have a body of 304 stainless steel. Seats shall be metal to metal, integral with the body and disc. Disc shall be 304 stainless steel with knife like beveled edges ground smooth to prevent packing or seat damage. Stem shall be stainless steel bolted to the disc and packed with corrosion resistant packing.

B. Knife gate valves shall be DeZurik or ENGINEER-approved equal.

2.12 Globe Valve

A. Globe valves two inches and smaller shall have a bronze body and union bonnet. Seats shall be integral with the valve body and provide leakproof shut off with the disc. Disc shall be a composition type mounted in a bronze retainer. Stem shall be bronze and packed with corrosion resistant packing.

B. Globe valves shall be DeZurik or ENGINEER-approved equal.

2.13 Butterfly Valve (Cast Iron)

A. General:

1. Butterfly valves shall be rubber-seated tight closing and shall conform to AWWA Standard C504 latest revision.

B. Class 150 Valves (Non-Cyclic Applications):

1. Valves shall be of the flangeless wafer body style. All valves shall be suitable for use with ANSI 150 pound flanges. Bodies shall be cast iron. Valves shall be rated at 175 psi. Bodies of all flangeless wafer valves shall have bolt guides to center the body in the pipeline.

C. All valves shall be furnished with self-lubricated bearings of TFE coated stainless steel. Shaft seals shall be provided to prevent leakage and to protect bearings from internal or external corrosion.

D. Valve seats shall be of the reinforced resilient type and shall be field replaceable. Seats shall also act as a body liner to prevent flow from contacting the body casting. Seats shall have flange sealing to provide a positive seal without use of flange gaskets. Seats shall be of Buna-N or EPDM suitable for use with potable water.

E. Shafts shall be one piece and shall be 316 stainless steel. Shaft diameter shall be suitable for the service conditions specified.

F. Shafts shall be finish ground to minimize bearing and shaft seal wear. Shafts of 12-inch and larger shall have a non-adjustable thrust collar. Shaft seals shall have a stuffing box and pull down packing gland. Packing shall be furnished with self-adjusting "V" type packing.

G. Discs shall be aluminum bronze. The disc-to-shaft connections shall be Type 316 stainless steel.

H. Pins, shaft, and disc of all valves shall be individually machined and completely interchangeable.

I. Valves shall be available with field interchangeable manual or powered actuators as required. The actuator-to-shaft connection shall be designed to shear and prevent internal valve damage if the disc closes on foreign material in the pipeline.

J. Factory Testing:

1. Test shall be conducted on each valve in accordance with Manufacturer's Quality Control procedures.

K. Butterfly valves shall be marked with the valve size, manufacturer's mark, year of manufacture, and class.

L. Butterfly valves shall be DeZurik, Val-Matic, Clow, or ENGINEER approved equal.

2.14 Butterfly Valve (PVC)

A. Provide Butterfly valves with PVC disk and body construction conforming to ASTM D1783 cell classification 12454, rated for 150 psi at 73 degrees Fahrenheit, and shall be suitable for dead-end service.

B. Valve seat and O-ring shall be Viton.

C. Seat shall be a non-liner type interlocked to valve body.

D. Disc shall be offset design with titanium stem.

E. Valve shall be provided with a worm gear drive gear operator with polypropylene handwheel and position indicator.

F. Valve body shall be supplied with factory installed stainless steel lugs.

G. PVC butterfly valve shall be manufactured by Spears Manufacturing or ENGINEER-approved equal.

2.15 Air Release Valve

A. Air Release valves shall have an ASTM A126 Class B cast iron body and cover with a threaded inlet connection of the size shown on the plans and a 1/2 in. NPT outlet connection. Valve body shall have a 2 in. NPT plugged port near the base to facilitate cleanout of large solids as well as a 1/2 in. NPT connection near the top and 1 in. NPT port near the bottom to permit the installation of flushing attachments.

B. Valves shall have an 18-8 stainless steel float and a replaceable seat of Buna-N or other suitable material. Internal linkage mechanism shall be 18-8 stainless steel, plastic or bronze is not acceptable. Linkage mechanism shall be capable of being removed from the cover without disassembly of the mechanism.

C. Valves shall have 3/16 inch diameter stainless steel orifice for working pressures up to 150 PSI. Valve shall close drop tight.

D. The valve shall automatically exhaust accumulated air from a fluid system while the system is pressurized and operational.

E. Air release valves shall be Golden Anderson, Val-Matic or ENGINEER-approved equal.

2.16 Sewage Air Release and Vacuum Break Valve

A. Valve shall consist of a compact tubular all stainless steel fabricated body, hollow direct acting float and solid large orifice float in HDPE - stainless steel nozzle and woven dirt inhibitor screen, EPDM rubber seals and seat.

B. Valve shall have an integral Anti-Surge" Orifice mechanism which shall operate automatically to limit transient pressure rise or shock induced by closure to less than 1.5 x valve rated working pressure.

C. Intake orifice area shall be equal to the nominal size of the valve i.e., a 6" valve shall have a 6" intake orifice. Large orifice sealing shall be effected by the flat face of the control float seating against a EPDM rubber O-ring housed in a dovetail groove circumferentially surrounding the orifice.

D. Discharge of pressurized air shall be controlled by the seating & unseating of a small orifice nozzle on a natural rubber seal affixed into the control float. The nozzle shall have a flat seating land surrounding the orifice so that damage to the rubber seal is prevented.

E. Valve construction shall be proportioned with regard to material strength characteristics, so that deformation, leaking or damage of any kind does not occur by submission to twice the designed working pressure.

F. Connection to the valve inlet shall be facilitated by flanged ends conforming to ANSI 616.5 Class 150 or Class 300 Standards. Flanged ends shall be supplied with the requisite number of stainless steel screwed studs inserted for alignment to the specified standard. Nuts and washers shall be included.

1. Prior to the ingress of liquid into the valve chamber, as when the pipeline is being filled, valves shall vent through the large orifice when sewage/effluent approach velocities are relative to a transient pressure rise, on valve closure, of less than 1.5 x valve rated pressure.

2. At higher sewage/effluent approach velocities, which have a potential to induce transient pressure rises greater than 1.5 x valve rated pressure on valve closure, the valve shall automatically discharge air/gas through the "Anti-Surge" Orifice and reduce sewage/effluent approach velocity, so that on closure a maximum Transient pressure rise of less than 1.5 x valve rated pressure is realized.

3. Valves shall not exhibit leaks or weeping of liquid past the large orifice seal at operating pressures of 7.2 psi to 1.5 x valve rated working pressure.

4. Valves shall respond to the presence of airgas by discharging it through the small orifice at any pressures within a specified design range, i.e. 7.2 psi to 145 psi and shall remain leak tight in the absence of air.

5. Valves shall react immediately to pipeline drainage or liquid column separation by the full opening of the large orifice so as to allow unobstructed air intake at the lowest possible negative internal pipeline pressure.

G. Valves shall be Vent-O-Mat Series RGX or ENGINEER-approved equal.

2.17 Pressure Relief Valve

A. Provide flanged Pressure Relief Valve constructed from PVC conforming to ASTM D1783 cell classification 12454 with Viton seals. Valves shall be rated for a maximum 110 psi at 73 degrees Fahrenheit. Valve shall be factory adjusted to relieve five percent solution of sodium hypochlorite at 80 psig. Bolts, nuts and washers shall be resistant to sodium hypochlorite.

B. Manufacturer: ASAHI/America or approved equal.

2.18 Ball Valve

A. Ball valves have a working pressure of 200 psig, except PVC which is 150 psig, drop tight shut off, full port material bronze body, hard chrome plated ball teflon or viton seats and/or 316 stainless steel body and ball, teflon seats and/or PVC body and ball teflon seats depending on the service, with stops at full open and full closed.

B. Ball valve shall be manufactured by Apollo Conbroco, Jamesbur Series 500, Chemtrol, Hazward or ENGINEER approved equal.

2.19 Diaphragm Valve

A. Provide flanged Diaphragm valves with PVC body and bonnet construction conforming to ASTM D1783 cell classification 12454.

B. Valve shall be provided with position indicator, travel stop and bonnet O-ring sealing arrangement.

C. Valve shall be weir type with a square sealing body sealing design and bayonet connected diaphragm (1/2 to 2 inch) or round bonnet body sealing design and threaded stud diaphragm connection (21/2 to 4 inch). Provide valve with PTFE diaphragm.

D. Valve shall be rated to 150 psi at 70 degrees Fahrenheit. Valve shall be suitable for service in sodium hypochlorite applications. Bolts, nuts and washers shall be resistant to sodium hypochlorite.

E. Provide electric motor actuators on the valves indicated on the Contract Drawings. Motor actuator shall provide declutching manual override, NEMA 4 plastic or epoxy coated corrosion resistant housing, permanently lubricated gear train, integral thermal overload protection with auto reset. Provide limit switches required for indication and control. Provide torque select to open or close valve against a 25 ft head differential.

F. Diaphragm valve shall be manufactured by ASAHI/America or ENGINEER approved equal.

2.20 Solenoid Valve

A. Provide CPVC Solenoid Valves with Viton O-rings and piston seals, socket-union connections, normally closed, 100% duty cycle NEMA 4 solenoid rated for 120 VAC, 60 HZ.

B. Solenoid valve shall be manufactured by Hayward Industrial Products, Inc. or ENGINEER approved equal

2.21 Plug Valve

A. Eccentric plug valves shall be of the tight closing, resilient faced non-lubricating variety and shall be of eccentric design such that the valve's pressure member (plug) rises off the body seat contact area immediately upon shaft rotation during the opening movement.

B. Valves shall be drop-tight at the rated pressure (175 psi for valve up to 12” in diameter, and 150 psi for valves 14” in diameter and above) and shall be satisfactory for applications involving throttling service as well as frequent or infrequent on-off service.

C. Valve closing member should rotate approximately 90 degrees from the full-open to full-closed position and vice-versa.

D. Valve body shall be constructed of cast iron (semi-steel) conforming to ASTM A 126, Class B. Body ends shall be as indicated on the plans and as follows:

1. Flanged with dimensions, facing, and drilling in full conformance with ANSI B 16.1, Class 125. This includes flange thickness.

2. Mechanical Joint to meet the requirements of AWWA C111/ANSI A21.11.

3. Grooved ends to meet the requirements of AWWA C606.

E. Eccentric Plug Valves shall have a rectangular shaped port. Port areas for 3" - 20" valves shall be a minimum 80% full pipe area. Port area for 24" valve shall be a minimum 70% of full pipe area.

F. Valve seat surface shall be welded-in overlay, cylindrically shaped of not less than 90% pure nickel. Seat area shall be raised, with raised area completely covered with weld to insure proper seat contact. Machined seat area shall be a minimum of 0.125” thick and 0.500” wide.

G. Valve plug shall be constructed of cast iron (semi-steel) conforming to ASTM A126, Class B. Plug shall have a cylindrical seating surface that is offset from the center of the plug shafts. Plug shafts shall be integral.

H. Entire plug shall be 100% encapsulated with Buna-N rubber in all valve sizes. Rubber compound shall be approximately 70 (Shore A) durometer hardness. Rubber to metal bond must withstand 75 lbs, pull under test procedure ASTM D- 429-73 Method B.

I. Shaft bearings, upper and lower, shall be sleeve type metal bearings, sintered, oil impregnated and permanently lubricated Type 316 stainless steel. Thrust bearings shall be Nylatron.

J. Plug valve shaft seals shall be on the multiple V-ring (Chevron) and shall be adjustable. All packing shall be replaceable without removing the bonnet or actuator and while the valve is in service. Shaft seals shall be made of Buna-N.

K. Each valve shall be given a test against the seat at the full rated working pressure and a hydrostatic shell test at twice the rated working pressure. Certified copies of individual tests shall be submitted when requested. Certified copies of proof-of-design tests shall be submitted upon request.

L. Manual valves shall have lever or worm gear type actuators with handwheels, 2" square nuts, chainwheels attached. Lever actuators shall be furnished on valves 8" and smaller where the maximum unseating pressure is 25 psig or less. Worm gear type actuators shall be furnished on all 4" or larger valves where the maximum unseating pressure is 25 psig or more.

M. Eccentric plug valves shall be Clow or approved equal.

2.22 Pressure Reducing / Pressure Sustaining Valve

A. Pressure control and regulation valves will maintain a constant downstream pressure regardless of varying inlet pressure.

B. Valves shall be globe pattern or angle pattern as required by the installation shown on drawings and/or as called for.

C. Valves shall be hydraulically operated, pilot-controlled, and of the diaphragm operated type.

D. Diaphragm shall be nylon fabric-reinforced synthetic rubber, and the disc shall have a rectangular cross-section.

E. Valve may also be a self-contained differential piston type with the small end of the piston representing one of the sealing contacts, and the large end representing the effective area to provide the closing force.

F. External pilot valves and piping shall be arranged for either pressure-sustaining or pressure-reducing service for the pressure range as shown on the drawings.

G. Valves shall be cast iron or semi-steel body, bronze trim and be designed for 150 psi working pressure. Valve piston shall be of cast bronze provided with renewable leather cup and rubber seat securely held in place. The liner of the valve shall be of cast bronze provided with a leather cup securely held in place. There shall be a cast bronze seat crown screwed into place within the valve body and it shall be provided with cored "V" port opening to permit water passage.

H. The pilot control shall be a direct-acting, adjustable, spring-loaded diaphragm type, permitting convenient adjustment over a range of no less than 30 psi.

I. Valves shall be furnished with a valve position indicator, opening and closing speed controls, and a strainer in the pilot system. Flow symbols shall be cast in the valve body, or the inlet end shall be identified to facilitate correct installation in the piping. Valves shall have ANSI 125-pound flanged connections.

J. Valve shall be air and water cushioned to prevent hammer and shock. It shall, when required, close off tightly, and when necessary, open wide to permit full pipe line opening.

K. Bronze castings shall conform to ASTM Specification B62, and the cast iron body and lid shall conform to ASTM Specification A126, Class B.

L. Pressure control valves shall be manufactured by Cla-val, Golden Anderson or ENGINEER approved equal.

2.23 Valve Lever/Handwheel Operators

A. For valves 6 inches and smaller, latch lock levers shall provide automatic, positive latching in the open, closed, or eight intermediate positions. These valves shall allow locking in any position with a standard padlock. Infinite position levers shall allow manual throttling and locking in any position from open to close.

B. For valves 8 inches and larger shall be manually actuated and operated using a cast iron housed handwheel actuator with crank or optional chainwheel. Units to have adjustable open and closed position stops with provision to prevent accidental adjustment changes. Operating shaft shall be supported axially and radically at input end by permanently lubricated bronze thrust and sleeve bearings.

2.24 Valve Actuators

A. Cylinder actuators shall have working mechanism fully enclosed, and shall be sized for operation using 100 psig pneumatic supply. Cylinder actuators shall have pilot valves and positioners where indicated on the drawings. Units shall have adjustable end position stops. Valves used for automatic throttling applications shall incorporate a position transmitter. Manual valves shall include limit switches as shown on drawings.

B. Valve operators shall be EIM, Rotork or ENGINEER approved equal.

2.25 Electric Motor Operators

A. General:

1. Electric motor operators for open-shut service shall meet the requirements of AWWA C504, Electric Operators, except as herein specified.

B. Controls shall be either "integrally mounted" in the valve body or separated from the valve body in a "wall-mounted" enclosure.

C. Electrical equipment shall be mounted in a NEMA 4 or 7 enclosure whether on the valve body or in the wall-mounted enclosure. Enclosure shall be NEMA 4 unless shown otherwise on the drawings.

D. Motorized valve operators scheduled with integrally mounted controls in the valve body shall include the motor, reversing starter with remote-local switch, associated gearing, limit switches, torque switches, auxiliary handwheel for manual operation, a valve mounted mechanical dial valve position indicator, Open-Close-Stop push buttons, and accessories.

E. Motorized valve operators scheduled with "wall-mounted" controls shall include the motor, reversing starter, and remote-local switch mounted in the valve body or the wall-mounted enclosure at the manufacturer's option, associated gearing, limit switches and torque switches mounted on the valve body, auxiliary handwheel for manual operation, a valve mounted mechanical dial valve position indicator, the wall-mounted control enclosure, and accessories as listed.

F. Wall-mounted control enclosure shall include valve "open" (amber) and "closed" (green) indicating lights, a remote-local switch even if there is a remote-local switch at the valve body, Open-Stop-Close push buttons and a terminal strip to accept incoming and outgoing wires.

G. Wires shall be tagged at each end of the wire with individual wire markers. Each terminal of the terminal strips shall be numbered and identified with a marker. Schematics shall be provided with Shop Drawings showing wire numbers, terminals, field wiring, etc. Connections for remote equipment shall be wired to terminal blocks. Equipment shall be factory wired and tested before shipment.

H. Motor starters shall be the reversing contactor type complete with gang-operated switch, 2 mechanically interlocking reversing contactors, 120 volt control power transformer when motor voltage is other than 120 volt, thermal overload protection for each phase, and associated wiring. Operating voltage shall be as shown on the drawings.

I. Limit switches shall be provided at the extreme open and close position of the operator travel. At least 2 independent switches at each end of motor travel shall be provided as standard for the local indicator lights and interlocking. An additional 4 switches shall be provided for remote use.

J. Torque switches shall be provided in both the open and closed circuits of the operators. Torque switches shall be field adjustable and designed to stop the operator motor when the torque exceeds safe limits for either the operator or the valve. An electrical or mechanical interlock shall be provided to prevent the open torque switch from tripping when unseating a torque seated valve.

K. A local mechanical dial position indicator shall be provided on the valve operator to indicate the position of the valve.

L. Motors shall be standard-duty rated, totally enclosed nonventilated, Class B insulated, 60 Hertz with voltage and phase, specially designed for valve service. Design shall combine low inertia with a high starting and stalling torque. Motors shall be sized to operate valves from full open to full closed in one to three minute cycles under the full specified unbalance operating head stated in the Specifications. Motor winding temperature rise shall be NEMA standard for Class B insulation at the rated service factor load.

M. Gear case shall be cast iron. Pedestals shall be fabricated steel or cast iron. Stem nut shall be high-tensile bronze.

N. Mechanical emergency operation in event of power failure shall be provided by a clutchable handwheel drive mechanism completely independent from the motor gearing. Hand operation shall be direct drive permitting fast manual valve operation. Failure of motor gearing shall not prevent emergency handwheel operation. Manual operation shall prevent (disconnect) electrical operation.

O. Acceptable manufacturers: Auma, Limitorque, or Rotork. No others shall be accepted.

2.26 Cone Valve and Actuator

A. General:

1. Cone valves shall be Rotovalve as manufactured by Rodney Hunt Company, or ENGINEER approved equal. It shall be a full ported valve and shall be complete with actuator and accessories as specified herein.

B. Operation:

1. Operation of the cone valve shall employ an axial motion to lift the valve plug from its seat, followed by a 90 degree rotary motion of the plug to open the valve and axial motion to reseat it in the open position. Closing movement of the valve plug shall be in reverse order. It shall be designed to operate satisfactorily at the flow conditions specified.

C. Valve Construction:

1. Valve body shall be provided with seat rings of Monel metal electrically fused to the body waterway and sufficiently raised above the internal surface of the body to assure free operation.

2. Valve shall be complete with ANSI Class flanges to mate with adjacent equipment.

3. Valve plug shall be fully skirted with integrally cast trunnions. It shall have a set of Monel seat rings electrically fused to the plug waterway and sufficiently raised above the extended surface of the plug to assure free operation. If sealing in the open position is required to prevent flow around the plug, a second set of seats shall be furnished. Trunnion bearings on the plug shall be bronze or stainless steel and shall mate with bronze or stainless steel bearings in the body and head. The head shall make a registered connection with the valve body to assure proper bearing alignment. It shall be designed to support the cone valve mechanism and operating forces.

4. Valve castings shall be ASTM A126 Class C cast iron, ASTM A536 Grade 65-45-12 ductile iron, or ASTM A216 Grade WCB cast steel.

5. Valve shaft shall be stainless steel Type 630 with 125,000 psi minimum yield strength, and shall be pinned to the plug.

6. Packing shall be fiber and graphite with a bronze adjustable packing gland.

D. Mechanism Construction:

1. Operating mechanism shall be totally enclosed in a cast iron housing with an integrally cast mounting bracket to assure proper alignment.
2. Housing shall be designed for either right of left hand actuator mounting. Mechanism cover shall be cast iron and make a registered connection to tile mechanism housing. Cover shall be bronze bushed where the valve shaft extends through it. Bronze lift nut shall be contained completely within the mechanism housing with provision for external lubrication.

3. Crosshead shall be of bronze B584 C86200 and shall travel on stainless steel guide rods. Two covered access holes shall be provided for access to the tube fittings on the crosshead.

4. An oil indicator shall be mounted on the end of the valve shaft for local position indication.

E. Actuator:

1. Actuator will be sized to operate the valve from full open to full closed at rated pressure with a maximum of` 80 ft./lb. of input torque on a manual actuator. The valve manufacturer shall be responsible for sizing electrical of cylinder actuators based on the flow conditions.

F. Testing:

1. Cone valve body and head shall be hydrostatically tested for 10 minutes at a test pressure of one and one-half times maximum working pressure for which the valve is intended. Under test, parts shall show no evidence of distress and shall be free from any leaks. When fully shop assembled, each cone valve shall be leak tested at the rated pressure. Leakage shall not exceed 0.4 oz /min /inch of diameter.

G. Pump Check Controls:

1. The pump check controls shall be supplied, mounted and tested by the valve manufacturer. They shall consist of a 4-way solenoid valve with manual override, speed control valves, open /close limit switches, pump shutdown limit switch and a pressure switch positioned on the upstream side of the valve. When the pump reaches the designated pressure, the pressure switch is activated, energizing the solenoid control valve causing the cone valve to open at a predetermined rate. To shutdown pump operation, the solenoid control valve is de-energized causing the cone valve to close. When the cone valve is approximately 95% closed the pump shutdown limit switch shall be activated, shutting down the pump.

2.27 Pressure Gauges

A. Pressure gauge shall have 4-1/2-inch dial face with stainless steel movement.

B. Install gauges with nipples no shorter than 2 inches and equip with a shutoff ball valve. Provide nipples and valve of same material as piping system to which they are connected.

C. Provide diaphragm seals with protective diaphragm attachment, factory mounted. Provide PVC diaphragm housing constructed such that the diaphragm is held between 2 halves of housing and assembly in secured by 6through bolts with nuts. Provide diaphragms of Viton.

D. Provide diaphragms filled with manufacturer's recommended fluid. Diaphragm seals shall be removable housing design for cleaning of diaphragm without refilling or recalibration the protected gauge.

E. Provide brass snubbers between seals and gauge to dampen pressure variations.

F. Pressure gauges shall be as manufactured by Ashcroft, Trerice Marsh, or approved equal.

Part 3 Execution

3.01 Contractor's Verification

A. CONTRACTOR shall field measure all dimensions and check possible interferences for the pipe system and accessories.

3.02 Preparation

A. Pipe fittings and accessories shall be free of foreign matter.

B. Accumulations of dirt, rust, scale, etc., shall be removed prior to installation.

C. Pipe ends shall be reamed and deburred to prevent loose particles from getting into the pipe line.

3.03 Installation

A. General:

1. Pipe systems shall be installed to line and grade indicated on the Plans.

2. Valves shall be located as indicated on the Plans.

3. Piping connections to equipment shall be aligned and supported in such manner that no load or thrust will be exerted upon the equipment by the piping at installation or in operating conditions.

4. Cutting of the pipe shall be done in a neat workmanlike manner with the least amount of waste and without damage to existing or new lines. A fine tooth saw, tubing, or pipe cutter, or similar tool shall be used to cut the pipe. Cuts must be square and ragged edges removed with a burring tool and/or file.

5. After cutting bell and spigot or socket pipe a stop mark shall be made with a pencil or crayon using dimensions as shown by the manufacturer's instructions or by using another pipe in the field as a guideline.

6. Cutting of concrete walls, floors or ceilings shall be avoided and requires written approval from ENGINEER. If approved, holes shall be core drilled and patched. Reinforcement steel shall not be cut or disturbed.

7. At the termination of pipe installation any open ends of pipelines shall be closed off by a suitable cover until installation operations are resumed.

8. Provide plugged wyes, tees, or crosses with threaded joints at all changes in direction to facilitate cleaning of chemical lines.

B. Pipe Supports:

1. Pipe supports, pedestals, base elbows and tees and pipe hangers shall be provided and installed as required by ENGINEER in accordance with the following:

Pipe Size (inches)	Maximum Distance Between Supports (feet)	Minimum Diameter of Hanger Rod (inches)
1/2 thru 2	6	3/8
2-1/4 thru 4	8	3/8
4-1/4 thru 12	9	7/8
14 thru 30	9	1

2. Polyvinyl chloride pipe, fiber glass reinforced pipe, rubber hose, tubing, etc., shall be supported along the entire length by means of a steel channel or angle iron or approved tray anchored to the floor, wall, or ceiling with supports per above. Where shown chemical feed lines are installed in containment piping.

3. Piping systems shall be supported by hangers, guides, anchors, and sway bracing or by resting on structural brackets or racks. Piping 8-inch and larger located close to the floor shall be supported in concrete saddles. Welding to structural steel members shall not be permitted without written approval of ENGINEER. Valves shall be supported to keep undue strain off of piping and adjacent equipment. Equipment requiring periodic maintenance shall be supported to allow easy removal with a minimum of temporary supporting.

4. Hanger rods shall be connected to beam clamps or concrete inserts. Clamps or inserts shall be Underwriters' Laboratories approved. "C" clamps will not be permitted. Expansion anchors may be used upon written approval by ENGINEER. Holes for expansion anchors shall be made by rotary drilling only, hammering devices will not be permitted. Explosive studs may be used provided they are driven under safe conditions.

5. Anchors, guides and sway braces shall be provided to allow for forces on the piping system. Sleeves shall be provided on pipe subject to movement. Sleeves shall be no less than four inches wide or have a width equal to 1/3 the diameter of the pipe, whichever is larger.

6. Vertical piping shall be supported at each floor or grating level with approved riser clamps except where prohibited by piping flexibility requirements. Lateral movement of exposed vertical piping at building walls shall be restrained by anchor devices attached to walls except where prohibited by piping flexibility requirements. Provide retaining straps when clamps are used.

C. Pipe Connections:

1. General:

a. Joint connections shall be as indicated on the Plans and specified herein. Excluding connections for valves, fittings, equipment, etc., joints in the pipe line shall be minimal yet provide easy access as required for maintenance.

2. Threaded:

a. A joint compound of oil and graphite, Teflon tape or other ENGINEER-approved material shall be applied to the male threaded end only. Care shall be used to prevent the joint compound from entering the pipe interior.

3. Electrical Conductivity:

a. When indicated on the Plans or specified, ductile iron piping joints shall be bonded to provide electrical conductivity across the joints of both bell and mechanical joint pipe and fittings.

b. Cable conductor shall be flexible to simplify assembly and to withstand ground and pipe movement after installation. Installation shall provide a positive lasting connection.

c. Where required, bonds shall be made between cast and/or ductile iron pipe and steel pipe to ensure electrical conductivity across the joints.

D. Expansion Joints:

1. Expansion joints shall be installed where indicated on the Plans and in accordance with the manufacturer's recommendations. Pipe systems shall be properly supported so expansion joints do not carry any loads. Piping on equipment adjacent to expansion joints shall be anchored to prevent excessive elongation of the pipe system when subject to pressure. Restrained expansion joints shall be used when adequate anchoring is not available.

2. Misalignment of installation shall not exceed 1/8 inch to allow full movement of expansion joints when necessary. Do not cover expansion joints with insulation. Straight, concentric or eccentric tapered joints shall be used as indicated on the Plans.

E. Miscellaneous System Connections:

1. Connection to large size pipe or headers for gages, sampler lines or other small inlets or outlets shall be made as indicated on the Plans and specified herein.

2. Connections to large steel pipe shall be by welding on the threaded saddle. The small line shall be socket or nipple type for either threaded or welded connection.

3. Tapping saddles shall be used on large PVC or fiberglass pipe. The small line connection shall be threaded.

4. Connections shall have gate valve installed adjacent to pipe.

3.04 Field Quality Control

A. General:

1. Installed pipe systems shall be tested by hydrostatic or pneumatic means as specified in Section 40 0500, Mechanical General Requirement, and herein. Hydrostatic testing shall be for any fluid type material to be handled with pneumatic testing for any gas or air pressurized lines.

2. Testing shall be made with the temperatures of surrounding air and test water or air are approximately constant within operating temperature ranges.

3. Pipe ends shall be valved or blanked off.

4. Exterior surfaces of pipes, fittings, or valves shall show no cracks or other forms of leakage.

B. Hydrostatic Testing:

1. Lines shall be tested with water and shall be drop tight for a period of two hours under test pressure.

2. Test pressure shall be 100 psi for water, nonpotable service water, and chemical solution lines.

C. Pneumatic Testing:

1. Lines shall be pressurized to test pressure and shall not have a drop exceeding 1% over a one-hour period after cutting off the source of pressure.

End of Section

Section 40 9000
Process Instrumentation, Controls and Monitoring Equipment - General Requirements

Part 1 General

1.01 Scope of Work

A. This Section encompasses general provisions relating to instrumentation work. Work included in this Section pertains to all instrumentation work contained in Division 22, Division 23, Division 26, or Division 40, unless modified therein, as though this Section was repeated in its entirety in each Section.

B. Furnish labor, materials, equipment and accessories required to provide complete operating instrumentation at the facility as described in the specifications, listed on the schedules and shown on the Drawings.

C. Install and/or connect furnished equipment, including equipment furnished by others, as detailed herein and as shown on the Drawings.

D. It is the intent of these Contract Documents that the instrumentation shall be suitable in every way for the service required. Material and all work that may be reasonably implied as being required for a complete fully functioning, automated and manually controlled facility shall be furnished at no extra cost.

E. Make field connections to process instruments and other equipment furnished under this Contract; to equipment furnished by OWNER under separate contract, if any; and to reworked or relocated existing equipment as in the Contract Documents.

F. Provide mounting, mount, and wire process instruments furnished under Contract. Furnish wire, and interconnections between process instrumentation primary elements, transmitters, local indicators, and receivers. Mount and wire surge protection equipment where indicated on the Drawings.

G. Provide mounting, mount, and make field connections to "packaged" instruments furnished under this Contract. Electrically or pneumatically connect "package" control systems to other related panels or instrumentation defined by the Contract Documents.

H. Process Instrumentation equipment and materials furnished under this Contract, shall be installed under Division 40. This installation Work shall include mounting, and making of process and signal connections to the equipment. This Work, with the exception of factory-mounting of certain instruments, shall be performed under the supervision of a qualified representative of the vendor of the system or equipment. This installation Work and the completed installation shall be in compliance with instructions of the above mentioned vendor's representative and in accordance with the Drawings and documentation prepared by the vendor of the system or equipment and approved by ENGINEER.

1.02 Related Work Specified Elsewhere

A. Section 26 0500: Electrical General Requirements
B. Section 26 0510: Basic Materials and Methods

1.03 Responsibilities

A. CONTRACTOR shall assume responsibility to take field measurements of related and connecting work, and to determine the entire scope of the work required for a finished and completed project, in accordance with the Contract Documents and as approved by ENGINEER.

B. Drawings upon which this Contract is based show the arrangement, general design and extent of the systems and components. Systems are suitably outlined on the Drawings with regard to size, locations, general arrangements and installation details. Connections are shown in diagram form, except where in certain cases the drawings may include details giving the exact locations and arrangements. Drawings shall not be scaled to determine location. Work shall be installed in such a manner to avoid interferences.

C. Where any parts of the systems or piece of equipment are located by dimensions on the Drawings, said dimensions shall be checked and verified in the field. Should discrepancies or interferences occur which will necessitate major revisions in the work, ENGINEER shall be notified immediately and his authority secured in writing for such revisions before proceeding with the Work.

D. Drawings are intended to convey the desired method of control and operation of the instrumentation and control system. CONTRACTOR shall retain the services of the Control System Supplier to be responsible for the system analysis, design and functional adequacy of equipment necessary to achieve required systems performance and to satisfy the intent of these Contract Documents.

E. Instrumentation and controls shall be installed under the supervision of the Control System Supplier. Insofar as possible, instrumentation and control equipment shall be furnished from a single supplier. CONTRACTOR shall retain the services of the Control System Supplier to supply the complete control and instrumentation system and prepare wiring diagrams, installation drawings and changes for existing equipment.

F. Modifications or additions to the electrical conduit and wiring installation for the instrumentation and control system required by the instrumentation and control system and not shown on the Contract Drawings shall be furnished and installed by CONTRACTOR, as approved by the equipment manufacturers. Other devices or wiring including energy sources and/or converters necessary to obtain proper operation of the instrumentation and control system, shall be provided and installed by CONTRACTOR. Special interface equipment required shall be provided and installed by CONTRACTOR at no additional cost to OWNER.

1.04 Reference Standards

A. Equipment, materials, and systems provided shall be designed, manufactured, finished, painted, tested, inspected, packaged, shipped, stored, installed, connected, and tested in accordance with the General Industry Standards of OSHA, MIOSHA, and local, county, state, and federal laws; and in accordance with the published codes, standards, and specifications of the following organizations:

1. ANSI - American National Standards Institute
2. ASTM - American Society for Testing and Materials
3. AWWA - American Water Works Association

4. IEEE - Institute of Electrical and Electronics Engineers
5. ISA - Instrument Society of America
6. MIOSHA - Michigan Occupational Safety and Health Administration
7. NEC - National Electric Code
8. NEMA - National Electrical Manufacturers Association
9. NFPA - National Fire Protection Association
10. OSHA - Occupational Safety and Health Administration (U.S. Depart. of Labor)

B. Equipment, materials, and systems shall be U.L. labeled or listed except for classes of materials and equipment not available with such listing.

1.05 Guarantee and Warranties

A. Guarantee work in accordance with the requirements of the Conditions of the Contract. With respect to instruments and equipment, guarantee shall cover:

1. Faulty or inadequate design
2. Improper assembly or erection
3. Defective workmanship or materials
4. Leakage, breakage, or other failure not caused by OWNER misuse.

B. For equipment bearing a manufacturer's warranty in excess of one year, furnish a copy of the warranty with OWNER named as beneficiary.

1.06 Improvements

A. Manufacturer's improvements involving specified systems or equipment needed to fulfill the intent of these specifications, and required to fulfill functionally the operational requirements, shall be provided at no additional cost to OWNER.

1.07 Submittals

A. Shop Drawings and Product Data:

1. Certified drawings and diagrams for all instrumentation and control work shall be furnished by CONTRACTOR and delivered to ENGINEER in accordance with Section 01 3300, Submittal Procedures. Information to be submitted for approval shall include:

    a. Schematic Wiring Diagrams

2. CONTRACTOR shall submit wiring diagrams of each piece of equipment, termination cabinet, starter, switch, relay, indicator, controller, recorder, annunciator, telemetering equipment, etc.

3. Drawings shall be 24" x 36" mylar with border, title block, symbols, etc., as used on the Contract Drawings and approved by ENGINEER. Ladder diagrams and wiring diagrams shall conform to JIC format and include line numbers, item numbers, source of power, terminal numbers, wire numbers, etc. Wire numbers and item numbers shall be assigned using the line numbers on the ladder diagrams.

4. Where applicable, and if CONTRACTOR desires, he may purchase mylars, vellums or electronic files (when approved by ENGINEER) of the process control drawings from ENGINEER, modify these drawings as required, and utilize them as shop drawings.

5. Bond copies will be acceptable for the approval issue only.

6. Manufacturer's specifications complete with descriptive information indicating design data underscored to assist in verification that equipment proposed is equal to or exceeds the technical requirements and intent of these specifications. Design data shall cover exact equipment furnished.

7. Dimensional outline drawings of all control and instrument enclosures including designated conduit or wireway entrances, internal equipment layouts and structural details.

8. Internal wiring diagrams of control enclosures identifying terminals and showing external and interconnecting terminals and field mounted devices.

9. Details necessary for fabrication of equipment specific to these control systems.

10. Working and/or construction drawings, showing conduit layout, locations, details, size, wire size and type and cables therein.

11. Technical information for all devices furnished.

12. Cable schedule detailing each cable, routing and all connections, as described in a format approved by ENGINEER.

13. A riser diagram shall be provided showing all cables, wires and conduits.

14. A complete list of all recommended spare parts and test equipment required for the upkeep of all instruments and controls devices installed under this Contract.

15. Complete parts lists of all materials and components incorporated in the system.

16. Individual manufacturer's instruction manuals for all devices.

17. CONTRACTOR shall submit as-built drawings, instruction manual material and assistance as required by Sections 01 7700, Closeout Procedures.

1.08 Shipping Precautions

A. After completion of shop assembly and tests, all control cabinets, panels and consoles, etc., shall be enclosed in heavy duty polyethylene envelopes or secured sheeting to provide complete protection from dust and moisture.

B. Dehumidifiers or desiccant materials shall be placed inside the polyethylene coverings prior to sealing. Equipment shall then be skid mounted and braced for final transport.

C. Lifting rings shall be provided for moving without removing protective coverings on all sections weighing more than 150 lbs. Boxed weights shall be shown on shipping tags together with instructions for unloading, transporting, storing and handling.

D. Equipment provided under this Contract shall not be delivered to the job site until scheduled for installation.

E. Special instructions for proper field handling and installation required by the manufacturer for proper protection shall be securely attached to each piece of equipment prior to shipment.

F. Each package shall be tagged to identify its location, tag number and function in the system. Identification shall be prominently displayed on outside of package.

G. A permanent stainless steel or other non-corrosive material tag firmly attached and permanently and indelibly marked with the instrument tag number, shall be provided on each piece of equipment supplied under the Contract.

1.09 Storage

A. Equipment shall not be stored out-of-doors. Equipment shall be stored in dry permanent shelters and shall be adequately protected against mechanical injury or damages by water.

1.10 Instrument Identification

A. Major instrumentation and equipment items or system specified shall be identified by system and tag numbers. This same number appears in the tag number designations on the drawings and on the schedule.

B. Instrumentation and equipment shall be identified by nameplates or tags.

C. Nameplates for panels and panel mounted equipment shall be as specified in the respective Section.

D. Field equipment shall be tagged with assigned instrumentation tag number and function.

1. Tags shall be white lamacoid with engraved black characters of 3/16 inch minimum height.

2. Tags shall be attached to equipment with a commercial tag holder using a stainless steel band with a worm screw clamping device or by a holder fabricated with standard hose clamps and meeting the same description. In cases where this would be impractical, use 20 gage stainless steel screws installed in an unobtrusive manner.

E. In addition to tags, field mounted control stations, recorders or indicators shall have a nameplate indicating their function and the variable controlled or displayed.

1. Nameplate shall be attached by one of the above methods.

1.11 Signal Isolators, Converters, and Conditioners

A. Ensure that input-output signals of all instruments and control devices are compatible.

B. Unless otherwise specified, signals between field and panels shall be 4 to 20 mA DC unless specifically approved otherwise.

C. Granting such approval does not relieve the compatibility requirement above.

D. Provide signal isolators and converters as necessary to obtain the required system performance. Mount the devices inside or behind control panels, or in the field at point of application.

1.12 Process Connections

A. Provide instrument piping, tubing, and capillary tubing to meet the intended process service and ambient environmental condition for corrosion resistance.

B. Slope lines according to service to promote a self draining or venting back to the process.

C. Terminate connection to process lines or vessels in a service rated block valve that will permit closing off the sense line or removal of the element without requiring shutdown of the process.

D. Include drip legs and blow-down valves for terminations of sensing lines at the instruments when mounted in such a way that condensation can accumulate.

E. Process vessels, line penetrations, connecting fittings, and block valves shall be furnished by CONTRACTOR.

1.13 Manufacturer's Service

A. General:

1. CONTRACTOR shall furnish the services of a factory representative of the instrumentation equipment manufacturer to provide field supervision during installation, to direct the installation of the equipment, and to conduct initial equipment checkout and system start-up.

2. CONTRACTOR shall furnish the services of a factory trained and qualified serviceman of the manufacturers of the instrumentation equipment and accessories supplied under this Contract to perform the following:

B. Supervision:

1. Supervisory service of a trained serviceman, specifically trained on the type of equipment herein specified, shall be provided during construction to assist in, location of sleeves, methods of installing conduit and special cable, mounting piping and wiring for each type of device, and the methods of protecting all of the equipment prior to placing it in service.

C. Power Check-Out:

1. Checking the installation of all components before power is applied.

2. No form of energy shall be applied to any part of the instrumentation system prior to receipt by ENGINEER of a certified statement of approval of the installation from CONTRACTOR, containing his Control System Supplier’s authorization for turning on energy to the system.

D. Check-Out:

1. Placing the equipment into operation and making necessary adjustments including tests and loop checks.

2. CONTRACTOR shall provide the Control System Supplier’s services to maintain all control system equipment in good operating condition and furnish-on-call maintenance as required to minimize equipment down time, until the project has attained Substantial Completion.

a. Control System Supplier shall provide scheduled preventative maintenance based on ENGINEER approved listing specifying the time required for preventative maintenance on the various types of equipment and shall provide remedial maintenance services as required.

b. Additional service time shall be provided during the one-year warranty period for at least three 8-hour day service visits to the site to check and readjust the equipment supplied under this Section.

1.14 Tools and Spare Parts

A. One complete sets of any specialty instrument required to adjust and calibrate the instrumentation equipment shall be furnished with the equipment.

1. They shall include hand tools for maintenance and calibration such as: unique screwdrivers and wrenches plus other tools as required.
2. They shall be supplied in a durable case.

3. Calibration tools for instrumentation equipment such as magmeters, flowmeters, and pneumatic instruments shall also be provided.

B. A universal, portable input-output calibrator shall be provided.

1. The unit shall be suitable for use as a current or voltage source, current or voltage measuring device and as a power supply for two wire transmitters.

2. Output section shall contain 6 current and 5 voltage ranges.

3. Internal power supply shall contain 3 ranges.

4. A self contained portable potentiometer shall also be provided.

5. Tester shall be Fluke model 789 or ENGINEER approved equal.

1.15 Spare Parts

A. Spares consumed during installation and testing shall be replaced by CONTRACTOR prior to final acceptance of the system.

B. Control System Supplier shall supply a complete list of all suggested spare parts and supplies he considers required for the continuous operation of the system.

1. List shall include catalog and serial numbers of the hardware devices, spare parts part numbers, commercial part numbers and price in effect when the list is prepared.

2. Spare parts shall be 100% of the manufacturer's recommended spare parts for each device.

C. Spare parts for specific equipment, if necessary to be furnished by CONTRACTOR, shall be specified in the Sections for the specific equipment.

1.16 Source Quality Control

A. Instruments and controls shall be installed under the supervision of Control System Supplier.

1. In order to ensure a coordinated instrumentation and control system, CONTRACTOR shall require the Control System Supplier to certify coordination of the overall control and instrumentation system so that all devices provided under this Contract are compatible and provide a complete and operable system.

2. Control System Supplier shall inspect each component piece of equipment supplied for each system to assure that it is new, in good working order and complies with the intent of Contract Documents.

3. Components not fulfilling these criteria shall be rejected.

Part 2 Products

2.01 Instrumentation General

A. Electronic instrumentation shall be of the solid-state type, of manufacturer's latest design; preferably designed and packaged for miniature, high density mounting configuration.

1. Where available, the instruments will be supplied with self-supporting, draw-out feature when in extended position.

2. Transmitted analog signals shall be 4-20 mAdc; however, signals between instruments within the same panel/cabinet may be 1-5V.

3. Zero base transmission signals will not be allowed, only "live zero" signals. An exception would include outputs of sensing devices specified hereafter, however, converted to compatible high level signals for remote transmission.

B. Field mounted equipment shall be in NEMA 4X enclosures and, if required, shall include suitable strip heaters to prevent accumulation of moisture.

C. Equipment installed in hazardous areas, shall meet Class I, Group D, Division I to comply with the National Electrical Code.

D. Indicators and recorder readouts will be linear in process units.

E. Transmitters shall be provided with either integral indicators or separately mounted indicators reading in process units. Special features listed in the individual instrument specifications are required and all information listed therein shall be considered as minimum requirements.

F. Equipment furnished shall be approved for specific application by Underwriter's Laboratories, Inc., or Factory Mutual if applicable.

2.02 Electrical

A. Refer to Division 26.

B. Equipment shall be designed to operate on a 60 Hertz alternating current power source at 105 to 135 volts, except as noted. Regulators and power supplies required for compliance with the above shall be provided between power supply and interconnected instrument loop. Where equipment requires voltage regulation, constant voltage transformers shall be supplied.

C. Switches shall have single-pole double-throw contacts rated at 600 VA.

D. Contacts for low voltage signals shall be gold flashed.

2.03 Power Failure

A. Equipment shall be designed and constructed so that in the event of a power interruption the equipment shall resume normal operation without manual resetting when power is restored.

2.04 Control System Suppliers

A. Available Control System Suppliers: Subject to compliance with requirements, provide a Control System Supplier of the following:

1. Commerce Controls, Inc.

Control System Supplier. Equipment specified and shown on Drawings shall be designed as a system, fabricated or purchased, shipped to job site, and started up by a qualified and approved Control System Supplier listed under this heading. Intent is for unit responsibility.

B. Control System Supplier shall not assign any of his rights or delegate any of his obligations.

C. Direct purchase of any items by CONTRACTOR is not in compliance with this Specification and will not be permitted.

D. Control System Supplier shall assign a qualified representative to act as Project Engineer for the work efforts specified. Control System Supplier shall submit a resume outlining the qualifications of this individual to ENGINEER for approval within 3 days of notice to proceed. Project Engineer shall, at a minimum, have the following qualifications:

1. Successfully completed vendor factory training for the digital equipment supplied.
2. Successfully completed projects of similar size and complexity.

E. Project Engineer shall be interviewed at ENGINEER's office in Taylor, Michigan after the contract has been awarded. Individuals selected as Project Engineer must be approved by ENGINEER. Individuals not approved by ENGINEER shall not function as Project Engineer.

F. Project Engineer shall be the focal point for all design, fabrication, contract communications, and construction and shall be responsible for start-up and acceptance.

1. The Project Engineer shall be at the factory test, at the job site during the entire construction process start-up, and at the job site during the entire acceptance procedure.

2. Only qualified and approved Control System Suppliers will be accepted as meeting this Specification.

3. The Control System Supplier shall also assign a full-time service technician during the construction process effort to assist in verifying and making minor corrections to wiring which may be necessary as determined by ENGINEER.

4. The start-up/acceptance procedure shall not begin until all installation has been completed and any punch list items are minor in nature.

G. Installation and Start-up. Control System Supplier shall have an established service facility from which qualified technical service personnel and parts may be dispatched upon call. Such a service facility shall be no more than six (6) hours travel time by ground from the jobsite.

2.05 Training

A. General:

1. CONTRACTOR shall provide two 8-hour days of training of OWNER's personnel in aspects of operation and maintenance such as direction on calibration of field instruments, fuse locations, instruction manuals, etc.

2. At-the-plant training and instructions shall be given by the Project Engineer assigned to the project by the Control System Supplier or other personnel as approved by ENGINEER.

B. Digital Equipment:

1. Control System Supplier shall provide comprehensive instruction for the programmable controllers and software packages supplied. This instruction shall be performed by the manufacturer of the products at their factory training facility.

2. CONTRACTOR shall submit to ENGINEER, an outline of the proposed training courses to meet the requirements set forth below.

a. Hardware training (3 individuals)

(1) 1 day, Maintenance and Troubleshooting

b. Software training (3 individuals)

(1) 1 day, Software Concepts

3. CONTRACTOR shall also provide to ENGINEER a list of additional courses available from the manufacturer.

4. Upon review, ENGINEER may request that a substitution be made of a course content that better fits the needs of OWNER.

a. Such substitution shall only be requested for courses of equal length cost and availability. The content of these courses and proposed lengths shall be as follows:

C. OWNER shall determine actual division of attendance. Written course materials shall be included along with hands-on exercises with instructional equipment. Factory training shall be conducted on a schedule acceptable to OWNER and shall commence prior to system factory testing.

D. For training conducted at other then OWNER's facilities, CONTRACTOR shall bear all transportation (air fare, car rental, etc.) and subsistence (hotel, meals, etc.) costs for training.

1. Daily subsistence allowance shall be $150/day/person.

2. CONTRACTOR shall arrange for all training for OWNER with a minimum of 6 week notification of training schedule prior to actual course being provided.

3. Scheduling of courses and their contents shall be approved by ENGINEER and provided at a time and location agreeable to OWNER.

4. Course shall be conducted at locations normally established for such courses by manufacturers of software and computer products.

Part 3 Execution

3.01 Inspection

A. Inspect each instrument and piece of equipment for damage, defects, completeness, and correct operation before installing. Inspect previously installed related work and verify that it is ready for installation of instruments and equipment.

3.02 CONTRACTOR's Certified Reports

A. CONTRACTOR shall submit a certified report for control panel and associated field instruments certifying that the equipment:

1. Has been properly installed under Control System Supplier's supervision.

2. Is in accurate calibration.

3. Was placed in operation in under Control System Supplier's presence.

4. Has been checked, inspected, calibrated, and adjusted as necessary.

5. Has been operated under maximum power variation conditions and has operated satisfactorily.

6. Is fully covered under the terms of the guarantee.

3.03 Demonstration and Final Operating Test Plans and Results

A. Submit for approval, a written plan for demonstrating that each system of equipment provided meets the specified operational requirements.

1. The plan shall include procedures to be used in final operational testing of entire system including description for each system of test methods and materials, testing instruments and recorders, a list of the equipment involved with the functional parameters to be recorded on each item, and shop drawings of required temporary bypasses and like facilities.

3.04 Preparation

A. Ensure that installation areas are clean and that concrete or masonry operations are completed prior to installing instruments and equipment. Maintain the areas in a broom-clean condition during installation operations.

3.05 Installation

A. Instrumentation and accessory equipment shall be installed in accordance with the Control System Supplier's instructions.

1. Locations of equipment, transmitters, alarms and similar devices shown on the Drawings are approximate only. Exact locations shall be as approved by ENGINEER during construction.

2. Field verify information relevant to the placing of process control equipment and in case of any interference, proceed as determined by ENGINEER.

3. Furnish labor and materials necessary to complete the work in an approved manner.

B. Instrumentation loop diagrams on the Drawings indicate the intent of the interconnection for the instruments specified.

1. Work shall be executed in full accordance with codes and local rulings. Should any work be performed contrary to said rulings, ordinances and regulations, CONTRACTOR shall bear full responsibility for such violations and assume all costs arising there from.

2. Field instruments requiring power supplies shall be provided with local electrical shut-offs.

C. Brackets and hangers required for mounting of equipment shall be provided and shall be installed in a workmanlike manner so as to not interfere with other equipment.

1. CONTRACTOR shall investigate each space in the building through which equipment must pass to reach its final location.

2. If necessary, the manufacturer shall be required to ship this material in sections sized to permit passing through such restrictive areas in the building.

D. The shield on each process instrumentation cable shall be grounded as directed by the manufacturer of the instrumentation equipment but in no case shall more than one ground be employed for each shield.

1. Cable shields will be continuously maintained by termination to "shield" terminals which are not grounded except at the Main Control Panel. The sole exception is if the manufacturer requires ground of the shield at the field device.

E. Each pair of wires shall be tagged within four inches of each termination with the assigned cable, pair and terminal numbers.

1. Low energy signal (4-20 mAdc) shall be run in instrumentation cables in conduits separated from AC power, control and annunciator wiring.

2. Lifting eyes shall be removed from cabinets/assemblies.

3. Holes in cabinet or boxes shall be plugged.

4. The plug will be of the same color as the cabinet or box and shall be gasketed.

3.06 Instrument Calibration

A. Provide the services of factory trained instrumentation technicians, tools and equipment to field calibrate each instrument to its specified accuracy in accordance with the manufacturer's specifications instructions for calibration.

B. Each instrument shall be calibrated at 10%, 50%, and 90% of span using test instruments to simulate inputs and read outputs that are rated to an accuracy of at least 5 times greater than the specified accuracy of the instrument being calibrated. Such test instruments shall have accuracies traceable to the National Bureau of Standards, as applicable.

C. Provide a list and basic specifications for instruments used.

D. Provide a written report to ENGINEER on each instrument certifying that it has been calibrated to its published specified accuracy.

1. Report shall include applicable data as listed below plus any defects noted, correction action required and correction made.

2. Data shall be recorded on prepared forms and shall include not less than the following items.

a. Facility identification (name, location).
b. Loop identification (name or function).
c. Equipment tag and serial numbers.
d. Scale ranges and units.
e. Test mode or type of test.
f. Input values or settings.
g. Expected outputs and tolerances.
h. Date of actual calibration.
i. Actual readings.
j. Explanations or special notes as applicable.
k. Tester's certification with name and signature.

3.07 System Validation

A. Provide the services of factory trained and field experienced instrumentation engineer(s) to validate each system to verify that each system is operational and performing its intended function within system tolerance.

1. System tolerance is defined as the root-mean-square sum of the system component published specified accuracies from input to output.

B. Validate each system by simulating inputs at the first element in loop (i.e., sensor) of 10%, 50%, and 90% of span, or on/off and verifying loop output devices (i.e., recorder, indicator, alarm, etc., except controllers).

1. During system validation, make provisional settings on levels, and alarms.

2. Verify controllers by observing that the final control element moves in the proper direction to correct the process variable as compared to the set point.

3. Verify that alarms and logic sequences operate in accordance with the specifications.

C. Cause malfunctions to sound alarms or switch to standby to check system operation. Check all systems thoroughly for correct operation.

D. Immediately correct defects and malfunctions disclosed by tests. Use new parts and materials as required and approved and retest.

E. Provide a report certifying completion of validation of each instrument system.

1. Report shall indicate calculated system tolerances, data verifying that the system meets these tolerances, and any provisional settings made to devices.

2. Data sheets shall be similar to those used for calibration.

3.08 Final Operational Testing and Acceptance

A. Upon completion of instrument calibration and system validation, test system under process conditions.

1. The intent of this test is to demonstrate and verify the operational interrelationship of the instrumentation systems.

2. Testing shall include, but not be limited to, specified operational modes, taking process variables to their limits (simulated or process) to verify all alarms, failure interlocks, and operational interlocks between systems and mechanical equipment.

B. Immediately correct defects and malfunctions with approved methods and materials in each case and repeat and testing.

C. Upon completion of final operational testing, submit certified report, with substantiating data sheets, indicating that total instrumentation and control system meets the functional requirements specified herein.

D. Testing shall be observed by ENGINEER.

1. Notify ENGINEER in writing a minimum of 48 hours prior to the proposed date for commencing the testing.

2. Upon completion of this test CONTRACTOR shall begin or have begun system start-up.

3. OWNER reserves the right to set the schedule.

3.09 Start-Up Assistance

A. Provide the services of a factory trained and field experienced instrumentation engineer for a minimum of 1 day at the project site to assist ENGINEER in field checkout and start-up of software. This period shall be scheduled by ENGINEER.

B. Provide the services of a factory trained and field experienced instrumentation engineer for a minimum of two (2) working days to assist OWNER's personnel during startup of the system. Purpose of this assistance is to support in making final adjustments of settings on the instrument systems.

3.10 Coordination

A. Work shall be coordination with other trades involved in the construction project.

B. Work shall be carefully laid out in advance so that architectural, structural, mechanical, electrical, and instrumentation features of construction will be coordinated.

3.11 Digital Equipment

A. Digital equipment supplier shall provide an authorized, service representative for a minimum of three times at jobsite, including once during installation and start-up and once during acceptance to inspect and check out the control system.

B. Service representative shall revisit jobsite for 8 hours per day as often as necessary after installation until trouble is corrected and equipment has passed acceptance test and is operating satisfactorily to ENGINEER.

End of Section

Exhibit 1
Wessels FXA-5000-WG Pressure Tank

SINCE 1908
wessels company

SUBMITTAL

FXA-SERIES with WessGuard®

HYDRO-PNEUMATIC TANKS

Models: FXA-1000-WG thru FXA-15000-WG
Submittal Sheet No. C-1011**B** Date: 4/16

Job Name	_____	Submitted By	_____	Date	_____
Location	_____	Approved By	_____	Date	_____
	_____	Order No.	_____	Date	_____
Engineer	_____	Notes	_____		
Contractor	_____		_____		
Sales Rep.	_____		_____		

Description

Wessels type FXA tanks are ASME replaceable bladder type pre-charged hydro-pneumatic tanks with WessGuard® bladder monitor for commercial and industrial well and water systems, booster systems, or other potable water applications. They are designed to deliver water under pressure between pump cycles to provide sufficient flow to meet demands. WessGuard monitor will activate an audible LED alarm to notify maintenance staff of this potential systems issue. The water is contained in a butyl bladder. All FXA hydro-pneumatic tanks can be installed vertically or horizontally.

Construction

Shell: Carbon steel
Bladder: Heavy-duty butyl (FDA Approved)
System Connection: Epoxy lined

Performance Limitations

Maximum Design Temperature: 240°F
Maximum Design Pressure: 125 PSIG*

*200 & 250 PSIG available

NSF
Listed
Material

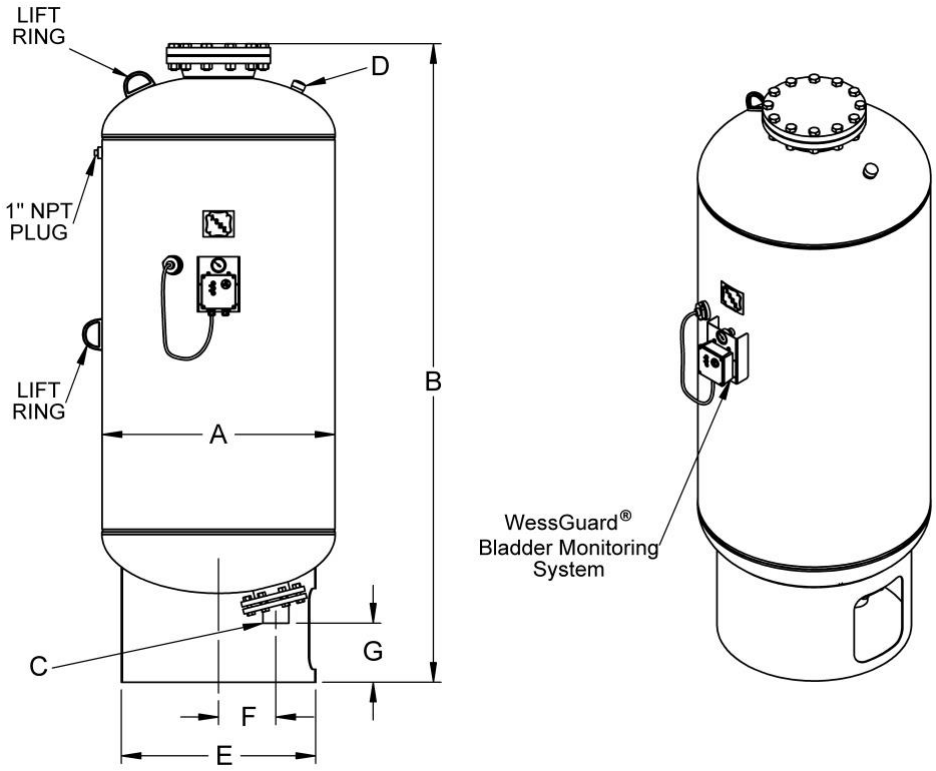
Model Number	Part Number	Tank Volume (Gallons)	Tagging Information	Quantity
FXA-1000-WG	61011000	264		
FXA-1200-WG	61011200	317		
FXA-1400-WG	61011400	370		
FXA-1600-WG	61011600	422		
FXA-2000-WG	61012000	528		
FXA-2500-WG	61012500	660		
FXA-3000L-WG	61013000	792		
FXA-3000S-WG	61013001	792		
FXA-4000-WG	61014000	1056		
FXA-5000-WG	61015000	1320		
FXA-7500-WG	61017500	1980		
FXA-10000-WG	61019999	2640		
FXA-15000-WG	61010000	3963		

Typical Specification

Furnish and install, as shown on plans, a _____ gallon _____" diameter X _____" (high) pre-charged steel hydro-pneumatic tank with replaceable heavy-duty butyl bladder. The tank shall have capacitive sensor bladder monitor with visual and audible alarm that activates based on excessive bladder movement. The tank shall have NPT epoxy lined system connections and a 0.302"-32 charging valve connection (standard tire valve) to facilitate the on-site charging of the tank to meet system requirements. The tank must be constructed in accordance with most recent addendum of Section VIII Division 1 of the ASME Boiler and Pressure Vessel Code.

Each tank shall be Wessels model number SMART TANK SERIES™ FXA- _____-WG or approved equal.

101 TANK ST ● GREENWOOD, IN 46143 ● (317) 888-9800 ● (317) 888-9988 FAX ● www.westank.com



FXA-1000-WG thru FXA-15000-WG

Dimensions & Weights

Model Number	Dimensions in Inches							Approx. Ship Wt. (lbs)
	A	B	System Connection C	Charging Valve D	E	F	G	
FXA-1000-WG	36	87	3	0.302 - 32NC	30	8	8 1/2	735
FXA-1200-WG		98 1/2						745
FXA-1400-WG		110 1/2						900
FXA-1600-WG	48	84			42	9	8 3/4	1210
FXA-2000-WG		96						1305
FXA-2500-WG		110	4				8 1/4	1430
FXA-3000L-WG		133						1575
FXA-3000S-WG	60	93			54	10		2169
FXA-4000-WG		115						2638
FXA-5000-WG		138						3246
FXA-7500-WG	72	140			60	11		4080
FXA-10000-WG		172						4920
FXA-15000-WG		243						6000

Notes

- Tanks are factory pre-charged at 30 psi and field adjustable.
- California code-sight glass is available upon request.
- Tanks installed horizontally must have the system connection below the horizontal centerline of the tank.
- Available with mounting clips.

Exhibit 2
Rosemount 8750W Magnetic Flow Meter
2-inch dia ASME – 150, SO/RF

Product Data Sheet
00813-0300-4750, Rev CB
May 2019

Rosemount® 8750W Magnetic Flowmeter System

for Utility, Water, and Wastewater Applications

- Best in class value with performance, reliability, and diagnostics suited for monitoring applications
- Reliable all welded coil housing and lightweight sensor design rated to IP68
- Available in 4–20mA with HART®, FOUNDATION™ Fieldbus, Modbus® RS-485, Process Diagnostics, and SMART™ Meter Verification to improve reliability and performance
- Available with drinking water certifications

ROSEMOUNT™

EMERSON™

Product Selection Guide

The Rosemount 8750W Magnetic Flowmetersensor is available in a flanged style and transmitter is available in remote and integral transmitter configurations to ensure compatibility with all utility, water, and wastewater applications.

Transmitter selection

Transmitter	General characteristics
Field mount 	■ Integral and remote configurations available ■ HART/Analog and Pulse outputs available ■ FOUNDATION™ Fieldbus and pulse output available ■ Modbus RS-485 and Pulse output available ■ Advanced Diagnostics available ■ LCD display (optional) — With optional optical switch local operator interface(1) ■ Two discrete channels (optional)
Wall mount 	■ Wall mount configuration ■ HART/Analog and Pulse outputs available ■ Modbus RS-485 and Pulse output available ■ FOUNDATION™ Fieldbus and pulse output available ■ Advanced Diagnostics available ■ Local LCD display (optional) — With optional 15 button tactile key pad(1) ■ Two discrete channels (optional)

(1) HART or Modbus protocol only.

Contents

Sensor selection

Table 1: Sensor Selection

Sensor	General characteristics
Flanged 	■ Flanged process connections Welded coil housing ■ ½-in. (15 mm) to 48-in. (1200 mm) ■ Standard, reference, and bullet-nose electrodes available

Selecting materials

For guidance on selecting materials, refer to the *Rosemount™ Magnetic Flowmeter Material Selection Guide (00816-0100-3033)* , available at www.emerson.com/rosemount.

Magmeter Diagnostics

Rosemount diagnostics reduce cost & improve output by enabling new practices

Rosemount Magnetic Flowmeters provide device diagnostics that detect and warn of abnormal situations throughout the life of the meter - from installation to maintenance and meter verification. With Rosemount Magnetic Flowmeter diagnostics enabled, plant availability and throughput can be improved, and costs through simplified installation, maintenance and troubleshooting can be reduced.

Table 2: Magnetic flowmeter diagnostics

Diagnostic name	Diagnostic category	Product capability
Basic diagnostics		
Tunable Empty Pipe	Process	Standard
Electronics Temperature	Meter Health	Standard
Coil Fault	Meter Health	Standard
Transmitter Fault	Meter Health	Standard
Reverse Flow	Process	Standard
Coil current	Maintenance	Standard
Electrode saturation	Process/Maintenance	Standard
Advanced diagnostics		
High Process Noise	Process	Suite 1 (DA1)
Grounding and Wiring Fault	Installation	Suite 1 (DA1)
Coated Electrode Detection	Process	Suite 1 (DA1)
Commanded Smart Meter Verification	Meter Health	Suite 2 (DA2)
Continuous Smart Meter Verification	Meter Health	Suite 2 (DA2)

Table 2: Magnetic flowmeter diagnostics *(continued)*

Diagnostic name	Diagnostic category	Product capability
4-20 mA Loop Verification(1)	Installation	Suite 2 (DA2)

(1) Available with HART output only.

Options for accessing diagnostics

Rosemount Magmeter Diagnostics can be accessed through the Local Operator Interface (LOI), ProLink® III v3.1, a HART Field Communicator(1), and AMS® Suite: Intelligent Device Manager(1). Contact your local Rosemount representative to activate diagnostics or for diagnostic availability on existing transmitters.

Access diagnostics through the LOI for quicker installation, maintenance, and meter verification

Rosemount Magnetic Flowmeter Diagnostics are available through the LOI to simplify maintenance.

Access diagnostics through ProLink III v. 3.0 (HART)/ProLink III v. 3.1 (HART, Modbus)

Simplify maintenance and troubleshooting practices by utilizing ProLink III v3.0/v3.1 to access diagnostics and troubleshooting information, log variable data, run SMART Meter Verification, and print verification reports.

Access diagnostics through AMS Intelligent Device Manager(1) for the ultimate value

The value of the diagnostics increases significantly when AMS Intelligent Device Manager is used. AMS Intelligent Device Manager provides a simplified screen flow and procedures for how to respond to the diagnostic messages.

Magnetic Flowmeter Sizing

Selecting the appropriate sensor size is an important step when considering a magnetic flowmeter. The physical properties of the process fluid, as well as the fluid velocity should be considered. It may be necessary to select a flow sensor that is larger or smaller than the adjacent piping to ensure the fluid velocity is in the recommended flow range for the application.

- Operation outside these guidelines may also give acceptable performance.

Table 3: Sizing guidelines

Application	Velocity range (ft/s)	Velocity range (m/s)
Normal Service	0–39	0–12
Preferred Service	2–20	0.6–6.1

Note
Operation outside these guidelines may also give acceptable performance.

To convert flow rate to velocity, use the appropriate factor listed in Table 4 and the following equation:

$$\text{Velocity} = \frac{\text{Flow Rate}}{\text{Factor}}$$

(1) Available with HART output only.

Example: English units	Example: SI units
Magmeter Size: 4 in. (factor from Table 4 = 39.679) Normal Flow Rate: 300 GPM $\text{Velocity} = \frac{300\ (\text{gpm})}{39.679}$ **Velocity = 7.56 ft/s**	Magmeter Size: 100 mm (factor from Table 4 = 492.78)Normal Flow Rate: 800 L/min $\text{Velocity} = \frac{800\ (\text{L/min})}{492.78}$ **Velocity = 1.62 m/s**

Table 4: Line size vs. conversion factor

Nominal line size—Inches (mm)	Gallons per minute factor	Liters per minute factor
½ (15)	0.947	11.762
1 (25)	2.694	33.455
1½ (40)	6.345	78.806
2 (50)	10.459	129.89
2 ½ (65)	14.923	185.33
3 (80)	23.042	286.17
4 (100)	39.679	492.78
5 (125)	62.356	774.42
6 (150)	90.048	1,118.3
8 (200)	155.93	1,936.5
10 (250)	245.78	3,052.4
12 (300)	352.51	4,378.0
14 (350)	421.70	5,237.3
16 (400)	550.80	6,840.6
18 (450)	697.19	8,658.6
20 (500)	866.51	10,761
24 (600)	1,253.2	15,564
30 (750)	2006.0	24,913
36 (900)	2,935.0	36,451
40 (1000)	3,652.1	45,357
42 (1050)	4,115.1	51,107
48 (1200)	5,407.6	67,159

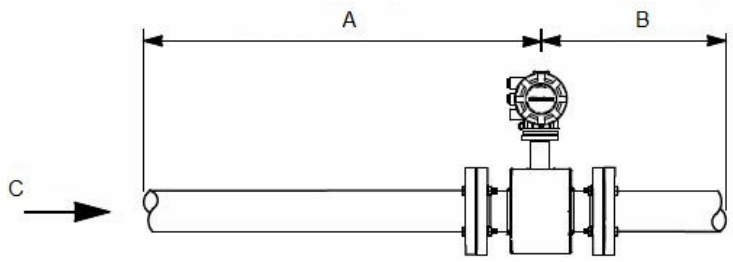
Table 5: Line size vs. velocity/rate

Nominal line size in inches (mm)	Minimum/maximum flow rate							
	Gallons per minute				Liters per minute			
	at 0.04 ft/s (low-flow cutoff)	at 1 ft/s (min range setting)	at 3 ft/s	at 39.37 ft/s (max range setting)	at 0.012 m/s (low-flow cutoff)	at 0.3 m/s (min range setting)	at 1 m/s	at 12 m/s (max range setting)
½ (15)	0.038	0.947	2.841	37.287	0.141	3.529	11.76	141.15
1 (25)	0.108	2.694	8.081	106.05	0.401	10.04	33.45	401.46
1½ (40)	0.254	6.345	19.04	249.82	0.946	23.64	78.81	945.67
2 (50)	0.418	10.459	31.38	411.77	1.559	38.97	129.89	1,558.7
2½ (65)	0.597	14.923	44.77	587.51	2.224	55.60	185.33	2,224.0
3 (80)	0.922	23.042	69.13	907.17	3.434	85.85	286.17	3,434.0
4 (100)	1.587	39.679	119.04	1,562.2	5.913	147.84	492.78	5,913.4
5 (125)	2.494	62.356	187.07	2,454.9	9.293	232.33	774.42	9,293.0
6 (150)	3.602	90.048	270.14	3,545.2	13.42	335.50	1,118.3	13,420
8 (200)	6.237	155.93	467.79	6,138.9	23.24	580.96	1,936.5	23,238
10 (250)	9.831	245.78	737.34	9,676.3	36.63	915.73	3,052.4	36,629
12 (300)	14.10	352.51	1,057.5	13,878	52.54	1,313.4	4,378.0	52,535
14 (350)	16.87	421.71	1,265.1	16,603	62.85	1,571.2	5,237.3	62,848
16 (400)	22.03	550.80	1,652.4	21,685	82.09	2,052.2	6,840.6	82,087
18 (450)	27.89	697.19	2,091.6	27,448	103.90	2,597.6	8,658.6	103,903
20 (500)	34.66	866.51	2,599.5	34,114	129.14	3,228.4	10,761	129,137
24 (600)	50.13	1,253.2	3,759.6	49,339	186.77	4,669.2	15,564	186,769
30 (750)	80.24	2,006.0	6,018.0	78,976	298.96	7,474.0	24,913	298,959
36 (900)	117.40	2,935.0	8,805.1	115,553	437.42	10,935	36,451	437,416
40 (1000)	146.09	3,652.1	10,956	143,785	544.29	13,607	45,357	544,286
42 (1050)	164.60	4,115.1	12,345	162,011	613.28	15,332	51,107	613,278
48 (1200)	216.30	5,407.6	16,223	212.898	805.91	20,148	67,159	805,908

Upstream and downstream piping

To ensure specified accuracy over widely varying process conditions, install the sensor with a minimum of five straight pipe diameters upstream and two pipe diameters downstream from the electrode plane.

Figure 1: Upstream and downstream straight pipe diameters



A. Five pipe diameters (upstream)
B. Two pipe diameters (downstream)
C. Flow direction

Installations with reduced upstream and downstream straight runs are possible. In reduced straight run installations, the meter may not meet accuracy specifications. Reported flow rates will still be highly repeatable.

Sensor grounding

A reliable ground path is required between the sensor and the process fluid. Optional grounding rings or process reference electrodes are available with the sensor to ensure proper grounding. See Table 5 and Table 6.

Ordering Information

Rosemount 8750W Magnetic Flowmeter Platform

The Rosemount 8750W Magnetic Flowmeter is available in a flanged sensor design. The sensors are fabricated from stainless and carbon steel and welded to provide a sealed coil housing that protects against moisture or other contaminants. Sizes range from 1/2-in. (15 mm) to 48-in. (1200 mm). The field mount transmitter has a die cast aluminum housing for excellent reliability. The wall mount transmitter features an easy to use operator interface. Both transmitter styles are available with advanced diagnostics to provide the best insight into the process and the meter's health.

Note
The starred (★) offerings represent the most common options, and should be selected for best delivery.

Model code structure

Example model code with one selection out of each category:
`8750W D M T 1 A 1 F P S A 010 C A1 Z5 DA2 AX M4 BD G5 B6 R15 V1 Q4 HR7 WG YF`

Table 6: Requirements - select one from each available choice

Example code	Category
8750W	Base model—Magnetic Flowmeter System (utility, water, and wastewater)
D	Sensor design revision—Revision "D"
M	Transmitter class (Table 8)
T	Transmitter mount (Table 9)
1	Transmitter power (Table 10)

Table 6: Requirements - select one from each available choice *(continued)*

Example code	Category
A	Transmitter outputs (Table 11)
1	Conduit entries (Table 12)
F	Sensor style (Table 13)
P	Lining material (Table 14)
S	Electrode material (Table 15)
A	Electrode type (Table 16)
010	Line size (Table 17)
C	Flange type and material (Table 18)
A1	Flange rating (Table 19)

Table 7: Options - select only as needed

Example code	Category
Z5	Hazardous area certifications (Table 20)
DA2	Advanced diagnostics (Table 21)
AX	Discrete input/output (Table 22)
M4	Display (Table 23)
BD	Certifications (Table 24)
G5	Grounding rings (Table 25)
B6	Miscellaneous (Table 26)
R15	Submergence protection (Table 27)
V1	Special paint (Table 28)
Q4	Quality certificates (Table 29)
HR7	Revision configuration (Table 30)
WG	Witness inspection (Table 31)
Yx	Quick Start Guide language (Table 32)

Requirements

Table 8: Rosemount 8750W transmitter class

Code	Description	
M	Revision 4 electronics	★
0	Spare sensor, no transmitter	

Table 9: Rosemount 8750W transmitter mount

Code	Description	
T	Integral field mount	★
R	Remote field mount	★

Table 9: Rosemount 8750W transmitter mount *(continued)*

Code	Description	
W	Remote wall mount	★

Table 10: Rosemount 8750W transmitter power

Code	Description	
1	AC Power Supply (90 -250VAC, 50/60Hz)	★
2	DC Power Supply (12 - 42VDC)	★
0	Spare sensor, no transmitter	

Table 11: Rosemount 8750W transmitter outputs

Code	Description	
A	4-20mA output with digital HART protocol & scalable pulse output	★
F	FOUNDATION™ Fieldbus & scalable pulse output	★
M	Modbus RS-485 electronics, scalable pulse	★
0	Spare sensor, no transmitter	

Table 12: Rosemount 8750W conduit entries

Code	Description	Integral mount quantity	Remote mount quantity	
1	½–14 NPT	2	4	★
2	M20–1.5 adapters	2	4	★
4(1)	½–14 NPT, additional entry	3	5	
5(1)	M20–1.5, additional entry	3	5	
0	Spare sensor, integral mount only, no transmitter	N/A	N/A	

(1) Not available with the wall mount transmitter.

Table 13: Rosemount 8750W sensor style

Code	Description	
F	Flanged	★
0	Spare transmitter, no sensor	

Table 14: Rosemount 8750W lining material

Code	Description	
T(1)	PTFE	★
P(2)	Polyurethane	★
N(3)	Neoprene	★
0	Spare transmitter, no sensor	

(1) Available in ½ - to 36-in. (15 mm to 900 mm) line sizes.
(2) Available in line sizes 1- to 36-in., 42-in., and 48-in. (25 mm to 900 mm, 1050 mm, and 1200 mm) line sizes.
(3) Available in line sizes 1- to 48-in. (25 mm to 1200 mm) line sizes.

Table 15: Rosemount 8750W electrode material

Code	Description	
S	316L stainless steel	★
H	Nickel alloy 276 (UNS N 10276)	★
0	Spare transmitter, no sensor	

Table 16: Rosemount 8750W electrode type

Code	Description	
A	2 Measurement electrodes – standard	★
B(1)	2 Measurement electrodes – bulletnose	★
E	2 Measurement electrodes plus 1 reference electrode – standard	★
F(1)	2 Measurment electrodes plus 1 reference electrode – bulletnose	★
0	Spare transmitter, no sensor	

(1) Not available in ½-in. (15mm).

Table 17: Rosemount 8750W line size

Code	Line size	Liner availability In this table, the starred (★) offerings represent available liner based on line size. Consult factory for additional Flange Type/Rating sensor availability		
		PTFE code T	Poly code P	Neoprene code N
005	½-in. (15 mm)	★		
010	1-in. (25 mm)	★	★	★
015	1½-in. (40 mm)	★	★	★
020	2-in. (50 mm)	★	★	★
025	2½-in. (65 mm)	★		★
030	3-in. (80 mm)	★	★	★
040	4-in. (100 mm)	★	★	★
050	5-in. (125 mm)	★		★
060	6-in. (150 mm)	★	★	★
080	8-in. (200 mm)	★	★	★
100	10-in. (250 mm)	★	★	★
120	12-in. (300 mm)	★	★	★
140	14-in. (350 mm)	★	★	★
160	16-in. (400 mm)	★	★	★
180	18-in. (450 mm)	★	★	★
200	20-in. (500 mm)	★	★	★
240	24-in. (600 mm)	★	★	★
300	30-in. (750 mm)	★	★	★

Table 17: Rosemount 8750W line size *(continued)*

Code	Line size	Liner availability In this table, the starred (★) offerings represent available liner based on line size. Consult factory for additional Flange Type/Rating sensor availability		
		PTFE code T	Poly code P	Neoprene code N
360	36-in. (900 mm)	★	★	★
400	40-in. (1000 mm)			★
420	42-in. (1050 mm)		★	★
480	48-in. (1200 mm)		★	★
000	Spare transmitter, no sensor			

Table 18: Rosemount 8750W flange type and material

Code	Description (see Table 33 for line size vs. flange type and rating)	
C	Slip-on,raised-face, carbon steel	★
S	Slip-on,raised-face, 304/304L SST	★
F	Slip-on, flat-face, carbon steel	
G	Slip-on,flat-face, 304/304L SST	
0	Spare transmitter, no sensor	

Table 19: Rosemount 8750W flange rating

Code	Description (see Table 33 for line size vs. flange type and rating)
A1	ASME B16.5, Class 150
A3	ASME B16.5, Class 300
AD	AWWA C207Class D; line size 30-in. and above; flat face flange only
AE	AWWA C207Class E; line size 30-in. and above; flat face flange only
DD	EN1092-1,PN10
DE	EN1092-1,PN16
DF	EN 1092-1, PN25
DH	EN 1092-1, PN40
GD	GB/T9119,PN10
GE	GB/T9119,PN16
GH	GB/T9119,PN40
JP	JISB2220, 10K
JR	JISB2220, 20K
KU	AS4087, PN16
KW	AS4087, PN21
KY	AS4087, PN35
TK	AS2129, Table D

Table 19: Rosemount 8750W flange rating *(continued)*

Code	Description (see Table 33 for line size vs. flange type and rating)
TL	AS2129, Table E
00	Spare transmitter, no sensor

Options

Note
These are not required, but they must be included in the model number if desired.

Table 20: Rosemount 8750W hazardous area certifications

Code	Description	
-(1)	Ordinary Locations - (no code required)	★
Z5	US Approvals, Class I Div 2, Non-Incendive and Dust for Non-Flammable Fluids	★
Z6	Canadian Approvals, Class I Div 2, Non-Incendive and Dust for Non-Flammable Fluids	★
ND	ATEX Dust	★
Z1	ATEX Non-Sparking and Dust for Non-Flammable Fluids	★
NF	IECEx Dust	★
Z7	IECEx Non-Sparking and Dust for Non-Flammable Fluids	★
Z2	INMETRO Non-Sparking and Dust for Non-Flammable Fluids	★
Z3	NEPSI Non-Sparking and Dust for Non-Flammable Fluids	★

(1) CSA (C/US) marked, CE marked, EAC marked and C-tick marked.

Table 21: Rosemount 8750W advanced diagnostics

Code	Description	
DA1	Process Diagnostics, High Process Noise Detection, Ground/Wiring Fault Detection, and Electrode Coating	★
DA2	Smart Meter Verification	★

Table 22: Rosemount 8750W discrete input/discrete output

Code	Description	
AX(1)(2)	Two Discrete Channels (DI/DO 1, DO 2)	★

(1) Requires Conduit Entry code 4 or 5 when ordered with field mount transmitter.
(2) Not available with FOUNDATION Fieldbus (output code F).

Table 23: Rosemount 8750W display

Code	Description	
M4(1)	LCD with Local Operator Interface	★
M5	LCD display only	

(1) Not available with FOUNDATION Fieldbus (output code F).

Table 24: Rosemount 8750W certifications

Code	Description	
PD	European Pressure Equipment Directive Certification (PED)	★
CR	Canadian Registration Number (CRN) Certification	
BD	ASME B31.3 Process Piping Standard	
DW(1)	NSF DrinkingWater Certification	

(1) NSF drinking water certification is available with the PTFE liner in line sizes 0.5- to 36-in (15 mm to 900 mm) and the polyurethane liner in line sizes 4-to 36-in., 42-in., and 48-in. (80 mm to 900 mm, 1050 mm, and 1200 mm).

Table 25: Rosemount 8750W grounding rings

Code	Description	
G1	316L stainless steel (Qty 2)	★
G2	Nickel alloy C-276; UNS N 10276 (Qty 2)	
G5	316L stainless steel (Qty 1)	★
G6	Nickel alloy C-276; UNS N 10276 (Qty 1)	

Table 26: Rosemount 8750W miscellaneous

Code	Description
C1	Custom Configuration (completed CDS form required with order)
D1	High Accuracy Calibration (base ref accuracy 0.25% of rate)
B6	316 SST Mounting Bracket with U-bolt Kit for 2-in. Pipe Mount
P05(1)	5-point verification
P10(2)	10-point verification

(1) Available for ½ - to 24-in (15 mm to 600 mm) at velocities 1, 3, 5, 7, 10 ft/s; 30-in. (700 mm) at velocities 1, 3, 5, 7, 9.5 ft/s; 36-in. (900 mm) at velocities 1, 2, 3, 5,6.5 ft/s;40- to 48-in.(1000mm to 1200mm).

(2) Available for ½ - to 24-in. (15 mm to 600 mm) at velocities 1, 2, 3, 4, 5, 6, 7, 8, 9, 10 ft/s; 30- to 48-in. (700 mm to 1200 mm) not available.

Table 27: Rosemount 8750W submergence protection

Code	Description
R05	Potted junction box with 50 feet of combo cable/cable gland for use in conduit
R10	Potted junction box with 100 feet of combo cable/cable gland for use in conduit
R15	Potted junction box with 150 feet of combo cable/cable gland for use in conduit
R20	Potted junction box with 200 feet of combo cable/cable gland for use in conduit
R25	Potted junction box with 250 feet of combo cable/cable gland for use in conduit
R30	Potted junction box with 300 feet of combo cable/cable gland for use in conduit
S05	Potted junction box with 50 feet of submersible combo cable/cable gland
S10	Potted junction box with 100 feet of submersible combo cable/cable gland
S15	Potted junction box with 150 feet of submersible combo cable/cable gland
S20	Potted junction box with 200 feet of submersible combo cable/cable gland
S25	Potted junction box with 250 feet of submersible combo cable/cable gland

Table 27: Rosemount 8750W submergence protection *(continued)*

Code	Description
S30	Potted junction box with 300 feet of submersible combo cable/cable gland

Table 28: Rosemount 8750W special paint

Code	Description
V1	Coal tar paint (submersible/direct burial)

Table 29: Rosemount 8750W quality certificates

Code	Description
Q4	Calibration certificate per ISO 10474 3.1B/EN 10204 3.1
Q8	Material traceability per ISO 10474 3.1B/EN 10204 3.1

Table 30: Rosemount 8750W revision configuration

Code	Description
HR7	HART Revision 7

Table 31: Rosemount 8750W witness inspection

Code	Description
WG	Witness Inspection

Table 32: Rosemount 8750W Quick Start Guide language

Code	Description	
YF	French	★
YG	German	★
YI	Italian	★
YM	Chinese (Mandarin)	★
YP	Portuguese (Brazil)	★
YR	Russian	★
YS	Spanish	★

Table 33: Slip on flange options by line size

	Flange code and rating																	
	A1	A3	AD	AE	DD	DE	DF	DH	GD	GE	GH	JP	JR	KU	KW	KY	TK	TL
Size code	ASME Class 150	ASME Class 300	AWWA Class D	AWWA Class E	EN PN10	EN PN16	EN PN25	EN PN40	GB/T PN 10	GB/T PN 16	GB/T PN 40	JIS 10K	JIS 20K	AS4087 PN16	AS4087 PN21	AS4087 PN35	AS2129 Table D	AS2129 Table E
005	★	★						★			★	★	★				★	★
010	★	★						★			★	★	★				★	★

Table 33: Slip on flange options by line size *(continued)*

	Flange code and rating																	
	A1	**A3**	**AD**	**AE**	**DD**	**DE**	**DF**	**DH**	**GD**	**GE**	**GH**	**JP**	**JR**	**KU**	**KW**	**KY**	**TK**	**TL**
Size code	ASME Class 150	ASME Class 300	AWWA Class D	AWWA Class E	EN PN10	EN PN16	EN PN25	EN PN40	GB/T PN 10	GB/T PN 16	GB/T PN 40	JIS 10K	JIS 20K	AS4087 PN16	AS4087 PN21	AS4087 PN35	AS2129 Table D	AS2129 Table E
015	★	★						★			★	★	★				★	★
020	★	★				★		★			★	★	★	★	★	★	★	★
025	★	★				★		★			★	★	★	★	★	★	★	★
030	★	★				★		★			★	★	★	★	★	★	★	★
040	★	★				★		★		★	★	★	★	★	★	★	★	★
050	★	★				★		★		★	★	★	★	★	★	★	★	★
060	★	★				★		★		★	★	★	★	★	★	★	★	★
080	★	★			★	★	★	★	★	★	★	★	★				★	★
100	★	★			★	★	★	★	★	★	★	★	★	★	★	★	★	★
120	★	★			★	★	★	★	★	★	★	★	★	★	★	★	★	★
140	★	★			★	★	★	★	★	★	★	★	★	★	★	★	★	★
160	★	★			★	★	★	★	★	★	★	★	★	★	★	★	★	★
180	★	★			★	★	★	★	★	★	★	★	★	★	★	★	★	★
200	★	★			★	★	★	★	★	★	★	★	★	★	★	★	★	★
240	★	★			★	★	★	★	★	★	★	★	★	★	★	★	★	★
300			★	★										★	★	★	★	★
360			★	★	★	★			★	★				★	★	★	★	★
400			★	★	★	★			★	★				★	★		★	★
420			★	★														
480			★	★	★												★	★

Ordering flowmeter equipment

Ordering procedure

To order, select the desired sensor and/or transmitter by specifying model codes from the ordering table.

For remote transmitter applications, note the cable specification requirements.

Standard configuration

Unless the Configuration Data Sheet is completed, the transmitter will be shipped as follows:

Engineering units:	ft/sec
4mA:	0
20mA:	30
Sensor size:	3-in.
Empty pipe:	On
Sensor calibration number:	1000005010000000

Integrally mounted transmitters are factory configured with the paired sensor size and appropriate calibration number.

Custom configuration (option code C1)

If Option Code C1 is ordered, the Configuration Data Sheet (CDS) must be submitted at the time of order.

Standard tagging

Instrument tags for the transmitter and sensors are as follows:

- 316SST laser etched label, permanently attached
- Main label - Tag name: 1 line 21characters
- Additional 316SST 'wire-on' tag available: 5 lines, 17 characters per line (6mm height)

Interconnecting cable

Interconnecting cables are required to connect a remote mount transmitter to the sensor. When ordering cable, review the hazardous area approval requirements and the installation location requirements for proper cable selection.

- Cables can be ordered as individual component cables or a combination coil drive/electrode cable.
- Cables can be ordered as part of the transmitter model number or as a spare parts kit. Integrally mounted transmitters are factory wired and do not require additional interconnecting cables.
- Individual component cables require equal lengths of coil drive cable and electrode cable and should be limited to less than 500 feet (152 m). Consult Technical Support for lengths between 500-1000 feet (152-304 m).
- Combination coil drive/electrode cable is only available for Ordinary Locations and should be limited to less than 330 feet (100 m).

Component cable kits

Standard temp (-20 °C to 75 °C)				
Cable kit #	Description	Component	Rosemount p/n	Alpha p/n
08732-0065-0001 (feet)	Kit, Component Cables, Std Temp, (includes Coil and Electrode)	Coil	08732-0060-0001	2442C
		Electrode	08732-0061-0001	2413C

Standard temp (-20 °C to 75 °C)				
08732-0065-0002 (meters)	Kit, Component Cables, Std Temp (includes Coil and Electrode)	Coil	08732-0060-0002	2442C
		Electrode	08732-0061-0002	2413C
08732-0065-0003 (feet)	Kit, Component Cables, Std Temp (includes Coil and I. S. Electrode)	Coil	08732-0060-0001	2442C
		I. S. Electrode	08732-0061-0003	Not available
08732-0065-0004 (meters)	Kit, Component Cables, Std Temp (includes Coil and I. S. Electrode)	Coil	08732-0060-0002	2442C
		I.S. Electrode	08732-0061-0004	Not available

Extended temp (-50 °C to 125 °C)				
Cable kit #	Description	Component	Rosemount p/n	Alpha p/n
08732-0065-1001 (feet)	Kit, Component Cables, Ext Temp (includes Coil and Electrode)	Coil	08732-0060-1001	Not available
		Electrode	08732-0061-1001	Not available
08732-0065-1002 (meters)	Kit, Component Cables, Ext Temp (includes Coil and Electrode)	Coil	08732-0060-1002	Not available
		Electrode	08732-0061-1002	Not available
08732-0065-1003 (feet)	Kit, Component Cables, Ext Temp (includes Coil and I. S. Electrode)	Coil	08732-0060-1001	Not available
		I. S. Electrode	08732-0061-1003	Not available
08732-0065-1004 (meters)	Kit, Component Cables, Ext Temp (includes Coil and I. S. Electrode)	Coil	08732-0060-1002	Not available
		I.S. Electrode	08732-0061-1004	Not available

Combo cable kits

Coil/electrode cable (-20 °C to 80 °C)	
Cable Kit #(1)	
08732-0065-2001 (feet)	Kit, Combo Cable, Standard
08732-0065-2002 (meters)	
08732-0065-3001 (feet)	Kit, Combo Cable, Submersible(2)
08732-0065-3002 (meters)	

(1) Only available for Ordinary Locations.
(2) 80 °C dry/60 °C wet/33ft continuous submergence.

Product Specifications

Basic specifications

The tables below outline some of the basic performance, physical, and functional specifications.

Table 34: Wall mount transmitter Specifications

	Style	Wall mount
	Base accuracy(1)	0.5% Standard 0.25% High Accuracy Option
	Mounting	Remote
	Power supply	Global AC or DC
	User interface	LCD display with 15 button tactile keypad (optional) LCD display only (optional) No display (standard)
	Communication protocol	HART with 4–20mA FOUNDATION™ fieldbus Modbus RS-485
	Diagnostics	Basic, DA1, DA2
	Sensor compatibility	All Rosemount plus other manufacturers
	Detailed specifications	Transmitter specifications
	Ordering information	Ordering Information

(1) For complete accuracy specifications, please refer to Transmitter functional specifications.

Table 35: Field mount transmitter specifications

	Style	Field mount
	Base accuracy(1)	0.5% Standard 0.25% High Accuracy Option
	Mounting	Integral or Remote
	Power supply	Global AC or DC
	User interface	LCD display with 4 Optical Switch LOI (optional) LCD display only (optional) No display (standard)
	Communication protocol	HART FOUNDATION™ fieldbus Modbus RS-485
	Diagnostics	Basic, DA1, DA2
	Sensor compatibility	All Rosemount plus other manufacturers
	Detailed specifications	Transmitter specifications
	Ordering information	Ordering Information

(1) For complete accuracy specifications, please refer to Transmitter functional specifications.

Table 36: Sensor specifications

	Style	Flanged
	Base accuracy(1)	0.5% Standard 0.25% High Accuracy Option
	Line sizes	½-in. to 48-in. (15 mm to 1200 mm)
	Design features	Standard Process Design
	Detailed specifications	Sensor specifications
	Ordering information	Ordering Information

(1) For complete accuracy specifications, refer to the sensor detailed specifications.

Table 37: Lining Material Selection

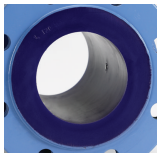
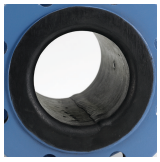
Liner material	General characteristics
PTFE 	Process temperature: 0 to +248 °F (-18 to +120 °C)
Polyurethane 	Process temperature: 0 to +140 °F (-18 to +60 °C)
	Typically applied in clean water
Neoprene 	Typically applied in water with chemicals, and sea water
	Process temperature: 0 to 176 °F (-18 to 80 °C)

Table 38: Electrode Material

Electrode material	General characteristics
316L Stainless Steel	Good corrosion resistance
	Good abrasion resistance
Nickel Alloy 276 (UNS N10276)	Better corrosion resistance
	High strength

Table 39: Electrode Type

Electrode type	General characteristics
Standard Measurement	Lowest cost
	Good for most applications
Measurement + Reference Electrode	Low cost grounding option especially for large line sizes

Table 39: Electrode Type *(continued)*

Electrode type	General characteristics
(Also see Table 40 and Table 41 for grounding options and installation)	Minimum conductivity of 100 microSiemens/cm
	Not recommended for electrolytic or galvanic corrosion applications
Bulletnose	Extended head protrudes into the flow stream for self-cleaning
	Best option for coating processes

Table 40: Process Reference Options

Grounding options	General characteristics
No Grounding Options (grounding straps)	Acceptable for conductive unlined pipe
	Grounding straps provided at no cost
Reference Electrode	Same material as measurement electrodes
	Sufficient grounding option when process fluid conductivity is greater than 100 microSiemens/cm
	Not recommended in electrolysis applications, galvanic corrosion applications, applications where the electrodes may coat, or non-conductive pipe.
Grounding Rings	Low conductivity process fluids
	Cathodic or electrolysis applications that may have stray currents in or around the process
	Variety of materials for process fluid compatibility

Table 41: Process Reference Installation

Type of pipe	Grounding straps	Grounding rings	Reference electrode	Lining protectors
Conductive unlined pipe	Acceptable	Not required	Not required	Not required
Conductive lined pipe	Not acceptable	Acceptable	Acceptable	Acceptable
Non-conductive pipe	Not acceptable	Acceptable	Not recommended	Acceptable

Transmitter specifications

Transmitter functional specifications

Transmitter coil drive current

500mA

Flow rate range

Capable of processing signals from fluids with velocities between 0.04 and 39 ft/s (0.01 to 12 m/s) for both forward and reverse flow in all sensor sizes. Full scale continuously adjustable between –39 and 39 ft/s (–12 to 12 m/s).

Conductivity limits

Process liquid must have a conductivity of 5 microSiemens/cm (5 micromhos/cm) or greater.

Power supply

- 90 - 250VAC @ 50/60Hz

- 12 - 42VDC

Line power fuses

- 90 - 250VAC systems:
  - 2 amp quick acting
  - Bussman AGC2 or equivalent
- 12 - 42VDC systems
  - 3 amp quick acting
  - Bussman AGC3 or equivalent

Power consumption

- 90 - 250VAC: 40VA maximum
- 12 - 42VDC: 15W maximum

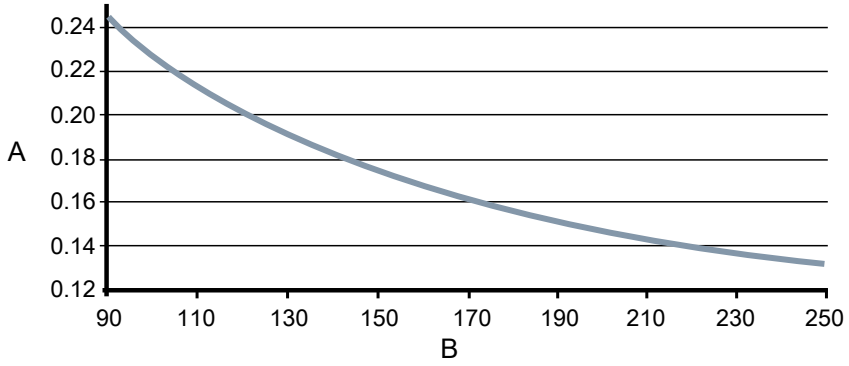
Switch-on current

- At 250VAC: Maximum 35.7A (< 5ms)
- At 42VDC: Maximum 42A (< 5ms)

AC power supply requirements

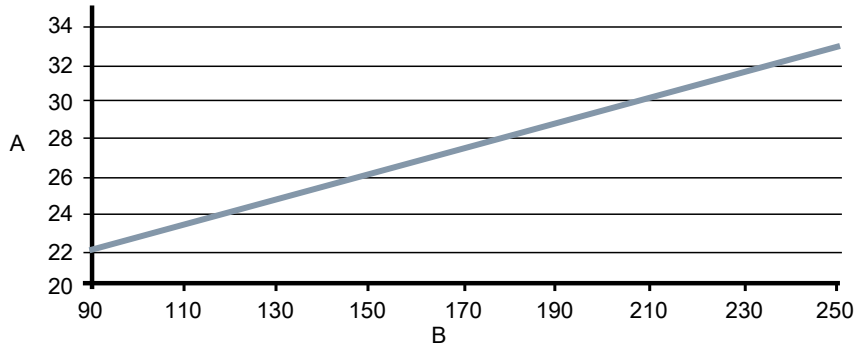
Units powered by 90 - 250VAC have the following power requirements. Peak inrush is 35.7A at 250VAC supply, lasting approximately 1ms. Inrush for other supply voltages can be estimated with: Inrush (Amps) = Supply (Volts) / 7.0

Figure 2: AC current requirements



A. Supply current (amps)
B. Power supply (VAC)

Figure 3: Apparent power

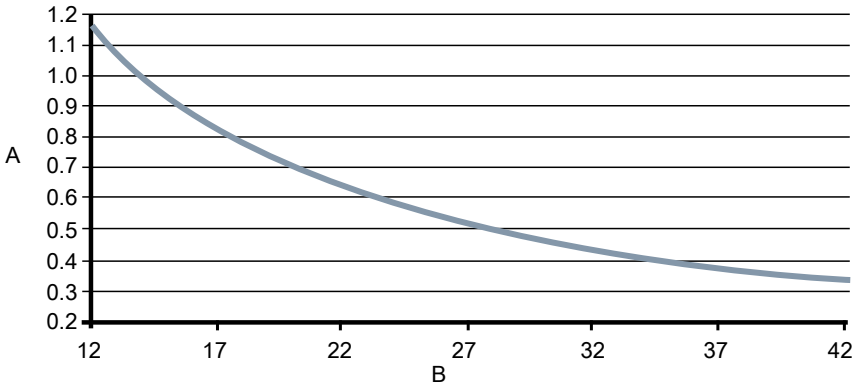


A. Apparent power (VA)
B. Power supply (VAC)

DC power supply requirements

Units powered by 12VDC power supply may draw up to 1.2A of current steady state. Peak inrush is 42A at 42VDC supply, lasting approximately 1ms. Inrush for other supply voltages can be estimated with: Inrush (Amps) = Supply (Volts) / 1.0

Figure 4: DC current requirements



A. Supply current (amps)
B. Power supply (VDC)

Ambient temperature limits

- Operating:
  - –58 to 140 °F (–50 to 60 °C) without LOI/Display
  - –4 to 140 °F (–20 to 60 °C) with LOI/Display
  - The LOI/Display will not be visible at temperatures below -20°C
- Storage:
  - –58 to 185 °F (–50 to 85 °C) without LOI/Display
  - –22 to 176 °F (–30 to 80 °C) with LOI/Display

Humidity limits

0–95% RH to 140 °F (60 °C)

Altitude

2000 meters maximum

Enclosure rating

Type 4X, IEC 60529, IP66 (transmitter)

Transient protection rating

Built in transient protection that conforms to:

- IEC 61000-4-4 for burst currents
- IEC 61000-4-5 for surge currents
- IEC 611185-2.2000, Class 3 up to 2kV and up to 2kA protection

Turn-on time

- 5 minutes to rated accuracy from power up
- 5 seconds from power interruption

Start-up time

50ms from zero flow

Low flow cut-off

Adjustable between 0.01 and 38.37 ft/s (0.003 and 11.7 m/s). Below selected value, output is driven to the zero flow rate signal level.

Overrange capability

Signal output will remain linear until 110% of upper range value or 44 ft/s (13 m/s). The signal output will remain constant above these values. Out of range message displayed on LOI/Display and the Field Communicator.

Damping

Adjustable between 0 and 256 seconds

Advanced diagnostics capabilities

Basic

- Self test
- Transmitter faults
- Analog output test
- Pulse output test
- Tunable empty pipe
- Reverse flow
- Coil circuit fault
- Electronics temperature

Process diagnostics (DA1)

- Ground/wiring fault
- High process noise
- Electrode coating diagnostic

Smart Meter Verification (DA2)

- Smart Meter Verification (continuous or on-demand)

- 4-20mA loop verification[2]

Output signals

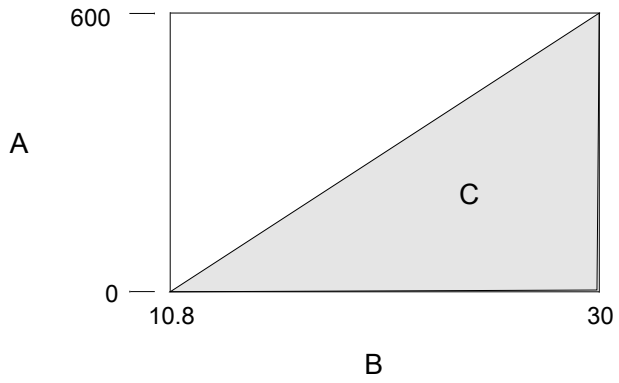
Analog output adjustment [3]

4–20mA, switch-selectable as internally or externally powered.

Analog loop load limitations

- Internally powered 24VDC max, 500 ohms max loop resistance
- Externally powered 10.8 - 30VDC max.
- Loop resistance is determined by the voltage level of the external power supply at the transmitter terminals:

Figure 5: Analog loop load limitations



A. Load (ohms)
B. Power supply (volts)
C. Operating region

- $R_{max} = 31.25 (V_{ps} – 10.8)$
- V_{ps} = power supply voltage (volts)
- Rmax = maximum loop resistance (ohms)

The analog output is automatically scaled to provide 4mA at lower range value and 20mA at upper range value. Full scale continuously adjustable between -39 and 39 ft/s (-12 to 12 m/sec), 1 ft/s (0.3 m/s) minimum span.

HART Communications is a digital flow signal. The digital signal is superimposed on the 4–20mA signal and is available for the control system interface. A minimum of 250 ohms loop resistance is required for HART communications.

Analog alarm mode

High or low alarm signal is user-selectable via the Alarm switch on the front of the electronics. NAMUR-compliant alarm limits are software configurable and can be preset via CDS (C1). Individual diagnostic alarms are also software configurable. Alarms will drive the analog signal to the following mA values. High or low alarm signal is user-selectable via the Alarm switch on the front of the electronics. NAMUR-compliant alarm limits are software configurable and can be preset via CDS (C1). Individual diagnostic alarms are also software configurable. Alarms will drive the analog signal to the following mA values.

Low	3.75 mA	Requires CDS (C1)
High	22.50 mA	Factory default
NAMUR Low	3.5 mA	Requires CDS (C1)

(2) Available with HART output only.
(3) For transmitters with intrinsically safe outputs (option code B), power must be supplied externally.

NAMUR High	22.6 mA	Requires CDS (C1)

FOUNDATION™ Fieldbus output

Output signal	Manchester-encoded digital signal that conforms to IEC 1158-2 and ISA 50.02
Scheduled Entries	Seven (7)
Links	Twenty (20)
Virtual Communications Relationships (VCRs)	One (1) predefined (F6, F7) Nineteen (19) configurable

FOUNDATION™ fieldbus function blocks

Table 42: Function block execution times

Block	Execution time (milliseconds)
Resource (RB)	—
Transducer (TB)	—
Analog Input (AI)	15
Proportional/Integral/Derivative (PID)	20
Integrator (INT)	25
Arithemetic (AR)	25
Discrete Output (DO)	15

Transducer Block	The transducer block calculates flow from the measured induced voltage. The calculation includes information related to the calibration number, line size, and diagnostics.
Resource Block	The resource block contains physical transmitter information, including available memory, manufacturer identification, device type, software tag, and unique identification.
Backup Link Active Scheduler (LAS)	The transmitter is classified as a device link master. A device link master can function as a Link Active Scheduler (LAS) if the current link master device fails or is removed from the segment. The host or other configuration tool is used to download the schedule for the application to the link master device. In the absence of a primary link master, the transmitter will claim the LAS and provide permanent control for the H1 segment.
Diagnostics	The transmitter automatically performs continuous self-diagnostics. The user can perform on-line testing of the transmitter digital signal. Advanced simulation diagnostics are available. This enables remote verification of the electronics via a flow signal generator built into the electronics. The sensor strength value can be used to view the process flow signal and provide information regarding filter settings.
Analog Input	The AI function block processes the measurement and makes it available to other function blocks. The AI function block also allows filtering, alarming, and engineering unit changes.
Arithmetic Block	Provides pre-defined application-based equations including flow with partial density compensation, electronic remote seals, hydrostatic tank gauging, ratio control and others.
Proportional/ Integral/Derivative	The PID function block provides a sophisticated implementation of the universal PID algorithm. The PID function block features input for feed forward control, alarms on the process variable, and control deviation. The PID type (series or Instrument Society of America [ISA]) is user-selectable on the derivative filter.
Integrator	The standard integrator block is available for totalization of flow.
	Reverse Flow Detects and reports reverse flow
	Software Lockout A write-lock switch and software lockout are provided in the resource function block.

	Totalizer	Non-volatile totalizer for net, gross, forward and reverse totals.
Discrete Output	The DO function block processes a discrete setpoint and saves it to a specified channel to produce an output signal. The block supports mode control, output tracking, and simulation.	

Modbus RS-485 output

Transmitters with a Modbus output provide an RS-485 signal to a Modbus host system; data rates can be configured from 1200 baud to 115.2 kilobaud.

Scalable pulse frequency adjustment

- 0-10,000Hz, switch-selectable as internally or externally powered (4)
- Pulse value can be set to equal desired volume in selected engineering units
- Pulse width adjustable from 0.1 to 650 ms
- Internally powered: Outputs up to 12VDC(5)
- Externally powered: Input 5 - 28VDC

Output testing

Analog output test (5)	Transmitter may be commanded to supply a specified current between 3.5 and 23mA.
Pulse output test	Transmitter may be commanded to supply a specified frequency between 1 and 10,000Hz.(4)

Optional discrete output function (AX option)

Externally powered at 5 - 28VDC, 240mA max, solid state switch closure to indicate either:

Reverse flow	Activates switch closure output when reverse flow is detected.
Zero flow	Activates switch closure output when flow goes to 0 ft/s or below low flow cutoff.
Empty pipe	Activates switch closure output when an empty pipe condition is detected.
Transmitter faults	Activates switch closure output when a transmitter fault is detected.
Flow limit 1, flow limit 2	Activates switch closure output when the transmitter measures a flow rate that meets the conditions established for this alert. There are two independent flow limit alerts that can be configured as discrete outputs.
Totalizer limit	Activates switch closure output when the transmitter measures a total flow that meets the conditions established for this alert.
Diagnostic status	Activates switch closure output when the transmitter detects a condition that meets the configured criteria of this output.

Optional discrete input function (AX option)

Externally powered at 5 - 28VDC, 1.4 - 20mA to activate switch closure to indicate either:

Reset Totalizer A (or B or C)	Resets Totalizer A (or B or C) value to zero.
Reset All Totals	Resets all totalizer values to zero.
Positive Zero Return (PZR)	Forces outputs of the transmitter to zero flow.

Security lockout

Security lockout switch on the electronics board can be set to deactivate all LOI and HART-based communicator functions to protect configuration variables from unwanted or accidental change.

(4) For transmitters with intrinsically safe outputs (option code B), frequency range is limited to 0-5000Hz.
(5) For transmitters with intrinsically safe outputs (option code B), power must be supplied externally.

LOI lockout

The display can be manually locked to prevent unintentional configuration changes. The display lock can be activated through a HART communication device, or by holding the UP arrow for 3 seconds and then following the on-screen instructions. When the display lock is activated, a lock symbol will appear in the lower right hand corner of the display. To deactivate the display lock, hold the UP arrow for 3 seconds and follow the on-screen instructions.

Display auto lock can be configured from the LOI with the following settings: OFF, 1 Minute, or 10 Minutes

Sensor compensation

Rosemount sensors are calibrated in a flow lab at the factory and are assigned a calibration number. The calibration number must be entered into the transmitter, enabling interchangeability of sensors without calculations or a compromise in standard accuracy.

Transmitters and other manufacturers' sensors can be calibrated at known process conditions or at the Rosemount NIST-Traceable Flow Facility. Transmitters calibrated on site require a two-step procedure to match a known flow rate. This procedure can be found in the operations manual.

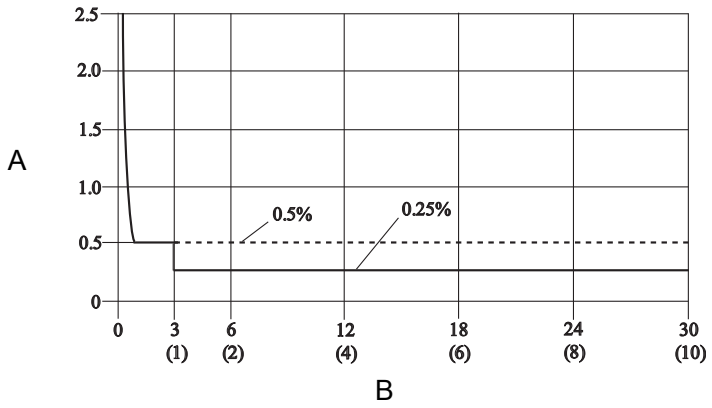
Performance specifications

System specifications are given using the frequency output and with the unit at reference conditions.

Accuracy

Includes the combined effects of linearity, hysteresis, and repeatability.

- Standard system accuracy:
  - ±0.5% of rate from 1 to 39 ft/s (0.3 to 12 m/s)
  - ±0.005 ft/s (0.0015 m/s) from the low flow cutoff to 1 ft/s (0.3 m/s)
- Optional high accuracy:(6)
  - ±0.25% of rate ±1.0 mm/sec from 3 to 39 ft/s (1 to 12 m/s)



A. Percentage of rate
B. Velocity in ft/s (m/s)

Analog output effects

Analog output has the same accuracy as frequency output plus an additional ±4 μ A at room temperature.

Repeatability	±0.1% of reading
Response time (analog output)	20 ms max response time to step change in input
Stability	±0.1% of rate over six months
Ambient temperature effect	±0.25% change over operating temperature range

(6) For sensor sizes greater than 12 in. (300 mm) the high accuracy is ±0.25% of rate from 3 to 39 ft/sec (1 to 12 m/sec).

Wall mount transmitter physical specifications

Materials of construction

Standard housing	Low copper aluminum Type 4X and IEC 60529 IP66
Paint	Polyurethane coat (1.8 to 2.2 mils thick)
Optional housing	Not available
Cover gaskets	Silicone

Electrical connections

Conduit entries	½ inch NPT or M20
Terminal block screws	6-32 (No. 6) suitable for up to 14 AWG wire
Safety grounding screws	External stainless assembly, M5; internal 8-32 (No. 8)

Vibration rating

2G per IEC 61298

Dimensions

See Dimensional drawings.

Weight

Wall mount transmitter	Aluminum	Approximately 9 lbs. (4 kg)

Add 1 pound (0.5 kg) for LOI/Display.

Field mount transmitter physical specifications

Materials of construction

Standard housing	Low copper aluminum Type 4X and IEC 60529 IP66
Paint	Polyurethane coat (1.8 to 2.2 mils thick)
Optional housing	316/316L unpainted, option code SH Type 4X and IEC 60529 IP66
Cover gasket	Aluminum housing: Buna-N

Ingress protection

Consult Emerson for installations requiring IP67/IP68/IP69K.

Electrical connections

Conduit entries	Available in 1/2 inch NPT or M20. See ordering table footnotes for details
Terminal block screws	6-32 (No. 6) suitable for up to 14 AWG wire
Safety grounding screws	External stainless assembly, M5; internal 8-32 (No. 8)

Vibration rating

Integral mount	2G per IEC 61298
Remote mount	5G per IEC 61298

Dimensions

See Dimensional drawings.

Weight

Field mount transmitter only	Aluminum	Approximately 7 lbs. (3.2 kg)
	316 stainless steel	Approximately 23 lbs. (10.5 kg)

Add 1 pound (0.5 kg) for LOI/Display.

Sensor specifications

Functional specifications

Service

Conductive liquids and slurries

Line sizes

½ –in. to 48-in. (15 mm to 1200 mm)

Sensor coil resistance

7 - 16 Ω

Interchangeability

System accuracy is maintained regardless of line size or optional features. Each sensor nameplate has a sixteen-digit calibration number that can be entered into a transmitter during configuration.

Upper range limit

39.37 ft/s (12 m/s)

Ambient temperature limits

- –20 to 140 °F (–29 to 60 °C) standard design

Pressure limits

See Process temperature limits.

Vacuum limits

PTFE lining	Full vacuum to +248 °F (+120 °C) through 4-in. (100 mm) line sizes. Consult Technical Support for vacuum applications with line sizes of 6 inches (150 mm) or larger
All other standard sensor lining materials	Full vacuum to maximum material temperature limits for all available line sizes.

Submergence protection IP68

The remote mount sensor is rated IP68 for submergence to a depth of 33 ft (10 m) for a period of 48 hours. IP68 rating requires that the transmitter must be remote mount. Installer must use IP68 approved cable glands, conduit connections, and/or conduit plugs.

For more details on proper installation techniques for IP68, reference Rosemount Technical Note 00840-0100-4750 available on www.emerson.com.

Conductivity limits

Process liquid must have a minimum conductivity of 5 microSiemens/cm (5 micromhos/cm) or greater.

Process temperature limits

PTFE lining	0 to +248 °F (–18 to +120 °C)
Polyurethane lining	0 to +140 °F (–18 to +60 °C)
Neoprene lining	0 to +176 °F (–18 to +80 °C)

Table 43: Temperature vs. Pressure Limits for ASME B16.5 class flanges (1)

Sensor temperature vs. pressure limits for ASME B16.5 class flanges (½ -in. to 24-in. Line Sizes)(2)					
Flange material	**Flange rating**	**Pressure**			
		@ -20 to 100 °F (-29 to 38 °C)	**@ 200 °F (93 °C)**	**@ 300 °F (149 °C)**	**@ 350 °F (177 °C)**
Carbon Steel	Class 150	285 psi	260 psi	230 psi	215 psi
	Class 300	740 psi	675 psi	655 psi	645 psi
304 Stainless Steel	Class 150	275 psi	235 psi	205 psi	190 psi
	Class 300	720 psi	600 psi	530 psi	500 psi

(1) Liner temperature limits must also be considered.
(2) 30-in. and 36-in. AWWA C207 Class D rated to 150 psi at atmospheric temperature.

Table 44: Temperature vs. Pressure Limits for AS2129 Table D and E flanges (1)

Sensor temperature vs. pressure limits for AS2129 Table D and E flanges (4-in. to 24-in. line sizes)					
Flange Material	**Flange Rating**	**Pressure**			
		@ -29 to 50 °C (-20 to 122 °F)	**@ 100 °C (212 °F)**	**@ 150 °C (302 °F)**	**@ 200 °C (392 °F)**
Carbon Steel	D	101.6 psi	101.6 psi	101.6 psi	94.3 psi
	E	203.1 psi	203.1 psi	203.1 psi	188.6 psi

(1) Liner temperature limits must also be considered.

Table 45: Temperature vs. Pressure Limits for EN 1092-1 flanges (1)

Sensor temperature vs. pressure limits for EN 1092-1 flanges (15 mm to 600 mm Line Sizes)					
Flange material	**Flange rating**	**Pressure**			
		@ -29 to 50 °C (-20 to 122 °F)	**@ 100 °C (212 °F)**	**@ 150°C (302 °F)**	**@ 175°C (347 °F)**
Carbon Steel	PN 10	10 bar	10 bar	9.7 bar	9.5 bar
	PN 16	16 bar	16 bar	15.6 bar	15.3 bar
	PN 40	40 bar	40 bar	39.1 bar	38.5 bar
304 Stainless Steel	PN 10	9.1 bar	7.5 bar	6.8 bar	6.5 bar
	PN 16	14.7 bar	12.1 bar	11.0 bar	10.6 bar
	PN 40	36.8 bar	30.3 bar	27.5 bar	26.5 bar

(1) Liner temperature limits must also be considered.

Table 46: Temperature vs. Pressure Limits for GB/T 9119 Flanges (1)

Temperature vs. Pressure Limits for GB/T 9119 Flanges				
Flange material	**Flange rating**	**Pressure (Mpa)**		
		≤ 20 °C	**@ 100 °C (212 °F)**	**@ 150 °C (302 °F)**
Carbon steel Group 3E0	PN 10	1.00	0.92	0.88
	PN 16	1.60	1.48	1.40
	PN 40	4.00	3.71	3.52
304 SST Group 11E0	PN 10	1.00	0.90	0.81
	PN 16	1.60	1.45	1.31
	PN 40	4.00	3.63	3.27

(1) Liner temperature limits must also be considered.

Table 47: Temperature vs. Pressure Limits for JIS B2220 Flanges (1)

Temperature vs. Pressure Limits for JIS B2220 Flanges			
Flange material	**Flange rating**	**Pressure (Mpa)**	
		≤ 50 °C (122 °F)	**@ 120 °C (248 °F)**
Carbon steel	10K	1.4	1.4
304 stainless steel (15 mm to 65 mm)	10K	1.4	1.4
304 stainless steel (≤ 80 mm)	10K	1.4	1.4

(1) Liner temperature limits must also be considered.

Physical specifications

Non-wetted materials

Sensor Pipe	Type 304/304L SST
Flanges	Carbon steel, Type 304/304L SST

Coil housing	Rolled carbon steel
Paint	Polyurethane coat (2.6 mils or greater)

Process-wetted materials

Lining	PTFE, Polyurethane, Neoprene
Electrodes	316L SST, Nickel Alloy 276 (UNS N10276)

Flat-faced flanges

Flat-faced flanges are manufactured with full-face liners. Available in Neoprene only.

Process connections

ASME B16.5	■ Class 150: ½ -in. to 24-in. (15 mm to 600 mm) ■ Class 300: ½ -in. to 24-in. (15 mm to 600 mm)
AWWA C207	■ Class D: 30-in. to 48-in. (750 mm to 1200 mm) ■ Class E: 30-in. to 48-in. (750 mm to 1200 mm)
EN 1092-1	■ PN10: 200 mm to 900 mm (8-in. to 36-in.) ■ PN16: 50 mm to 900 mm (2 -in. to 36-in.) ■ PN40: 15 mm to 900 mm (½-in. to 36-in.)
AS2129	■ Table D and Table E: 15 mm to 900 mm (½-in. to 36-in.)
AS4087	■ PN16, PN21: 2-in. to 40-in., 48-in. (8-in. excluded) (50 mm to 1000 mm, 1200 mm) ■ PN35: 2-in. to 36-in. (8-in. excluded) (50 mm to 900 mm)
GB/T9119	■ PN10: 8- and 24-, 36-, 40-, 48-in. (200 mm to 600 mm, 900 mm, 1000 mm, 1200 mm) ■ PN16: 4- and 24-, 36-, 40-in. (100 mm to 600 mm, 900 mm, 1000 mm) ■ PN40: ½- to 24-in. (15 mm to 600 mm)
JIS B2220	■ 10K, 20K: ½- to 24-in. (15 mm to 600 mm)

Electrical connections

Conduit entries	Available with 1/2 inch NPT and M20
Terminal block screws	6-32 (No. 6) suitable for up to 14 AWG wire
Safety grounding screws	External stainless assembly, M5; internal 8-32 (No. 8)

Process reference electrode (optional)

A process reference electrode can be installed similarly to the measurement electrodes through the sensor lining. It will be made of the same material as the measurement electrodes.

Grounding rings (optional)

Grounding rings can be installed between the flange and the sensor face on both ends of the sensor. Single ground rings can be installed on either end of the sensor. They have an I.D. slightly larger than the sensor I.D. and an external tab to attach ground wiring. Grounding rings are available in 316L SST, and Nickel Alloy 276 (UNS N10276). See Figure 5.

Dimensions

See Dimensional drawings.

Weight

See Table 48 through Table 55.

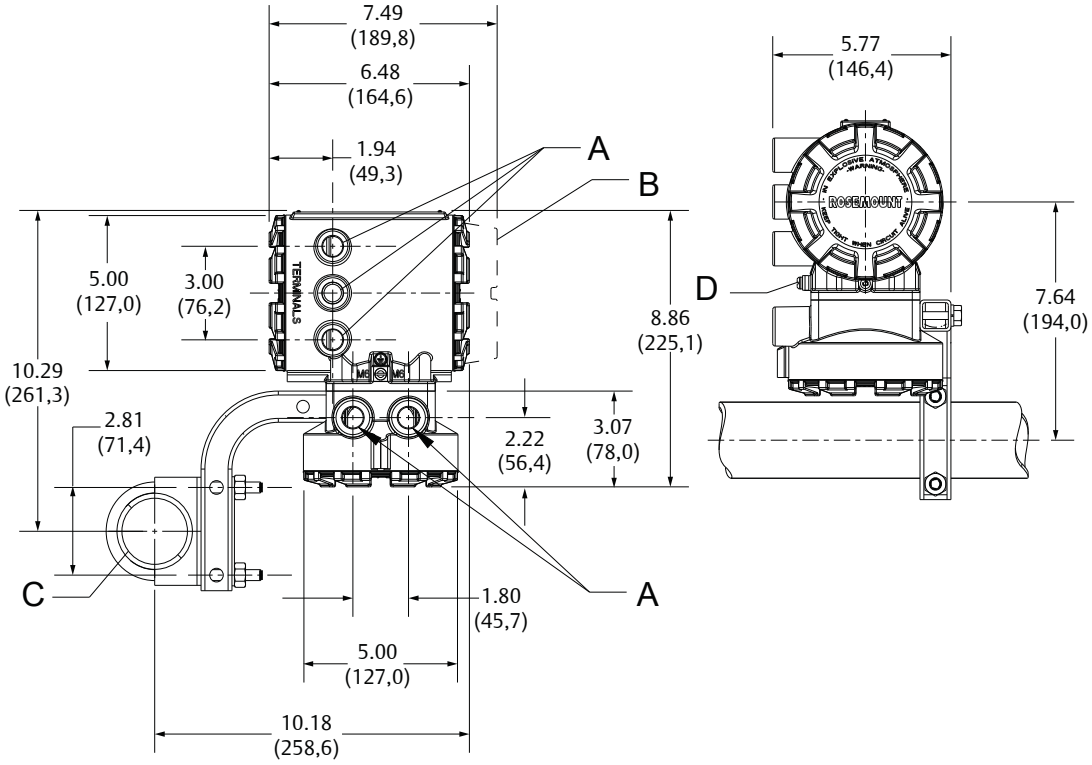
Product Certifications

For detailed approval certification information and installation drawings, please see the appropriate document listed below:

- Document number 00825-MA00-0004: *Rosemount 8750W Approval Document - IECEx and ATEX*
- Document number 00825-MA00-0005: *Rosemount 8750W Approval Document – Class Division*
- Document number 00825-MA00-0006: *Rosemount 8750W Approval Document – North America Zone*

Dimensional drawings

Figure 6: Remote field mount transmitter



A. ½-in.–14 NPT or M20 conduit entry
B. LOI cover
C. 2-in. pipe bracket
D. Ground lug

Figure 7: Integral field mount transmitter

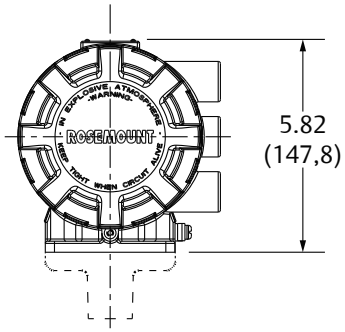
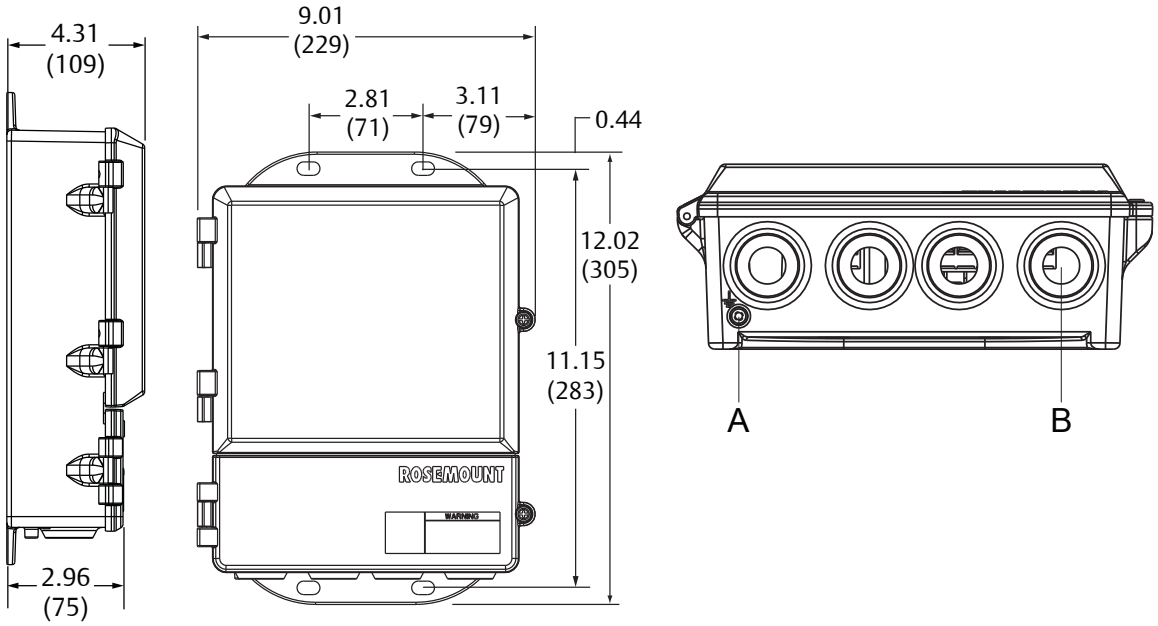


Figure 8: Wall mount transmitter with standard cover



A. Ground lug
B. ½-in.–14 NPT conduit connection (four places)

Figure 9: Wall mount transmitter with LOI cover

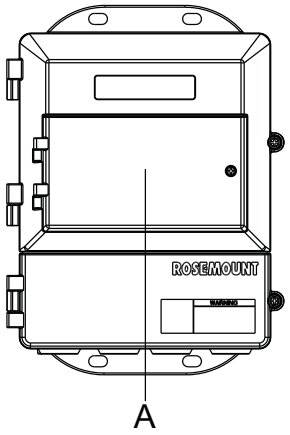
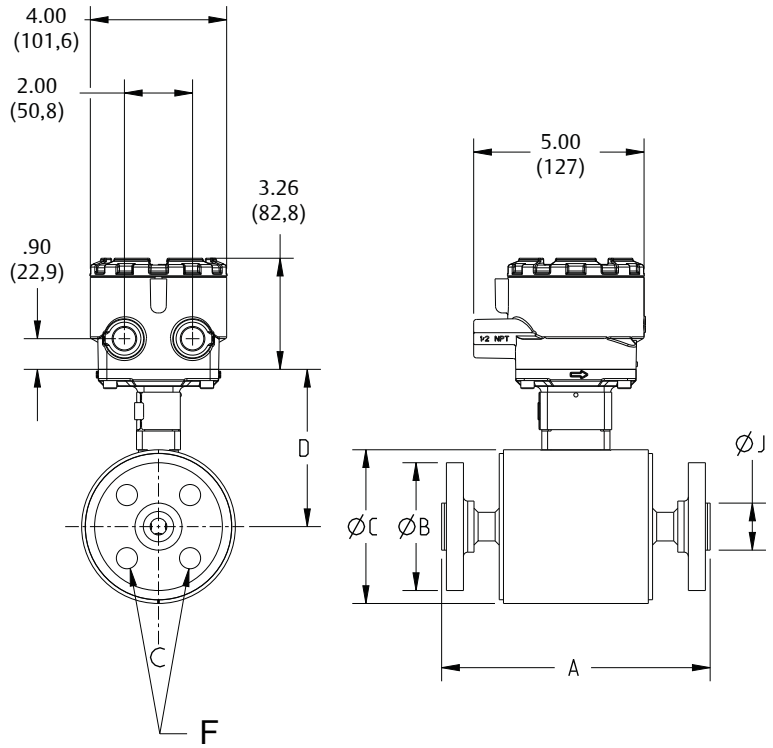


Figure 10: Raised face flanged sensor ½ - to 2½ -in. (15 mm to 65 mm)



- F – Flange bolts to straddle center line

Table 48: Raised face flanged sensor ½ - to 2½ -in. (15 mm to 65 mm) dimensions

Size, description	Overall length			Dim B	Dim C	Dim D	Dim J	Flow tube wgt (lbs./ kg)
	Dim A PTFE	Dim A Neoprene	Dim A Poly					
0.5-in. (15 mm) ASME - 150, SO/RF	7.88 (200)	7.88 (200)	7.88 (200)	3.50 (89)	4.50 (114)	4.41 (112)	1.38 (35)	9 (4)

Table 48: Raised face flanged sensor ½ - to 2½ -in. (15 mm to 65 mm) dimensions *(continued)*

Size, description	Overall length			Dim B	Dim C	Dim D	Dim J	Flow tube wgt (lbs./ kg)
	Dim A PTFE	Dim A Neoprene	Dim A Poly					
0.5-in. (15 mm) ASME - 300, SO/RF	7.88 (200)	7.88 (200)	7.88 (200)	3.74 (95)	4.50 (114)	4.41 (112)	1.38 (35)	10 (5)
0.5-in. (15 mm) EN 1092-1 - PN40, SO/RF	7.88 (200)	7.88 (200)	7.88 (200)	3.74 (95)	4.50 (114)	4.41 (112)	1.77 (45)	10 (5)
0.5-in. (15 mm) AS 2129 table D, SO/RF	7.88 (200)	7.88 (200)	7.88 (200)	3.74 (95)	4.50 (114)	4.41 (112)	1.85 (47)	8 (4)
0.5-in. (15 mm) AS 2129 table E, SO/RF	7.88 (200)	7.88 (200)	7.88 (200)	3.74 (95)	4.50 (114)	4.41 (112)	1.85 (47)	8 (4)
0.5-in. (15 mm) JIS B2220 - 10K, SO/RF	7.88 (200)	7.88 (200)	7.88 (200)	3.74 (95)	4.50 (114)	4.41 (112)	1.77 (45)	10 (5)
0.5-in. (15 mm) JIS B2220 - 20K, SO/RF	7.88 (200)	7.88 (200)	7.88 (200)	3.74 (95)	4.50 (114)	4.41 (112)	1.77 (45)	10 (5)
0.5-in. (15 mm) GB/T9119 PN40, SO/RF	7.88 (200)	7.88 (200)	7.88 (200)	3.74 (95)	4.50 (114)	4.41 (112)	1.77 (45)	10 (5)
1-in. (25 mm) ASME - 150, SO/RF	7.88 (200)	7.88 (200)	7.88 (200)	4.25 (108)	4.50 (114)	4.41 (112)	2.00 (51)	11 (5)
1-in. (25 mm) ASME - 300, SO/RF	7.88 (200)	7.88 (200)	7.88 (200)	4.88 (124)	4.50 (114)	4.41 (112)	2.00 (51)	14 (6)
1-in. (25 mm) EN 1092-1 - PN40, SO/RF	7.88 (200)	7.88 (200)	7.88 (200)	4.53 (115)	4.50 (114)	4.41 (112)	2.68 (68)	14 (6)
1-in. (25 mm) AS 2129 table D, SO/RF	7.88 (200)	7.88 (200)	7.88 (200)	4.53 (115)	4.50 (114)	4.41 (112)	2.56 (65)	10 (5)
1-in. (25 mm) AS 2129 table E, SO/RF	7.88 (200)	7.88 (200)	7.88 (200)	4.53 (115)	4.50 (114)	4.41 (112)	2.48 (63)	10 (5)
1 -in. (25mm) JISB2220-10K,SO/RF	7.88 (200)	7.88 (200)	7.88 (200)	4.92 (125)	4.50 (114)	4.41 (112)	2.64 (67)	13 (6)
1-in. (25 mm) JIS B2220 - 20K, SO/RF	7.88 (200)	7.88 (200)	7.88 (200)	4.92 (125)	4.50 (114)	4.41 (112)	2.64 (67)	14 (6)
1-in. (25 mm) GB/T9119 PN40, SO/RF	7.88 (200)	7.88 (200)	7.88 (200)	4.53 (115)	4.50 (114)	4.41 (112)	2.68 (68)	14 (6)
1.5-in (40 mm) ASME - 150, SO/RF	7.87 (200)	7.80 (198)	7.87 (200)	5.00 (127)	5.21 (132)	4.82 (122)	2.88 (73)	15 (7)
1.5-in. (40 mm) ASME - 300, SO/RF	7.87 (200)	7.80 (198)	7.87 (200)	6.12 (155)	5.21 (132)	4.82 (122)	2.88 (73)	21 (9)
1.5-in. (40 mm) EN 1092-1 - PN40, SO/RF	7.87 (200)	7.80 (198)	7.87 (200)	5.91 (150)	5.21 (132)	4.82 (122)	3.46 (88)	19 (9)
1.5-in. (40 mm) AS 2129 table D, SO/RF	7.87 (200)	7.80 (198)	7.87 (200)	5.31 (135)	5.21 (132)	4.82 (122)	3.07 (78)	12 (6)
1.5-in. (40 mm) AS 2129 table E, SO/RF	7.87 (200)	7.80 (198)	7.87 (200)	5.31 (135)	5.21 (132)	4.82 (122)	3.07 (78)	13 (6)

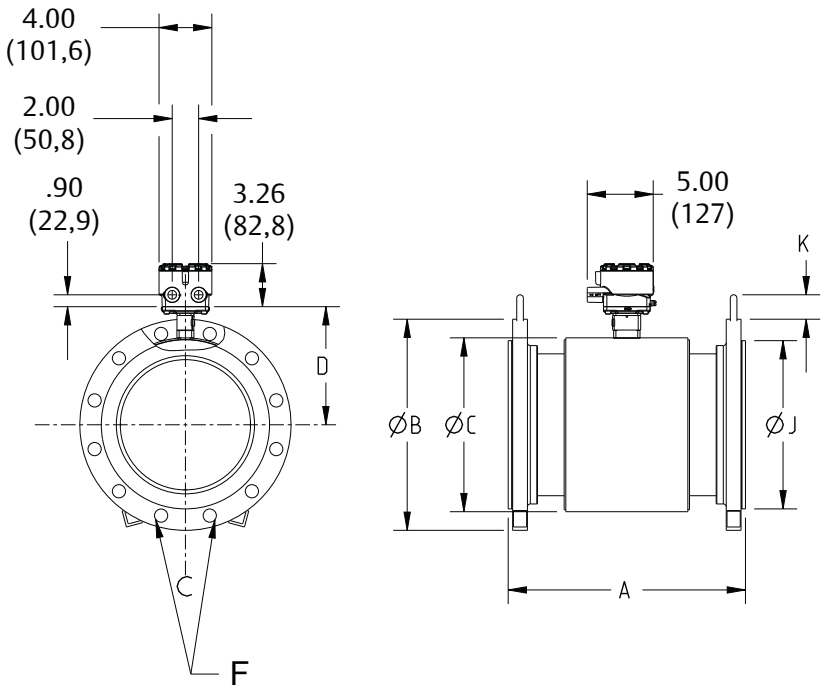
Table 48: Raised face flanged sensor ½ - to 2½ -in. (15 mm to 65 mm) dimensions *(continued)*

Size, description	Overall length			Dim B	Dim C	Dim D	Dim J	Flow tube wgt (lbs./ kg)
	Dim A PTFE	Dim A Neoprene	Dim A Poly					
1.5-in. (40 mm) JIS B2220 - 10K, SO/RF	7.87 (200)	7.80 (198)	7.87 (200)	5.51 (140)	5.21 (132)	4.82 (122)	3.19 (81)	16 (7)
1.5-in. (40 mm) JIS B2220 - 20K, SO/RF	7.87 (200)	7.80 (198)	7.87 (200)	5.51 (140)	5.21 (132)	4.82 (122)	3.19 (81)	17 (8)
1.5-in. (40 mm) GB/T9119 PN40, SO/RF	7.87 (200)	7.80 (198)	7.87 (200)	5.91 (150)	5.21 (132)	4.82 (122)	3.46 (88)	19 (9)
2-in. (50 mm) ASME - 150, SO/RF	7.87 (200)	7.80 (198)	7.87 (200)	6.00 (152)	5.21 (132)	4.82 (122)	3.62 (92)	20 (9)
2-in. (50 mm) ASME - 300, SO/RF	7.87 (200)	7.80 (198)	7.87 (200)	6.50 (165)	5.21 (132)	4.82 (122)	3.62 (92)	23 (11)
2-in. (50 mm) EN 1092-1 - PN40, SO/RF	7.87 (200)	7.80 (198)	7.87 (200)	6.50 (165)	5.21 (132)	4.82 (122)	4.02 (102)	24 (11)
2-in. (50 mm) AS 2129 table D, SO/RF	7.87 (200)	7.80 (198)	7.87 (200)	5.91 (150)	5.21 (132)	4.82 (122)	3.54 (90)	14 (6)
2-in. (50 mm) AS 2129 table E, SO/RF	7.87 (200)	7.80 (198)	7.87 (200)	5.91 (150)	5.21 (132)	4.82 (122)	3.54 (90)	15 (7)
2-in. (50 mm) JIS B2220 - 10K, SO/RF	7.87 (200)	7.80 (198)	7.87 (200)	6.10 (155)	5.21 (132)	4.82 (122)	3.78 (96)	18 (8)
2-in. (50 mm) JIS B2220 - 20K, SO/RF	7.87 (200)	7.80 (198)	7.87 (200)	6.10 (155)	5.21 (132)	4.82 (122)	3.78 (96)	19 (9)
2-in. (50 mm) AS 4087 PN16, SO/RF	7.87 (200)	7.80 (198)	7.87 (200)	5.91 (150)	5.21 (132)	4.82 (122)	3.54 (90)	16 (7)
2-in. (50 mm) AS 4087 PN21, SO/RF	7.87 (200)	7.80 (198)	7.87 (200)	6.50 (165)	5.21 (132)	4.82 (122)	4.06 (103)	34 (16)
2-in. (50 mm) AS 4087 PN35, SO/RF	7.87 (200)	7.80 (198)	7.87 (200)	6.50 (165)	5.21 (132)	4.82 (122)	4.06 (103)	96 (44)
2-in. (50 mm) GB/T9119 PN40, SO/RF	7.87 (200)	7.80 (198)	7.87 (200)	6.50 (165)	5.21 (132)	4.82 (122)	4.02 (102)	23 (11)
2.5-in. (65 mm) ASME - 150, SO/RF	7.82 (199)	7.76 (197)	N/A	7.00 (178)	6.31 (160)	5.37 (136)	4.12 (105)	27 (12)
2.5-in. (65 mm) ASME - 300, SO/RF	7.82 (199)	7.76 (197)	N/A	7.50 (191)	6.31 (160)	5.37 (136)	4.12 (105)	32 (15)
2.5-in. (65 mm) EN 1092-1 - PN16, SO/RF	7.82 (199)	7.76 (197)	N/A	7.28 (185)	6.31 (160)	5.37 (136)	4.80 (122)	27 (12)
2.5-in. (65 mm) EN 1092-1 - PN40, SO/RF	7.82 (199)	7.76 (197)	N/A	7.28 (185)	6.31 (160)	5.37 (136)	4.80 (122)	31 (14)
2.5-in. (65 mm) AS 2129 table D, SO/RF	7.82 (199)	7.76 (197)	N/A	6.50 (165)	6.31 (160)	5.37 (136)	4.06 (103)	17 (8)
2.5-in. (65 mm) AS 2129 table E, SO/RF	7.82 (199)	7.76 (197)	N/A	6.50 (165)	6.31 (160)	5.37 (136)	4.06 (103)	19 (9)

Table 48: Raised face flanged sensor ½ - to 2½ -in. (15 mm to 65 mm) dimensions *(continued)*

Size, description	Overall length			Dim B	Dim C	Dim D	Dim J	Flow tube wgt (lbs./ kg)
	Dim A PTFE	Dim A Neoprene	Dim A Poly					
2.5-in. (65 mm) JIS B2220 - 10K, SO/RF	7.82 (199)	7.76 (197)	N/A	6.89 (175)	6.31 (160)	5.37 (136)	4.57 (116)	25 (11)
2.5-in. (65 mm) JIS B2220 - 20K, SO/RF	7.82 (199)	7.76 (197)	N/A	6.89 (175)	6.31 (160)	5.37 (136)	4.57 (116)	26 (12)
2.5-in. (65 mm) AS 4087 PN16, SO/RF	7.82 (199)	7.76 (197)	N/A	6.50 (165)	6.31 (160)	5.37 (136)	4.06 (103)	18 (8)
2.5-in. (65 mm) AS 4087 PN21, SO/RF	7.82 (199)	7.76 (197)	N/A	7.28 (185)	6.31 (160)	5.37 (136)	4.80 (122)	24 (11)
2.5-in. (65 mm) AS 4087 PN35, SO/RF	7.82 (199)	7.76 (197)	N/A	7.28 (185)	6.31 (160)	5.37 (136)	4.80 (122)	27 (12)
2.5-in. (65 mm) GB/T9119 PN40, SO/RF	7.82 (199)	7.76 (197)	N/A	7.28 (185)	6.31 (160)	5.37 (136)	4.80 (122)	31 (14)

Figure 11: Raised face flanged sensor 3-in to 48-in. (75 mm to 1200 mm)



- F – Flange bolts to straddle center line

Table 49: Raised face flanged Sensor 3- to 6-in. (75 mm to 150 mm) dimensions

Size, description	Overall length			Dim B	Dim C	Dim D	Dim J	Dim K	Flow tube wgt (lbs./ kg)
	Dim A PTFE	Dim A Neoprene	Dim A Poly						
3-in. (80 mm) ASME - 150, SO/RF	7.87 (200)	7.75 (197)	7.87 (200)	7.50 (191)	7.21 (183)	5.82 (148)	5.00 (127)	1.70 (43)	34 (15)
3-in. (80 mm) ASME - 300, SO/RF	8.63 (219)	8.51 (216)	8.63 (219)	8.25 (210)	7.21 (183)	5.82 (148)	5.00 (127)	1.70 (43)	43 (19)
3-in. (80 mm) EN 1092-1 - PN40, SO/RF	7.87 (200)	7.75 (197)	7.87 (200)	7.87 (200)	7.21 (183)	5.82 (148)	5.43 (138)	1.70 (43)	38 (17)
3-in. (80 mm) AS 2129 table D, SO/RF	7.87 (200)	7.75 (197)	7.87 (200)	7.28 (185)	7.21 (183)	5.82 (148)	4.80 (122)	1.70 (43)	24 (11)
3-in. (80 mm) AS 2129 table E, SO/RF	7.87 (200)	7.75 (197)	7.87 (200)	7.28 (185)	7.21 (183)	5.82 (148)	4.80 (122)	1.70 (43)	25 (11)
3-in. (80 mm) JIS - 10K, SO/RF	7.87 (200)	7.75 (197)	7.87 (200)	7.28 (185)	7.21 (183)	5.82 (148)	4.96 (126)	1.70 (43)	28 (13)
3-in. (80 mm) JIS - 20K, SO/RF	7.87 (200)	7.75 (197)	7.87 (200)	7.87 (200)	7.21 (183)	5.82 (148)	5.20 (132)	1.70 (43)	34 (16)
3-in. (80 mm) AS 4087 PN16, SO/RF	7.87 (200)	7.75 (197)	7.87 (200)	7.28 (185)	7.21 (183)	5.82 (148)	4.80 (122)	1.70 (43)	20 (9)
3-in. (80 mm) AS 4087 PN21, SO/RF	7.87 (200)	7.75 (197)	7.87 (200)	8.07 (205)	7.21 (183)	5.82 (148)	5.55 (141)	1.70 (43)	56 (25)
3-in. (80 mm) AS 4087 PN35, SO/RF	7.87 (200)	7.75 (197)	7.87 (200)	8.07 (205)	7.21 (183)	5.82 (148)	5.55 (141)	1.70 (43)	109 (49)
3-in. (80 mm) GB/T9119 PN40, SO/RF	7.87 (200)	7.75 (197)	7.87 (200)	7.87 (200)	7.21 (183)	5.82 (148)	5.43 (138)	1.70 (43)	37 (17)
4-in. (100 mm) ASME - 150, SO/RF	9.84 (250)	9.69 (246)	9.84 (250)	9.00 (229)	7.91 (201)	6.17 (157)	6.19 (157)	1.70 (43)	45 (20)
4-in. (100 mm) ASME - 300, SO/RF	10.88 (276)	10.73 (273)	10.88 (276)	10.00 (254)	7.91 (201)	6.17 (157)	6.19 (157)	1.70 (43)	65 (29)
4-in. (100 mm) EN 1092-1 - PN16, SO/RF	9.84 (250)	9.69 (246)	9.84 (250)	8.66 (220)	7.91 (201)	6.17 (157)	6.22 (159)	1.70 (43)	41 (19)
4-in. (100 mm) EN 1092-1 - PN40, SO/RF	9.84 (250)	9.69 (246)	9.84 (250)	9.25 (235)	7.91 (201)	6.17 (157)	6.38 (162)	1.70 (43)	49 (22)
4-in. (100 mm) AS 2129 table D, SO/RF	9.84 (250)	9.69 (246)	9.84 (250)	8.46 (215)	7.91 (201)	6.17 (157)	6.06 (154)	1.70 (43)	31 (14)
4-in. (100 mm) AS 2129 table E, SO/RF	9.84 (250)	9.69 (246)	9.84 (250)	8.46 (215)	7.91 (201)	6.17 (157)	6.06 (154)	1.70 (43)	33 (15)
4-in. (100 mm) JIS - 10K, SO/RF	9.84 (250)	9.69 (246)	9.84 (250)	8.27 (210)	7.91 (201)	6.17 (157)	5.95 (151)	1.70 (43)	35 (16)
4-in. (100 mm) JIS - 20K, SO/RF	9.84 (250)	9.69 (246)	9.84 (250)	8.86 (225)	7.91 (201)	6.17 (157)	6.30 (160)	1.70 (43)	44 (20)
4-in. (100 mm) AS 4087 PN16, SO/RF	9.84 (250)	9.69 (246)	9.84 (250)	8.46 (215)	7.91 (201)	6.17 (157)	6.06 (154)	1.70 (43)	28 (13)

Table 49: Raised face flanged Sensor 3- to 6-in. (75 mm to 150 mm) dimensions *(continued)*

Size, description	Overall length			Dim B	Dim C	Dim D	Dim J	Dim K	Flow tube wgt (lbs./ kg)
	Dim A PTFE	Dim A Neoprene	Dim A Poly						
4-in. (100 mm) AS 4087 PN21, SO/RF	9.84 (250)	9.69 (246)	9.84 (250)	9.05 (230)	7.91 (201)	6.17 (157)	6.57 (167)	1.70 (43)	68 (31)
4-in. (100 mm) AS 4087 PN35, SO/RF	9.84 (250)	9.69 (246)	9.84 (250)	9.05 (230)	7.91 (201)	6.17 (157)	6.57 (167)	1.70 (43)	119 (54)
4-in. (100 mm) GB/T9119 PN16, SO/RF	9.84 (250)	9.69 (246)	9.84 (250)	8.66 (220)	7.91 (201)	6.17 (157)	6.22 (158)	1.70 (43)	41 (19)
4-in. (100 mm) GB/T9119 PN40, SO/RF	9.84 (250)	9.69 (246)	9.84 (250)	9.25 (235)	7.91 (201)	6.17 (157)	6.38 (162)	1.70 (43)	49 (22)
5-in. (125 mm) ASME - 150, SO/RF	9.79 (249)	9.71 (247)	N/A	10.00 (254)	9.61 (244)	7.02 (178)	7.31 (186)	1.70 (43)	54 (24)
5-in. (125 mm) ASME - 300,SO/RF	10.94 (278)	10.86 (276)	N/A	11.00 (279)	9.61 (244)	7.02 (178)	7.31 (186)	1.70 (43)	89 (40)
5-in. (125 mm) EN 1092-1 - PN16, SO/RF	9.79 (249)	9.50 (241)	N/A	9.84 (250)	9.61 (244)	7.02 (178)	7.40 (188)	1.70 (43)	55 (25)
5-in. (125 mm) EN 1092-1 - PN40, SO/RF	9.79 (249)	9.71 (247)	N/A	10.63 (270)	9.61 (244)	7.02 (178)	7.40 (188)	1.70 (43)	65 (29)
5-in. (125 mm) AS 2129 table D, SO/RF	9.79 (249)	9.71 (247)	N/A	10.04 (255)	9.61 (244)	7.02 (178)	7.32 (186)	1.70 (43)	43 (20)
5-in. (125 mm) AS 2129 table E, SO/RF	9.79 (249)	9.71 (247)	N/A	10.04 (255)	9.61 (244)	7.02 (178)	7.31 (186)	1.70 (43)	44 (20)
5-in. (125 mm) JIS - 10K, SO/RF	9.79 (249)	9.71 (247)	N/A	9.84 (250)	9.61 (244)	7.02 (178)	7.17 (182)	1.70 (43)	49 (22)
5-in. (125 mm) JIS - 20K, SO/RF	9.79 (249)	9.71 (247)	N/A	10.63 (270)	9.61 (244)	7.02 (178)	7.68 (195)	1.70 (43)	64 (29)
5-in. (125 mm) GB/T9119 PN16, SO/RF	9.79 (249)	9.50 (241)	N/A	9.84 (250)	9.61 (244)	7.02 (178)	7.40 (188)	1.70 (43)	51 (23)
5-in. (125 mm) GB/T9119 PN40, SO/RF	9.79 (249)	9.71 (247)	N/A	10.63 (270)	9.61 (244)	7.02 (178)	7.40 (188)	1.70 (43)	60 (27)
6-in. (150 mm) ASME - 150, SO/RF	11.81 (300)	11.61 (295)	11.73 (298)	11.00 (279)	9.98 (253)	7.30 (185)	8.50 (216)	1.70 (43)	68 (31)
6-in. (150 mm) ASME - 300, SO/RF	13.06 (302)	12.88 (327)	13.00 (330)	12.50 (318)	9.98 (253)	7.30 (185)	8.50 (216)	1.70 (43)	117 (53)
6-in. (150 mm) EN 1092-1 - PN16, SO/RF	11.81 (300)	11.61 (295)	11.73 (298)	11.22 (285)	9.98 (253)	7.30 (185)	8.35 (212)	1.70 (43)	67 (31)
6-in. (150 mm) EN 1092-1 - PN40, SO/RF	13.06 (332)	12.88 (327)	13.00 (330)	11.81 (300)	9.98 (253)	7.30 (185)	8.58 (218)	1.70 (43)	95 (43)
6-in. (150 mm) AS 2129 table D, SO/RF	11.81 (300)	11.61 (295)	11.73 (298)	11.02 (280)	9.98 (253)	7.30 (185)	8.31 (211)	1.70 (43)	52 (24)
6-in. (150 mm) AS 2129 table E, SO/RF	11.81 (300)	11.61 (295)	11.73 (298)	11.02 (280)	9.98 (253)	7.30 (185)	8.15 (207)	1.70 (43)	57 (26)

Table 49: Raised face flanged Sensor 3- to 6-in. (75 mm to 150 mm) dimensions *(continued)*

Size, description	Overall length			Dim B	Dim C	Dim D	Dim J	Dim K	Flow tube wgt (lbs./ kg)
	Dim A PTFE	Dim A Neoprene	Dim A Poly						
6-in. (150 mm) JIS - 10K, SO/RF	11.81 (300)	11.61 (295)	11.73 (298)	11.02 (280)	9.98 (253)	7.30 (185)	8.35 (212)	1.70 (43)	64 (29)
6-in. (150 mm) JIS - 20K, SO/RF	11.81 (300)	11.61 (295)	11.73 (298)	12.01 (305)	9.98 (253)	7.30 (185)	9.06 (230)	1.70 (43)	82 (37)
6-in. (150 mm) AS 4087 PN16,SO/RF	11.81 (300)	11.61 (295)	11.73 (298)	11.02 (280)	9.98 (253)	7.30 (185)	8.31 (211)	1.70 (43)	46 (21)
6-in. (150 mm) AS 4087 PN21,SO/RF	11.81 (300)	11.61 (295)	11.73 (298)	12.01 (305)	9.98 (253)	7.30 (185)	9.13 (232)	1.70 (43)	98 (45)
6-in. (150 mm) AS 4087 PN35, SO/RF	11.81 (300)	11.61 (295)	11.73 (298)	12.01 (305)	9.98 (253)	7.30 (185)	9.13 (232)	1.70 (43)	186 (84)
6-in. (150 mm) GB/T9119 PN16, SO/RF	11.81 (300)	11.61 (295)	11.73 (298)	11.22 (285)	9.98 (253)	7.30 (185)	8.35 (212)	1.70 (43)	64 (29)
6-in. (150 mm) GB/T9119 PN40, SO/RF	13.06 (332)	12.88 (327)	13.00 (330)	11.81 (300)	9.98 (253)	7.30 (185)	8.58 (218)	1.70 (43)	94 (43)

Table 50: Raised Face Flanged Sensor 8- to 12-in. (200 mm to 300 mm) dimensions

Size, description	Overall length			Dim B	Dim C	Dim D	Dim J	Dim K	Flow tube wgt (lbs./ kg)
	Dim A PTFE	Dim A Neoprene	Dim A Poly						
8-in. (200 mm) ASME - 150, SO/RF	13.78 (350)	13.53 (344)	13.65 (347)	13.50 (343)	11.92 (303)	8.27 (210)	10.62 (270)	1.70 (43)	105 (48)
8-in. (200 mm) ASME - 300,SO/RF	15.60 (396)	15.42 (392)	15.54 (395)	15.00 (381)	11.92 (303)	8.27 (210)	10.62 (270)	1.70 (43)	183 (83)
8-in. (200 mm) EN 1092-1 - PN10, SO/RF	13.78 (350)	13.53 (344)	13.65 (347)	13.39 (340)	11.92 (303)	8.27 (210)	10.55 (268)	1.70 (43)	97 (44)
8-in. (200 mm) EN 1092-1 - PN16, SO/RF	13.78 (350)	13.53 (344)	13.65 (347)	13.39 (340)	11.92 (303)	8.27 (210)	10.55 (268)	1.70 (43)	96 (43)
8-in. (200 mm) EN 1092-1 - PN25, SO/RF	13.78 (350)	13.53 (344)	13.65 (347)	14.17 (360)	11.92 (303)	8.27 (210)	10.94 (278)	1.70 (43)	120 (54)
8-in. (200 mm) EN 1092-1 - PN40, SO/RF	15.60 (396)	15.42 (392)	15.54 (395)	14.76 (375)	11.92 (303)	8.27 (210)	11.22 (285)	1.70 (43)	158 (72)
8-in. (200 mm) AS 2129 table D, SO/RF	13.78 (350)	13.53 (344)	13.65 (347)	13.19 (335)	11.92 (303)	8.27 (210)	10.55 (268)	1.70 (43)	77 (35)
8-in. (200 mm) AS 2129 table E, SO/RF	13.78 (350)	13.53 (344)	13.65 (347)	13.19 (335)	11.92 (303)	8.27 (210)	10.39 (264)	1.70 (43)	86 (39)
8-in. (200 mm) JIS - 10K, SO/RF	13.78 (350)	13.53 (344)	13.65 (347)	12.99 (330)	11.92 (303)	8.27 (210)	10.32 (262)	1.70 (43)	81 (37)
8-in. (200 mm) JIS - 20K, SO/RF	15.60 (396)	15.42 (392)	15.54 (395)	13.78 (350)	11.92 (303)	8.27 (210)	10.83 (275)	1.70 (43)	134 (61)

Table 50: Raised Face Flanged Sensor 8- to 12-in. (200 mm to 300 mm) dimensions *(continued)*

Size, description	Overall length			Dim B	Dim C	Dim D	Dim J	Dim K	Flow tube wgt (lbs./ kg)
	Dim A PTFE	Dim A Neoprene	Dim A Poly						
8-in. (200 mm) AS 4087 PN16, SO/RF	13.78 (350)	13.53 (344)	13.65 (347)	13.19 (335)	11.92 (303)	8.27 (210)	10.55 (268)	1.70 (43)	73 (32)
8-in. (200 mm) AS 4087 PN21, SO/RF	13.78 (350)	13.53 (344)	13.65 (347)	14.57 (370)	11.92 (303)	8.27 (210)	11.65 (296)	1.70 (43)	136 (62)
8-in. (200 mm) AS 4087 PN35, SO/RF	15.60 (396)	15.42 (392)	15.54 (395)	14.57 (370)	11.92 (303)	8.27 (210)	10.24 (260)	1.70 (43)	241 (109)
8-in. (200 mm) GB/T9119 PN10, SO/RF	13.78 (350)	13.53 (344)	13.65 (347)	13.39 (340)	11.92 (303)	8.27 (210)	10.55 (268)	1.70 (43)	96 (43)
8-in. (200 mm) GB/T9119 PN16, SO/RF	13.78 (350)	13.53 (344)	13.65 (347)	13.39 (340)	11.92 (303)	8.27 (210)	10.55 (268)	1.70 (43)	95 (43)
8-in. (200 mm) GB/T9119 PN40, SO/RF	15.60 (396)	15.42 (392)	15.54 (395)	14.76 (375)	11.92 (303)	8.27 (210)	11.22 (285)	1.70 (43)	154 (70)
10-in. (250 mm) ASME - 150, SO/RF	17.98 (457)	17.61 (447)	17.73 (450)	16.00 (406)	13.12 (333)	8.91 (226)	12.75 (324)	2.00 (51)	138 (63)
10-in. (250 mm) ASME - 300,SO/RF	17.88 (454)	17.61 (447)	17.73 (450)	17.50 (445)	13.12 (333)	8.91 (226)	12.75 (324)	2.00 (51)	247 (112)
10-in. (250 mm) EN 1092-1 - PN10, SO/RF	17.98 (457)	17.61 (447)	17.73 (450)	15.55 (395)	13.12 (333)	8.91 (226)	12.60 (320)	2.00 (51)	122 (55)
10-in. (250 mm) EN 1092-1 - PN16, SO/RF	17.98 (457)	17.61 (447)	17.73 (450)	15.94 (405)	13.12 (333)	8.91 (226)	12.60 (320)	2.00 (51)	126 (57)
10-in. (250 mm) EN 1092-1 - PN25, SO/RF	17.98 (457)	17.61 (447)	17.73 (450)	16.73 (425)	13.12 (333)	8.91 (226)	13.19 (335)	2.00 (51)	158 (72)
10-in. (250 mm) EN 1092-1 - PN40, SO/RF	17.98 (457)	17.61 (447)	17.73 (450)	17.72 (450)	13.12 (333)	8.91 (226)	13.58 (345)	2.00 (51)	221 (100)
10-in. (250 mm) AS 2129 table D, SO/RF	17.98 (457)	17.61 (447)	17.73 (450)	15.94 (405)	13.12 (333)	8.91 (226)	12.91 (328)	2.00 (51)	112 (51)
10-in. (250 mm) AS 2129 table E, SO/RF	17.98 (457)	17.61 (447)	17.73 (450)	15.94 (405)	13.12 (333)	8.91 (226)	12.91 (328)	2.00 (51)	127 (57)
10-in. (250 mm) JIS B2220 - 10K, SO/RF	17.98 (457)	17.61 (447)	17.73 (450)	15.75 (430)	13.12 (333)	8.91 (226)	12.76 (324)	2.00 (51)	118 (53)
10-in. (250 mm) AS 4087 PN16, SO/RF	17.98 (457)	17.61 (447)	17.73 (450)	15.94 (405)	13.12 (333)	8.91 (226)	12.91 (328)	2.00 (51)	168 (76)
10-in. (250 mm) AS 4087 PN21, SO/RF	17.98 (457)	17.61 (447)	17.73 (450)	16.93 (395)	13.12 (333)	8.91 (226)	13.74 (349)	2.00 (51)	258 (117)
10-in. (250) AS 4087 PN35, SO/RF	17.88 (454)	17.61 (447)	17.73 (450)	16.93 (395)	13.12 (333)	8.91 (226)	12.24 (311)	2.00 (51)	333 (151)
10-in. (250 mm) GB/T 9119 PN10, SO/RF	17.98 (457)	17.61 (447)	17.73 (450)	15.55 (395)	13.12 (333)	8.91 (226)	12.60 (320)	2.00 (51)	105 (48)
10-in. (250 mm) GB/T 9119 PN16, SO/RF	17.98 (457)	17.61 (447)	17.73 (450)	15.94 (405)	13.12 (333)	8.91 (226)	12.60 (320)	2.00 (51)	117 (53)

Table 50: Raised Face Flanged Sensor 8- to 12-in. (200 mm to 300 mm) dimensions *(continued)*

Size, description	Overall length			Dim B	Dim C	Dim D	Dim J	Dim K	Flow tube wgt (lbs./ kg)
	Dim A PTFE	Dim A Neoprene	Dim A Poly						
10-in. (250 mm) GB/T 9119 PN40, SO/RF	17.88 (454)	17.61 (447)	17.73 (450)	17.72 (450)	13.12 (333)	8.91 (226)	13.58 (345)	2.00 (51)	213 (97)
12-in. (300 mm) ASME - 150, SO/RF	19.91 (506)	19.58 (497)	19.70 (500)	19.00 (483)	15.12 (384)	9.91 (252)	15.00 (381)	2.00 (51)	238 (108)
12-in. (300 mm) ASME - 300,SO/RF	19.92 (506)	19.58 (497)	19.70 (500)	20.50 (521)	15.12 (384)	9.91 (252)	15.00 (381)	2.00 (51)	346 (157)
12-in. (300 mm) EN 1092-1 - PN10, SO/RF	19.91 (506)	19.58 (497)	19.70 (500)	17.52 (445)	15.12 (384)	9.91 (252)	14.57 (370)	2.00 (51)	187 (85)
12-in. (300 mm) EN 1092-1 - PN16, SO/RF	19.91 (506)	19.58 (497)	19.70 (500)	18.11 (460)	15.12 (384)	9.91 (252)	14.88 (378)	2.00 (51)	198 (90)
12-in. (300 mm) EN 1092-1 - PN25, SO/RF	19.91 (506)	19.58 (497)	19.70 (500)	19.09 (485)	15.12 (384)	9.91 (252)	15.55 (395)	2.00 (51)	243 (110)
12-in. (300 mm) EN 1092-1 - PN40, SO/RF	19.92 (506)	19.58 (497)	19.70 (500)	20.28 (515)	15.12 (384)	9.91 (252)	16.14 (410)	2.00 (51)	340 (154)
12-in. (300 mm) AS 2129 table D, SO/RF	19.91 (506)	19.58 (497)	19.70 (500)	17.91 (455)	15.12 (384)	9.91 (252)	14.88 (378)	2.00 (51)	185 (84)
12-in. (300 mm) AS 2129 table E, SO/RF	19.91 (506)	19.58 (497)	19.70 (500)	17.91 (455)	15.12 (384)	9.91 (252)	14.72 (374)	2.00 (51)	197 (89)
12-in. (300 mm) JIS B2220 - 10K, SO/RF	19.91 (506)	19.58 (497)	19.70 (500)	17.52 (445)	15.12 (384)	9.91 (252)	14.49 (368)	2.00 (51)	178 (81)
12-in. (300 mm) AS 4087 PN16, SO/RF	19.91 (506)	19.58 (497)	19.70 (500)	17.91 (455)	15.12 (384)	9.91 (252)	14.88 (378)	2.00 (51)	264 (120)
12-in. (300 mm) AS 4087 PN21, SO/RF	19.91 (506)	19.58 (497)	19.70 (500)	19.29 (490)	15.12 (384)	9.91 (252)	15.98 (406)	2.00 (51)	361 (164)
12-in. (300 mm) AS 4087 PN35, SO/RF	19.92 (506)	19.58 (497)	19.70 (500)	19.29 (490)	15.12 (384)	9.91 (252)	14.25 (362)	2.00 (51)	452 (205)
12-in. (300 mm) GB/T 9119 PN10, SO/RF	19.91 (506)	19.58 (497)	19.70 (500)	17.52 (445)	15.12 (384)	9.91 (252)	14.57 (370)	2.00 (51)	185 (84)
12-in. (300 mm) GB/T 9119 PN16, SO/RF	19.91 (506)	19.58 (497)	19.70 (500)	18.11 (460)	15.12 (384)	9.91 (252)	14.88 (378)	2.00 (51)	204 (92)
12-in. (300 mm) GB/T 9119 PN40, SO/RF	19.92 (506)	19.58 (497)	19.70 (500)	20.28 (515)	15.12 (384)	9.91 (252)	16.14 (410)	2.00 (51)	343 (156)

Table 51: Raised face flanged sensor 14- to 18-in. (350 mm to 450 mm) dimensions

Size, description	Overall length			Dim B	Dim C	Dim D	Dim J	Dim K	Flow tube wgt (lbs./ kg)
	Dim A PTFE	Dim A Neoprene	Dim A Poly						
14-in. (350 mm) ASME - 150,SO/RF	21.75 (553)	21.55 (547)	21.67 (550)	21.00 (533)	16.38 (416)	10.54 (268)	16.25 (413)	2.00 (51)	251 (114)

Table 51: Raised face flanged sensor 14- to 18-in. (350 mm to 450 mm) dimensions *(continued)*

Size, description	Overall length			Dim B	Dim C	Dim D	Dim J	Dim K	Flow tube wgt (lbs./ kg)
	Dim A PTFE	Dim A Neoprene	Dim A Poly						
14-in. (350 mm) ASME - 300, SO/RF	21.75 (553)	21.55 (547)	21.67 (550)	23.00 (584)	16.38 (416)	10.54 (268)	16.25 (413)	2.00 (51)	453 (205)
14-in. (350 mm) EN 1092-1 - PN10, SO/RF	21.75 (553)	21.55 (547)	21.67 (550)	19.88 (505)	16.38 (416)	10.54 (268)	16.93 (430)	2.00 (51)	198 (90)
14-in. (350 mm) EN 1092-1 - PN16, SO/RF	21.75 (553)	21.55 (547)	21.67 (550)	20.47 (520)	16.38 (416)	10.54 (268)	17.24 (438)	2.00 (51)	221 (100)
14-in. (350 mm) EN 1092-1 - PN25, SO/RF	21.75 (553)	21.55 (547)	21.67 (550)	21.85 (555)	16.38 (416)	10.54 (268)	17.72 (450)	2.00 (51)	297 (135)
14-in. (350 mm) EN 1092-1 - PN40, SO/RF	21.75 (553)	21.55 (547)	21.67 (550)	22.83 (580)	16.38 (416)	10.54 (268)	18.31 (465)	2.00 (51)	404 (183)
14-in. (350 mm) AS 2129 table D, SO/RF	21.75 (553)	21.55 (547)	21.67 (550)	20.67 (525)	16.38 (416)	10.54 (268)	17.24 (438)	2.00 (51)	181 (82)
14-in. (350 mm) AS 2129 table E, SO/RF	21.75 (553)	21.55 (547)	21.67 (550)	20.67 (525)	16.38 (416)	10.54 (268)	17.24 (438)	2.00 (51)	207 (94)
14-in. (350 mm) JIS B2220 - 10K, SO/RF	21.75 (553)	21.55 (547)	21.67 (550)	19.29 (490)	16.38 (416)	10.54 (268)	16.26 (413)	2.00 (51)	170 (77)
14-in. (350 mm) AS 4087 PN16,SO/RF	21.75 (553)	21.55 (547)	21.67 (550)	20.67 (525)	16.38 (416)	10.54 (268)	17.24 (438)	2.00 (51)	367 (167)
14 -in. (350mm) AS4087 PN21,SO/RF	21.75 (553)	21.55 (547)	21.67 (550)	21.65 (550)	16.38 (416)	10.54 (268)	18.07 (459)	2.00 (51)	409 (186)
14-in. (350 mm) AS 4087 PN35, SO/RF	21.75 (553)	21.55 (547)	21.67 (550)	21.65 (550)	16.38 (416)	10.54 (268)	16.50 (419)	2.00 (51)	622 (282)
14-in. (350 mm) GB/T 9119 PN10, SO/RF	21.75 (553)	21.55 (547)	21.67 (550)	19.88 (505)	16.38 (416)	10.54 (268)	16.93 (430)	2.00 (51)	192 (87)
14-in. (350 mm) GB/T 9119 PN16, SO/RF	21.75 (553)	21.55 (547)	21.67 (550)	20.47 (520)	16.38 (416)	10.54 (268)	17.24 (438)	2.00 (51)	219 (99)
14-in. (350 mm) GB/T 9119 PN40, SO/RF	21.75 (553)	21.55 (547)	21.67 (550)	22.83 (580)	16.38 (416)	10.54 (268)	18.31 (465)	2.00 (51)	421 (191)
16-in. (400 mm) ASME - 150, SO/RF	23.71 (602)	23.51 (597)	23.63 (600)	23.50 (597)	18.40 (467)	11.55 (293)	18.50 (470)	3.13 (80)	346 (157)
16-in. (400 mm) ASME - 300,SO/RF	23.71 (602)	23.51 (597)	23.63 (600)	25.50 (648)	18.40 (467)	11.55 (293)	18.50 (470)	3.13 (80)	632 (287)
16-in. (400 mm) EN 1092-1 - PN10, SO/RF	23.71 (602)	23.51 (597)	23.63 (600)	22.24 (565)	18.40 (467)	11.55 (293)	18.98 (482)	3.13 (80)	272 (123)
16-in. (400 mm) EN 1092-1 - PN16, SO/RF	23.71 (602)	23.51 (597)	23.63 (600)	22.83 (580)	18.40 (467)	11.55 (293)	19.28 (490)	3.13 (80)	306 (139)
16-in. (400 mm) EN 1092-1 - PN25, SO/RF	23.71 (602)	23.51 (597)	23.63 (600)	24.41 (620)	18.40 (467)	11.55 (293)	19.88 (505)	3.13 (80)	498 (226)
16-in. (400 mm) EN 1092-1 - PN40, SO/RF	23.71 (602)	23.51 (597)	23.63 (600)	25.98 (660)	18.40 (467)	11.55 (293)	21.06 (535)	3.13 (80)	606 (275)

Table 51: Raised face flanged sensor 14- to 18-in. (350 mm to 450 mm) dimensions *(continued)*

Size, description	Overall length			Dim B	Dim C	Dim D	Dim J	Dim K	Flow tube wgt (lbs./ kg)
	Dim A PTFE	Dim A Neoprene	Dim A Poly						
16-in. (400 mm) AS 2129 table D, SO/RF	23.71 (602)	23.51 (597)	23.63 (600)	22.83 (580)	18.40 (467)	11.55 (293)	19.25 (489)	3.13 (80)	243 (110)
16-in. (400 mm) AS 2129 table E, SO/RF	23.71 (602)	23.51 (597)	23.63 (600)	22.83 (580)	18.40 (467)	11.55 (293)	19.25 (489)	3.13 (80)	287 (130)
16-in. (400 mm) JIS B2220 - 10K, SO/RF	23.71 (602)	23.51 (597)	23.63 (600)	22.05 (560)	18.40 (467)	11.55 (293)	18.70 (475)	3.13 (80)	250 (114)
16-in. (400 mm) AS 4087 PN16, SO/RF	23.71 (602)	23.51 (597)	23.63 (600)	22.83 (580)	18.40 (467)	11.55 (293)	19.25 (489)	3.13 (80)	458 (208)
16-in. (400 mm) AS 4087 PN21,SO/RF	23.71 (602)	23.51 (597)	23.63 (600)	24.02 (610)	18.40 (467)	11.55 (293)	20.31 (516)	3.13 (80)	603 (273)
16-in. (400 mm) AS 4087 PN35, SO/RF	23.71 (602)	23.51 (597)	23.63 (600)	24.02 (610)	18.40 (467)	11.55 (293)	19.02 (483)	3.13 (80)	804 (364)
16-in. (400 mm) GB/T 9119 PN10, SO/RF	23.71 (602)	23.51 (597)	23.63 (600)	22.24 (565)	18.40 (467)	11.55 (293)	18.98 (482)	3.13 (80)	241 (109)
16-in. (400 mm) GB/T 9119 PN16, SO/RF	23.71 (602)	23.51 (597)	23.63 (600)	22.83 (580)	18.40 (467)	11.55 (293)	19.28 (490)	3.13 (80)	303 (137)
16-in. (400 mm) GB/T 9119 PN40, SO/RF	23.71 (602)	23.51 (597)	23.63 (600)	25.98 (660)	18.40 (467)	11.55 (293)	21.06 (535)	3.13 (80)	636 (289)
18-in. (450) ASME - 150, SO/RF	23.46 (596)	23.51 (597)	23.38 (594)	25.00 (635)	20.42 (519)	12.57 (319)	21.00 (533)	3.13 (80)	440 (200)
18-in. (450 mm) ASME - 300, SO/RF	23.46 (596)	23.51 (597)	23.38 (594)	28.00 (711)	20.42 (519)	12.57 (319)	21.00 (533)	3.13 (80)	849 (385)
18-in. (450 mm) EN 1092-1 - PN10, SO/RF	23.46 (596)	23.51 (597)	23.38 (594)	24.21 (615)	20.42 (519)	12.57 (319)	20.94 (532)	3.13 (80)	370 (168)
18-in. (450 mm) EN 1092-1 - PN16, SO/RF	23.46 (596)	23.51 (597)	23.38 (594)	25.20 (640)	20.42 (519)	12.57 (319)	21.65 (550)	3.13 (80)	423 (192)
18-in. (450 mm) EN 1092-1 - PN25, SO/RF	23.46 (596)	23.51 (597)	23.38 (594)	26.38 (670)	20.42 (519)	12.57 (319)	21.85 (555)	3.13 (80)	686 (312)
18-in. (450 mm) EN 1092-1 - PN40, SO/RF	23.46 (596)	23.51 (597)	23.38 (594)	26.97 (685)	20.42 (519)	12.57 (319)	22.05 (560)	3.13 (80)	759 (345)
18-in. (450 mm) AS 2129 table D, SO/RF	23.46 (596)	23.51 (597)	23.38 (594)	25.20 (640)	20.42 (519)	12.57 (319)	20.94 (532)	3.13 (80)	345 (156)
18-in. (450 mm) AS 2129 table E, SO/RF	23.46 (596)	23.51 (597)	23.38 (594)	25.20 (640)	20.42 (519)	12.57 (319)	21.73 (552)	3.13 (80)	403 (183)
18-in. (450 mm) JIS B2220 - 10K, SO/RF	23.46 (596)	23.51 (597)	23.38 (594)	24.41 (620)	20.42 (519)	12.57 (319)	20.87 (530)	3.13 (80)	362 (164)
18-in. (450 mm) JIS B2220 - 20K, SO/RF	23.46 (596)	23.51 (597)	23.38 (594)	26.58 (675)	20.42 (519)	12.57 (319)	22.05 (560)	3.13 (80)	693 (314)
18-in. (450 mm) AS 4087 PN16, SO/RF	23.46 (596)	23.51 (597)	23.38 (594)	25.20 (640)	20.42 (519)	12.57 (319)	21.73 (552)	3.13 (80)	312 (141)

Table 51: Raised face flanged sensor 14- to 18-in. (350 mm to 450 mm) dimensions *(continued)*

Size, description	Overall length			Dim B	Dim C	Dim D	Dim J	Dim K	Flow tube wgt (lbs./ kg)
	Dim A PTFE	Dim A Neoprene	Dim A Poly						
18-in. (450 mm) AS 4087 PN21, SO/RF	23.46 (596)	23.51 (597)	23.38 (594)	26.58 (675)	20.42 (519)	12.57 (319)	22.48 (571)	3.13 (80)	442 (200)
18-in. (450 mm) AS 4087 PN35, SO/RF	23.46 (596)	23.51 (597)	23.38 (594)	26.58 (675)	20.42 (519)	12.57 (319)	20.98 (533)	3.13 (80)	859 (390)
18-in. (450 mm) GB/T9119 PN10, SO/RF	23.46 (596)	23.51 (597)	23.38 (594)	24.41 (620)	20.42 (519)	12.57 (319)	20.94 (532)	3.13 (80)	370 (168)
18-in. (450 mm) GB/T9119 PN16, SO/RF	23.46 (596)	23.51 (597)	23.38 (594)	25.20 (640)	20.42 (519)	12.57 (319)	21.65 (550)	3.13 (80)	423 (192)
18-in. (450 mm) GB/T9119 PN40, SO/RF	23.46 (596)	23.51 (597)	23.38 (594)	26.97 (685)	20.42 (519)	12.57 (319)	22.05 (560)	3.13 (80)	782 (355)

Table 52: Raised face flanged sensor 20- to 36-in. (500 mm to 900 mm) dimensions

Size, description	Overall length			Dim B	Dim C	Dim D	Dim J	Dim K	Flow tube wgt (lbs./ kg)
	Dim A PTFE	Dim A Neoprene	Dim A Poly						
20-in. (500 mm) ASME - 150, SO/RF	23.46 (596)	23.51 (597)	23.38 (594)	27.50 (699)	22.44 (570)	13.58 (345)	23.00 (584)	3.13 (80)	544 (247)
20-in. (500 mm) ASME - 300, SO/RF	23.46 (596)	23.51 (597)	23.38 (594)	30.50 (775)	22.44 (570)	13.58 (345)	23.00 (584)	3.13 (80)	1027 (466)
20-in. (500 mm) EN 1092-1 - PN10, SO/RF	23.46 (596)	23.51 (597)	23.38 (594)	26.38 (670)	22.44 (570)	13.58 (345)	23.03 (585)	3.13 (80)	448 (204)
20-in. (500 mm) EN 1092-1 - PN16, SO/RF	23.46 (596)	23.51 (597)	23.38 (594)	28.15 (715)	22.44 (570)	13.58 (345)	24.02 (610)	3.13 (80)	542 (212)
20-in. (500 mm) EN 1092-1 - PN25, SO/RF	23.46 (596)	23.51 (597)	23.38 (594)	28.74 (730)	22.44 (570)	13.58 (345)	24.21 (615)	3.13 (80)	832 (378)
20-in. (500 mm) EN 1092-1 - PN40, SO/RF	23.46 (596)	23.51 (597)	23.38 (594)	29.72 (755)	22.44 (570)	13.58 (345)	24.21 (615)	3.13 (80)	913 (414)
20-in. (500 mm) AS 2129 table D, SO/RF	23.46 (596)	23.51 (597)	23.38 (594)	27.76 (705)	22.44 (570)	13.58 (345)	23.98 (609)	3.13 (80)	446 (203)
20-in. (500 mm) AS 2129 table E, SO/RF	23.46 (596)	23.51 (597)	23.38 (594)	27.76 (705)	22.44 (570)	13.58 (345)	23.98 (609)	3.13 (80)	503 (228)
20-in. (500 mm) JIS B2220 - 10K, SO/RF	23.46 (596)	23.51 (597)	23.38 (594)	26.58 (675)	22.44 (570)	13.58 (345)	23.03 (585)	3.13 (80)	428 (195)
20-in. (500 mm) JIS B2220 - 20K, SO/RF	23.46 (596)	23.51 (597)	23.38 (594)	28.74 (730)	22.44 (570)	13.58 (345)	24.21 (615)	3.13 (80)	819 (372)
20-in. (500 mm) AS 4087 PN16, SO/RF	23.46 (596)	23.51 (597)	23.38 (594)	27.76 (705)	22.44 (570)	13.58 (345)	23.98 (609)	3.13 (80)	428 (195)
20-in. (500 mm) AS 4087 PN21, SO/RF	23.46 (596)	23.51 (597)	23.38 (594)	28.94 (735)	22.44 (570)	13.58 (345)	24.96 (634)	3.13 (80)	602 (274)

Table 52: Raised face flanged sensor 20- to 36-in. (500 mm to 900 mm) dimensions *(continued)*

Size, description	Overall length			Dim B	Dim C	Dim D	Dim J	Dim K	Flow tube wgt (lbs./ kg)
	Dim A PTFE	Dim A Neoprene	Dim A Poly						
20-in. (500 mm) AS 4087 PN35,SO/RF	23.46 (596)	23.51 (597)	23.38 (594)	28.94 (735)	22.44 (570)	13.58 (345)	23.50 (587)	3.13 (80)	974 (442)
20-in. (500 mm) GB/T9119 PN10, SO/RF	23.46 (596)	23.51 (597)	23.38 (594)	26.38 (670)	22.44 (570)	13.58 (345)	23.03 (585)	3.13 (80)	445 (202)
20-in. (500 mm) GB/T9119 PN16, SO/RF	23.46 (596)	23.51 (597)	23.38 (594)	28.15 (715)	22.44 (570)	13.58 (345)	24.02 (610)	3.13 (80)	555 (252)
20-in. (500 mm) GB/T9119 PN40, SO/RF	23.46 (596)	23.51 (597)	23.38 (594)	29.72 (755)	22.44 (570)	13.58 (345)	24.21 (615)	3.13 (80)	978 (444)
24-in. (600 mm) ASME - 150, SO/RF	23.46 (596)	23.51 (597)	23.63 (600)	32.00 (813)	26.50 (673)	15.61 (396)	27.25 (692)	3.13 (80)	634 (287)
24-in. (600 mm) ASME - 300, SO/RF	23.46 (596)	23.51 (597)	23.63 (600)	36.00 (914)	26.50 (673)	15.61 (396)	27.25 (692)	3.13 (80)	1335 (606)
24-in. (600 mm) EN 1092-1 - PN10, SO/RF	23.46 (596)	23.51 (597)	23.63 (600)	30.71 (780)	26.50 (673)	15.61 (396)	26.97 (685)	3.13 (80)	466 (211)
24-in. (600 mm) EN 1092-1 - PN16, SO/RF	23.46 (596)	23.51 (597)	23.63 (600)	33.07 (840)	26.50 (673)	15.61 (396)	28.54 (725)	3.13 (80)	665 (302)
24-in. (600 mm) EN 1092-1 - PN25, SO/RF	23.46 (596)	23.51 (597)	23.63 (600)	33.27 (845)	26.50 (673)	15.61 (396)	28.35 (720)	3.13 (80)	938 (426)
24-in. (600 mm) EN 1092-1 - PN40, SO/RF	23.46 (596)	23.51 (597)	23.63 (600)	35.04 (890)	26.50 (673)	15.61 (396)	28.94 (735)	3.13 (80)	1207 (528)
24-in. (600 mm) AS 2129 table D, SO/RF	23.46 (596)	23.51 (597)	23.63 (600)	32.48 (825)	26.50 (673)	15.61 (396)	28.35 (720)	3.13 (80)	501 (227)
24-in. (600 mm) AS 2129 table E, SO/RF	23.46 (596)	23.51 (597)	23.63 (600)	32.48 (825)	26.50 (673)	15.61 (396)	28.23 (717)	3.13 (80)	625 (283)
24-in. (600 mm) JIS B2220 - 10K, SO/RF	23.46 (596)	23.51 (597)	23.63 (600)	31.30 (795)	26.50 (673)	15.61 (396)	27.17 (690)	3.13 (80)	451 (204)
24-in. (600 mm) AS 4087 PN16, SO/RF	23.46 (596)	23.51 (597)	23.63 (600)	32.48 (825)	26.50 (673)	15.61 (396)	28.35 (720)	3.13 (80)	1133 (514)
24-in. (600 mm) AS 4087 PN21,SO/RF	23.46 (596)	23.51 (597)	23.63 (600)	33.47 (850)	26.50 (673)	15.61 (396)	29.09 (739)	3.13 (80)	1605 (728)
24-in. (600 mm) AS 4087 PN35, SO/RF	23.46 (596)	23.51 (597)	23.63 (600)	33.47 (850)	26.50 (673)	15.61 (396)	27.52 (699)	3.13 (80)	1777 (806)
24-in. (600 mm) GB/T 9119 PN10, SO/RF	23.46 (596)	23.51 (597)	23.63 (600)	30.71 (780)	26.50 (673)	15.61 (396)	26.97 (685)	3.13 (80)	486 (221)
24-in. (600 mm) GB/T 9119 PN16, SO/RF	23.46 (596)	23.51 (597)	23.63 (600)	33.07 (840)	26.50 (673)	15.61 (396)	28.54 (725)	3.13 (80)	669 (304)
24-in. (600 mm) GB/T 9119 PN40, SO/RF	23.46 (596)	23.51 (597)	23.63 (600)	35.04 (890)	26.50 (673)	15.61 (396)	28.94 (735)	3.13 (80)	1282 (581)
30-in. (750 mm) AS 2129 table D, SO/RF	29.34 (745)	29.39 (747)	29.26 (743)	39.17 (995)	33.00 (838)	16.38 (416)	34.96 (888)	3.13 (80)	929 (421)

Table 52: Raised face flanged sensor 20- to 36-in. (500 mm to 900 mm) dimensions *(continued)*

Size, description	Overall length			Dim B	Dim C	Dim D	Dim J	Dim K	Flow tube wgt (lbs./ kg)
	Dim A PTFE	Dim A Neoprene	Dim A Poly						
30-in. (750 mm) AS 2129 table E, SO/RF	29.34 (745)	29.39 (747)	29.26 (743)	39.17 (995)	33.00 (838)	16.38 (416)	33.75 (857)	3.13 (80)	1059 (480)
30-in. (750 mm) AS 4087 PN16, SO/RF	29.34 (745)	29.39 (747)	29.26 (743)	39.17 (995)	33.00 (838)	16.38 (416)	34.96 (888)	3.13 (80)	975 (442)
30-in. (750 mm) AS 4087 PN21, SO/RF	29.34 (745)	29.39 (747)	29.26 (743)	39.96 (1015)	33.00 (838)	16.38 (416)	33.35 (898)	3.13 (80)	948 (430)
30-in. (750 mm) AS 4087 PN35, SO/RF	29.34 (745)	29.39 (747)	29.26 (743)	39.96 (1015)	33.00 (838)	16.38 (416)	33.35 (898)	3.13 (80)	2096 (950)
30-in. (750 mm) JIS B2220 - 10K, SO/RF	29.34 (745)	29.39 (747)	29.26 (743)	38.19 (970)	33.00 (838)	16.38 (416)	33.66 (855)	3.13 (80)	862 (392)
36-in. (900 mm) AS 2129 table D, SO/RF	35.25 (895)	35.30 (897)	35.17 (893)	46.26 (1175)	39.00 (991)	21.86 (555)	41.34 (1050)	3.13 (80)	1396 (633)
36-in. (900 mm) AS 2129 table E, SO/RF	35.25 (895)	35.30 (897)	35.17 (893)	46.26 (1175)	39.00 (991)	21.86 (555)	41.34 (1050)	3.13 (80)	1648 (747)
36-in. (900 mm) AS 4087 PN16, SO/RF	35.25 (895)	35.30 (897)	35.17 (893)	46.26 (1175)	39.00 (991)	21.86 (555)	41.34 (1050)	3.13 (80)	1574 (714)
36-in. (900 mm) AS 4087 PN21,SO/RF	35.25 (895)	35.30 (897)	35.17 (893)	46.26 (1175)	39.00 (991)	21.86 (555)	41.73 (1060)	3.13 (80)	2197 (997)
36-in. (900 mm) AS 4087 PN35, SO/RF	35.25 (895)	35.30 (897)	35.17 (893)	46.65 (1185)	39.00 (991)	21.86 (555)	40.55 (1030)	3.13 (80)	3133 (1421)
36-in. (900 mm) GB/T9119 PN10, SO/RF	35.25 (895)	35.30 (897)	35.17 (893)	43.9 (1115)	39.00 (991)	21.86 (555)	39.57 (1005)	3.13 (80)	1209 (549)
36-in. (900 mm) GB/T9119 PN16, SO/RF	35.25 (895)	35.30 (897)	35.17 (893)	44.29 (1125)	39.00 (991)	21.86 (555)	39.37 (1000)	3.13 (80)	1429 (649)
36-in. (900 mm) EN 1092-1 - PN10, SO/RF	35.25 (895)	35.30 (897)	35.17 (893)	43.90 (1120)	39.00 (991)	21.86 (555)	39.57 (1005)	3.13 (80)	1364 (619)
36-in. (900 mm) EN 1092-1 - PN16, SO/RF	35.25 (895)	35.30 (897)	35.17 (893)	44.29 (1125)	39.00 (991)	21.86 (555)	39.37 (1000)	3.13 (80)	1719 (780)
36-in. (900 mm) JIS B2220 - 10K, SO/RF	35.25 (895)	35.30 (897)	35.17 (893)	44.09 (1120)	39.00 (991)	21.86 (555)	39.57 (1005)	3.13 (80)	1194 (543)

Table 53: Raised face flanged sensor 40-in. and 48-in. (1000 mm and 1200 mm) dimensions

Size, description	Overall length			Dim B	Dim C	Dim D	Dim J	Dim K	Flow tube wgt (lbs./ kg)
	Dim A PTFE	Dim A Neoprene	Dim A Poly						
40-in. (1000 mm) EN 1092-1 - PN10, SO/RF	N/A	39.40 (1001)	NA	48.43 (1230)	47.27 (1201)	25.86 (657)	43.70 (1110)	3.38 86)	1444 (655)
40-in. (1000 mm) EN 1092-1 - PN16, SO/RF	N/A	39.40 (1001)	NA	49.41 (1255)	47.27 (1201)	25.86 (657)	43.90 (1115)	3.38 86)	1559 (707)

Table 53: Raised face flanged sensor 40-in. and 48-in. (1000 mm and 1200 mm) dimensions *(continued)*

Size, description	Overall length			Dim B	Dim C	Dim D	Dim J	Dim K	Flow tube wgt (lbs./ kg)
	Dim A PTFE	Dim A Neoprene	Dim A Poly						
40-in. (1000 mm) AS 2129 table D, SO/RF	N/A	39.40 (1001)	NA	49.41 (1255)	47.27 (1201)	25.86 (657)	44.61 (1133)	3.38 86)	1494 (678)
40-in. (1000 mm) AS 2129 table E, SO/RF	N/A	39.40 (1001)	NA	49.41 (1255)	47.27 (1201)	25.86 (657)	44.49 (1130)	3.38 86)	1806 (819)
40-in. (1000 mm) AS 4087 PN16, SO/RF	N/A	39.40 (1001)	NA	49.41 (1255)	47.27 (1201)	25.86 (657)	44.61 (1133)	3.38 86)	2175 (987)
40-in. (1000 mm) AS 4087 PN21, SO/RF	N/A	39.40 (1001)	NA	50.20 (1275)	47.27 (1201)	25.86 (657)	45.24 (149)	3.38 86)	2464 (1118)
40-in. (1000 mm) GB/T9119 PN10, SO/RF	N/A	39.40 (1001)	NA	48.43 (1230)	47.27 (1201)	25.86 (657)	43.70 (1110)	3.38 86)	1576 (715)
40-in. (1000 mm) GB/T9119 PN16, SO/RF	N/A	39.40 (1001)	NA	49.41 (1255)	47.27 (1201)	25.86 (657)	43.90 (1115)	3.38 86)	1735 (787)
48-in. (1200 mm) EN 1092-1 - PN10, SO/RF	N/A	47.20 (1199)	NA	57.28 (1455)	55.27 (1404)	29.86 (758)	52.36 (1330)	3.38 86)	1949 (884)
48-in. (1200 mm) AS 2129 table D, SO/RF	N/A	47.20 (1199)	NA	58.66 (1490)	55.27 (1404)	29.86 (758)	53.86 (1368)	3.38 86)	2068 (938)
48-in. (1200 mm) AS 2129 table E,SO/RF	N/A	47.20 (1199)	NA	58.66 (1490)	55.27 (1404)	29.86 (758)	53.74 (1365)	3.38 86)	2680 (1216)
48-in. (1200) AS 4087 PN16, SO/RF	N/A	47.20 (1199)	NA	58.66 (1490)	55.27 (1404)	29.86 (758)	53.86 (1368)	3.38 86)	2703 (1226)
48-in. (1200 mm) AS 4087 PN21,SO/RF	N/A	47.20 (1199)	NA	60.24 (1530)	55.27 (1404)	29.86 (758)	54.53 (1385)	3.38 86)	3152 (1430)
48-in. (1200 mm) GB/T9119 PN10, SO/RF	N/A	47.20 (1199)	NA	57.28 (1455)	55.27 (1404)	29.86 (758)	52.36 (1330)	3.38 86)	2081 (944)
48-in. (1200 mm) GB/T9119 PN16, SO/RF	N/A	47.20 (1199)	NA	58.46 (1485)	55.27 (1404)	29.86 (758)	52.36 (1330)	3.38 86)	2832 (1284)

Figure 12: Flat face sensor 30- to 48-kin. (750 mm to 1200 mm)

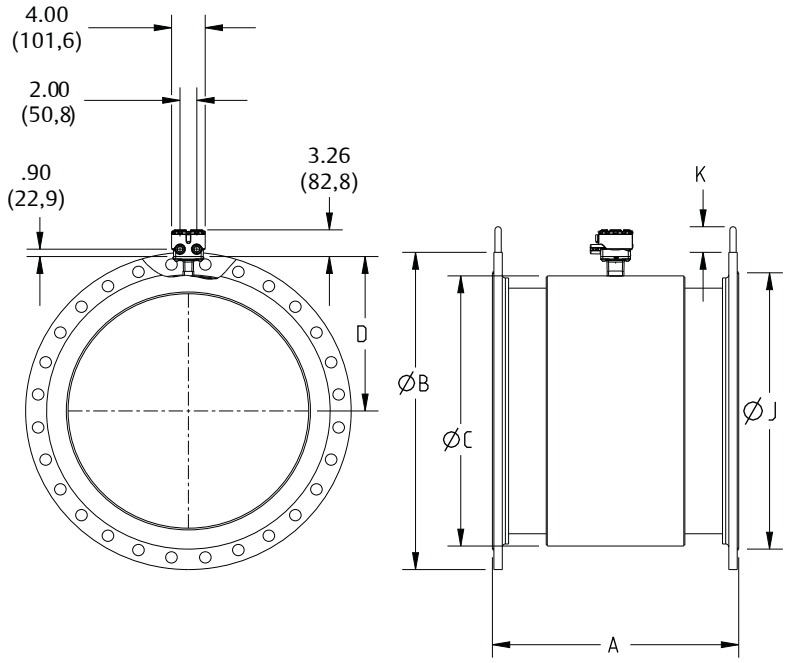


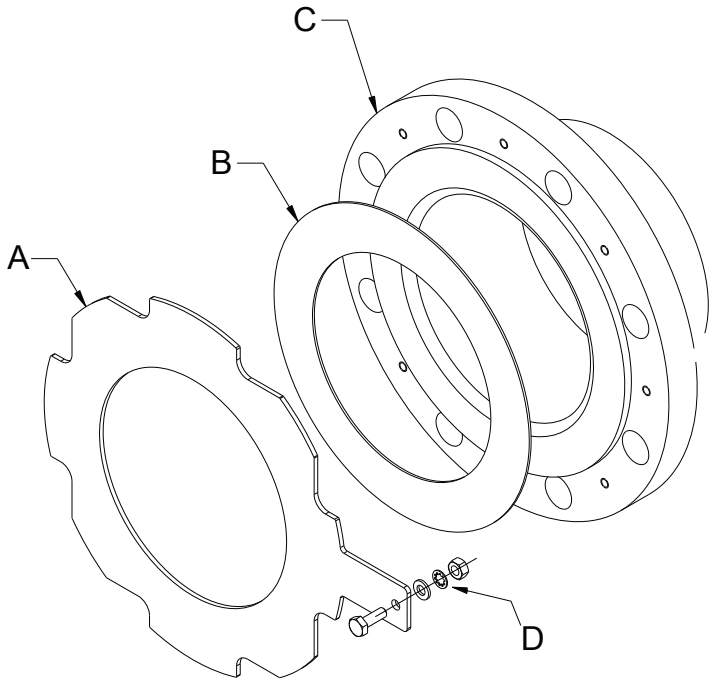
Table 54: Flat face sensor 30- to 48-in. (750 mm to 1200 mm) dimensions

Size, description	Length			Dim B	Dim C	Dim D	Liner Ø on face			Dim K	Flow tube wgt (lbs./kg)
	Dim A PTFE	Dim A Neoprene	Dim A Poly				Dim J PTFE	Dim J Neoprene	Dim J Poly		
30-in. (750 mm) AWWA CLASS D, SO/FF	29.34 (745)	29.39 (747)	29.26 (743)	38.75 (984)	33.00 (838)	16.38 (416)	33.75 (857)	38.75 (984)	33.75 (857)	3.13 (80)	789 (358)
30-in. (750 mm) AWWA CLASS E, SO/FF	29.34 (745)	29.39 (747)	29.26 (743)	38.75 (984)	33.00 (838)	16.38 (416)	33.75 (857)	38.75 (984)	33.75 (857)	3.13 (80)	1205 (548)
30-in. (750 mm) AWWA CLASS F, SO/FF	29.34 (745)	29.39 (747)	29.26 (743)	43.00 (1092)	33.00 (838)	16.38 (416)	33.75 (857)	43.0 (1092)	33.75 (857)	3.13 (80)	1795 (816)
36-in. (900) AWWA C207 CLASS D, SO/FF	35.25 (825)	35.3 (897)	35.17 (893)	46.00 (1168)	39.00 (991)	21.86 (555)	40.25 (1022)	40.25 (1022)	40.25 (1022)	3.13 (80)	1148 (521)
36-in. (900 mm) AWWA C207 CLASS E, SO/FF	35.25 (825)	35.30 (897)	35.17 (893)	46.00 (1168)	39.00 (991)	21.86 (555)	40.25 (1022)	46.00 (1168)	40.25 (1022)	3.13 (80)	1911 (867)
36-in. (900 mm) AWWA C207CLASS F, SO/FF	35.25 (825)	35.30 (897)	35.17 (893)	50.00 (1270)	39.00 (991)	21.86 (555)	40.25 (1022)	50.00 (1270)	40.25 (1022)	3.13 (80)	2651 (1202)
40-in. (1000 mm) AWWA CLASS D, SO/FF	N/A	39.40 (1001)	N/A	50.75 (1289)	47.27 (1201)	25.86 (657)	N/A	50.75 (1289)	N/A	3.38 (86)	1435 (651)
40-in. (1000 mm) AWWA CLASS E, SO/FF	N/A	39.40 (1001)	N/A	50.75 (1289)	47.27 (1201)	25.86 (657)	N/A	50.75 (1289)	N/A	3.38 (86)	2464 (1118)
42-in. (1050 mm) AWWA CLASS D, SO/FF	N/A	42.00 (1067)	N/A	53.00 (1346)	49.27 (1251)	26.86 (682)	N/A	53.00 (1346)	N/A	3.38 (86)	1550 (703)
42-in. (1050 mm) AWWA CLASS E, SO/FF	N/A	42.00 (1067)	N/A	53.00 (1346)	49.27 (1251)	26.86 (682)	N/A	53.00 (1346)	N/A	3.38 (86)	2400 (1089)

Table 54: Flat face sensor 30- to 48-in. (750 mm to 1200 mm) dimensions *(continued)*

Size, description	Length			Dim B	Dim C	Dim D	Liner Ø on face			Dim K	Flow tube wgt (lbs./kg)
	Dim A PTFE	Dim A Neoprene	Dim A Poly				Dim J PTFE	Dim J Neoprene	Dim J Poly		
48-in. (1200 mm) AWWA CLASS D, SO/FF	N/A	47.2 (1199)	N/A	59.50 (1511)	55.27 (1404)	29.86 (758)	N/A	59.50 (1511)	N/A	3.38 (86)	1892 (848)

Figure 13: Flanged sensor ½- to 48-in. (15 mm to 1200 mm) grounding ring



A. Grounding ring
B. Customer supplied gasket
C. Flow tube
D. Grounding strap hardware

Table 55: Flanged sensor ½- to 48-in. (15 mm to 1200 mm) grounding ring dimensions

	Single grounding ring thickness		Double grounding ring thickness	
	Min	Max	Min	Max
0.5-in. (15 mm)	0.059 (1,5)	N/A	0.12 (3)	N/A
1-in. (25 mm)	0.059 (1,5)	N/A	0.12 (3)	N/A
1.5-in. (40 mm)	0.059 (1,5)	N/A	0.12 (3)	N/A
2-in. (50 mm)	0.059 (1,5)	N/A	0.12 (3)	N/A
2.5-in. (65 mm)	0.059 (1,5)	N/A	0.12 (3)	N/A
3-in. (80 mm)	0.059 (1,5)	N/A	0.12 (3)	N/A
4-in. (100 mm)	0.059 (1,5)	N/A	0.12 (3)	N/A
5-in. (125 mm)	0.059 (1,5)	0.12 (3)	0.12 (3)	0.24 (6,1)

Table 55: Flanged sensor ½- to 48-in. (15 mm to 1200 mm) grounding ring dimensions *(continued)*

	Single grounding ring thickness		Double grounding ring thickness	
	Min	**Max**	**Min**	**Max**
6-in. (150 mm)	0.059 (1,5)	N/A	0.12 (3)	N/A
8-in. (200 mm)	0.059 (1,5)	N/A	0.12 (3)	N/A
10-in. (250mm)	0.059 (1,5)	N/A	0.12 (3)	N/A
12-in. (300mm)	0.059 (1,5)	0.12 (3)	0.12 (3)	0.24 (6,1)
14-in. (350mm)	0.12 (3)	0.25 (6,4)	0.24 (6,1)	0.5 (12,7)
16-in. (400mm)	0.12 (3)	0.25 (6,4)	0.24 (6,1)	0.5 (12,7)
18-in. (450mm)	0.12 (3)	0.25 (6,4)	0.24 (6,1)	0.5 (12,7)
20-in. (500mm)	0.12 (3)	0.25 (6,4)	0.24 (6,1)	0.5 (12,7)
24-in. (600mm)	0.187 (4,7)	0.25 (6,4)	0.374 (9.5)	0.5 (12,7)
30-in. (750mm)	0.187 (4,7)	0.25 (6,4)	0.374 (9.5)	0.5 (12,7)
36-in. (900mm)	0.187 (4,7)	0.25 (6,4)	0.374 (9.5)	0.5 (12,7)
40-in. (1000 mm)	0.25 (6,4)	N/A	0.5 (12,7)	N/A
42-in. (1050 mm)	0.25 (6,4)	N/A	0.5 (12,7)	N/A
48-in. (1200 mm)	0.25 (6,4)	N/A	0.5 (12,7)	N/A

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Exhibit 3
Goulds 95L
Submersible Well Pump

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Let's Solve Water

TECHNICAL BROCHURE
B50-320L R8

50L, 65L, 95L, 120L, 160L, 250L, 320L

6" Stainless Steel Submersible Pumps

60 HZ HIGH CAPACITY – FOR 6" AND LARGER WELLS

GOULDS
WATER TECHNOLOGY
a xylem brand

FEATURES

Powered for Continuous Operation: All ratings are within the working limits of the motor. Pump can be operated continuously.

New Design Features: Cast 304 SS discharge head and motor adapter.

Field Serviceable: Easy to install and service. All parts easily dismantled if field service is ever necessary.

Diverse Application: Designed for commercial, municipal and agricultural water needs.

Stainless Steel Construction: Durable in most waters.

Bearings: Replaceable, silicon carbide bearings allow excellent abrasives handling and wear resistance.

Built-in Check Valve: Positive sealing, stainless steel check valve assembly incorporated into discharge head.

Impellers: New stainless steel impeller design provides improved efficiency.

Maximum Temperature: 140°F (60°C) for pump.

Four-Fluted Shaft Design: Four sided stainless steel shaft eliminates impeller keys and provides positive drive.

Coupling: Removable heavy duty stainless steel, splined coupling for maximum load-carrying capability.

Suction Strainer: Stainless steel strainer restricts gravel and other debris from entering the pump.

Cable Guard: Stainless steel cable guard surrounds and protects motor leads.

Fasteners: All fasteners are stainless steel.

CentriPro Motors: Designed to NEMA standards. Stainless steel casing resists corrosion. Water filled design provides a constant supply of lubrication. Hermetically sealed stator assures moisture free windings. Durable Kingsbury type thrust bearing absorbs all thrust. Replaceable motor lead assembly.

Certified to NSF/ANSI 61, Annex G.

SPECIFICATIONS

Model	Horsepower Range	Discharge Connection	Recommended GPM Operating Range	GPM at Best Efficiency	Minimum* Well Size	Rotation at Discharge End
50L	3 - 20	3" NPT	17 - 70	50	6" / 8" *	CCW
65L	3 - 40		20 - 90	65		
95L	5 - 40		25 - 130	90		
120L	5 - 50		40 - 170	120		
160L	3 - 60		50 - 240	160	6"	
250L	7.5 - 60		70 - 300	250		
320L	7.5 - 60	4" NPT	100 - 400	320		

* Minimum well size refers only to dimensional fit in a well, the specifier or installer must determine the minimum required well diameter that will insure an adequate supply of water to the pump and also properly cool the motor. See Water End Data Chart for specific diameter by model number.

AGENCY LISTINGS

NSF/ANSI 372 – Drinking Water System Components – Lead Content

CLASS 6853 01 - Low Lead Content Certification Program - - Plumbing Products

NSF/ANSI 61-G

Pump/Water End - Drinking Water System Components - Certified to NSF/ANSI 61, Annex G

"L" SERIES MATERIALS OF CONSTRUCTION

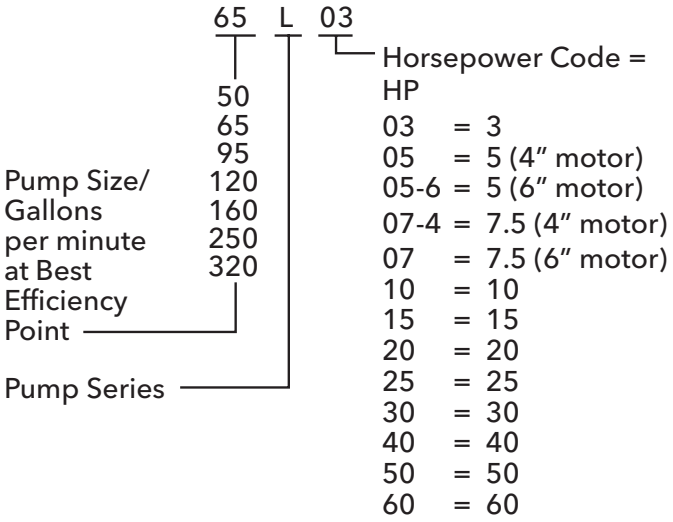
Ref. No.	Part Name	Material	Material Code
1	Discharge Head	Stainless steel	ASTM CF-8 (AISI 304 cast)
2	Check Valve Support	Stainless steel	ASTM CF-8 (AISI 304 cast)
3	Check Valve	Stainless steel	AISI 304 SS
4	Elastomers	Ethylene propylene	EPDM
5	Bolts and Screws	Stainless steel	AISI 304 SS
6	Shaft Sleeve and Bushing	Tungsten carbide	–
7	Thrust Bearing	PTFE+Graphite	–
8	Impeller	Stainless steel	AISI 304 SS
9	Diffuser	Stainless steel	AISI 304 SS
10	Spacer	Stainless steel	AISI 431 SS
11	Tie Rod	Stainless steel	AISI 304 SS
12	Cable Guard	Stainless steel	AISI 304 SS
13	Wear Rings	Technopolymer PPO	Engineered polymer
14	Strainer	Stainless steel	AISI 304 SS
15	Shaft	Stainless steel	AISI 431 SS
16	Shaft Coupling	Stainless steel	AISI 431 SS
17	Motor Adapter	Stainless steel	ASTM CF-8 (AISI 304 cast)

SYSTEM COMPONENTS

- **Pump/Water End:**
  - 50L-250L with 3" NPT discharge.
  - 320L with 4" NPT discharge.
  - 3 HP Water Ends Have 4" Motor Adapters
  - 5 & 7.5 HP Water Ends Have Either a 4" or 6" Motor Adapter (see Water End Data chart)
  - 10 HP and Larger Water Ends Have 6" Motor Adapters
- **Motor:**
  - 4" motor required for 3 HP and 5 HP pumps.
  - 4" or 6" motors can be used for 7.5 HP pumps.
  - 6" motor required for 10 HP and larger pumps.
- **Control Box:** Required for all single phase motors.
- **Magnetic Starter:** A magnetic starter with Class 10 overloads is required for all three phase units.

WATER ENDS AND MOTORS MUST BE ORDERED SEPARATELY AND ARE PACKAGED SEPARATELY.

ORDER NUMBER CODE



WATER END (PUMP) DATA

Model	Order No.	No. Stages	Min. HP Required	Required Motor Dia.	Dimensions & Weights					
					Length		Diameter		Weight	
					in.	mm	in.	mm	lbs.	kg.
50L	50L03	4	3	4	20.6	522	5.59	142	25	11
	50L05R**	7	5	4/6	25.8	656	5.67	144	35	16
	50L05**	8	5		27.8	706			40	18
	50L07**	11	7.5		33.3	844			49	22
	50L10	15	10	6	40.2	1020			57	26
	50L15	23	15		56.9	1446			82	37
	50L20	28	20		65.8	1670			94	43
65L	65L03	3	3	4	18.6	472	5.59	142	26	12
	65L05**	5	5	4/6	22.2	564	5.67	144	31	14
	65L07**	7	7.5		25.8	656			35	16
	65L10	10	10	6	31.3	794			44	20
	65L15	16	15		42.1	1070			60	27
	65L20	21	20		53.0	1346			75	34
	65L25	27	25		63.9	1622			90	41
	65L30*	32	30		98.7	2508	6.97*	177	220	100
	65L40*	41	40		115.0	2922			253	115
95L	95L05**	3	5	4/6	18.6	472	5.59	142	26	12
	95L07**	5	7.5		22.2	564	5.67	144	31	14
	95L10	7	10	6	25.8	656			35	16
	95L15	10	15		31.3	794			44	20
	95L20	14	20		38.5	978			53	24
	95L25	17	25		43.9	1116			62	28
	95L30	21	30		53.0	1346			75	34
	95L40*	28	40		67.3	1710	6.97*	177	156	71
120L	120L05**	2	5	4/6	16.8	426	5.59	142	22	10
	120L07**	3	7.5		19.5	495	5.67	144	26	12
	120L10	5	10	6	24.9	633			33	15
	120L15	7	15		30.4	771			40	18
	120L20	10	20		38.5	978			51	23
	120L25	12	25		43.9	1116			57	26
	120L30	15	30		52.1	1323			68	31
	120L40	20	40		65.7	1668			86	39
	120L50*	24	50		80.9	2055	6.97*	177	179	81
160L	160L03	1	3	4	14.5	367	5.59	142	18	8
	160L05**	2	5	4/6	17.2	436	5.67	144	22	10
	160L07**	3	7.5		19.9	505			26	12
	160L10	4	10	6	22.6	574			31	14
	160L15	6	15		28.0	712			37	17
	160L20	8	20		33.5	850			44	20
	160L25	9	25		36.2	919			46	21
	160L30	11	30		41.6	1057			53	24
	160L40	15	40		52.5	1333			68	31
	160L50	18	50		60.6	1540			77	35
	160L60	20	60		65.7	1668			86	39
250L	250L07**	2	7.5	4/6	20.8	528	5.67	144	26	12
	250L10	3	10	6	25.3	643			33	15
	250L15	5	15		34.4	873			44	20
	250L20	7	20		43.4	1103			55	25
	250L25	8	25		48.0	1218			60	27
	250L30	9	30		52.5	1333			66	30
	250L40	13	40		70.6	1793			88	40
	250L50	16	50		84.2	2138			104	47
	250L60	19	60		97.8	2484			128	58
320L	320L07**	2	7.5	4/6	21.8	553	5.67	144	27	12
	320L15	4	15	6	30.8	783			38	17
	320L20	5	20		35.4	898			45	20
	320L25	6	25		39.9	1013			50	22
	320L30	8	30		49.0	1243			61	27
	320L40	11	40		62.5	1588			78	35
	320L50	13	50		71.6	1818			89	40
	320L60	16	60		84.2	2138			104	47

* Note pump diameter – high pressure models have an exterior casing and larger diameters, verify they will fit your well.

** Pumps can be configured to accomodate a 4" or 6" motor. See product order code.

MOTOR DATA

NOTE: 4" diameter motors are required for 3 and 5 HP "L" Series pumps.
4" or 6" diameter motors can be used for 7.5 HP "L" Series pumps. See Water End Data Chart.
6" diameter motors are required for 10 HP and larger "L" Series pumps.

CENTRIPRO 4" MOTORS

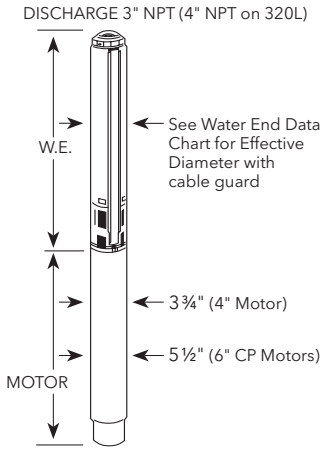
Single Phase Motors – Dimensions and Weights					
Motor Order No.	**HP**	**Motor Dia.**	**Volts**	**Length in. (mm)**	**Weight lbs. (Kg)**
M30412	3	4"	230	18.3 (466)	40 (18.1)
M50412	5			27.7 (703)	70 (31.8)
Three Phase Motors – Dimensions and Weights					
M30430	3	4"	200	15.3 (389)	32 (14.5)
M30432			230		
M30434			460		
M50430	5	4"	200	21.7 (550)	55 (24.9)
M50432			230		
M50434			460		
M75430	7.5	4"	200	27.7 (703)	70 (31.8)
M75432			230		
M75434			460		

CENTRIPRO 6" MOTORS

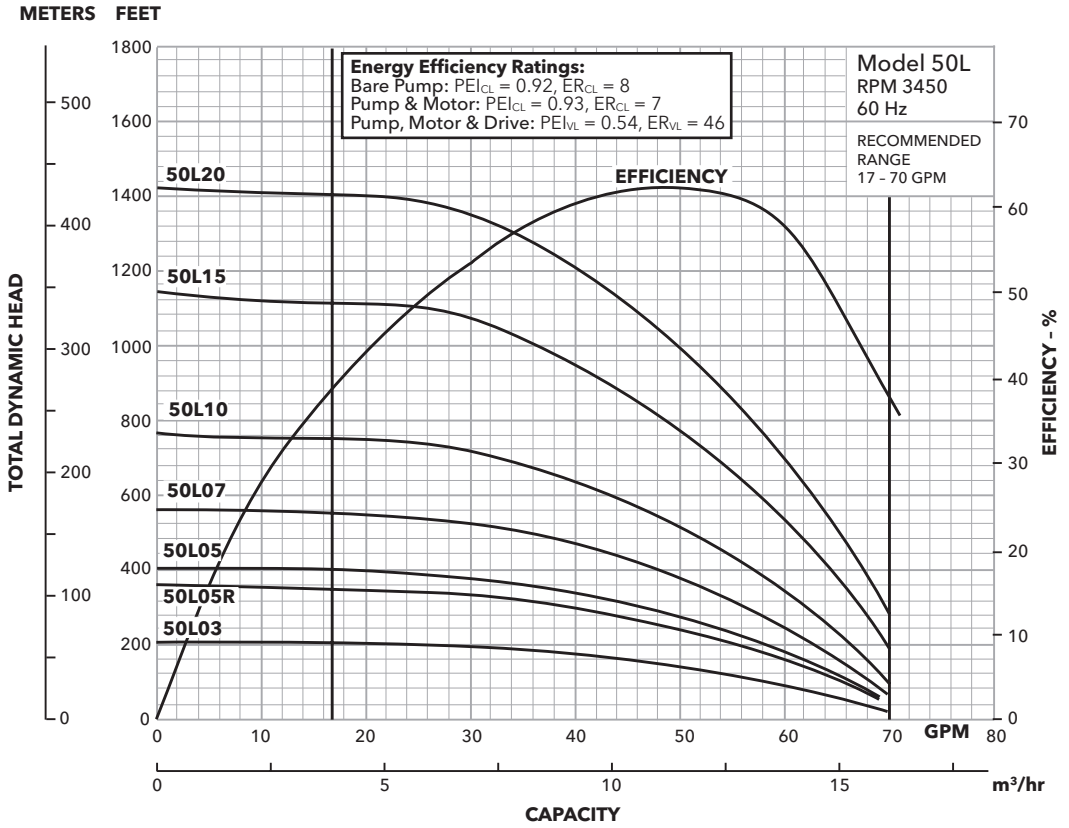
Single Phase Motors – Dimensions and Weights					
Motor Order No.	**HP**	**Motor Dia.**	**Volts**	**Length (inches)**	**Weight (lbs)**
6M071	7.5	6"	230	29.9	128
6M101	10	6"	230		
6M151	15	6"	230	33.5	148
Three Phase Motors – Dimensions and Weights					
6M078	7.5	6"	200	24.8	99
6M072			230		
6M074			460		
6M108	10		200	27.0	110
6M102			230		
6M104			460		
6M158	15		200	29.9	128
6M152			230		
6M154			460		
6M208	20		200	31.5	137
6M202			230		
6M204			460		
6M258	25		200	36.2	161
6M252			230		
6M254			460		
6M308	30		200	38.2	176
6M302			230		
6M304			460		
6M404	40			40.6	187
66M504	50			41.7	198
86M504	50	6" x 8"		46.4	353

CENTRIPRO FM-SERIES 6" MOTORS

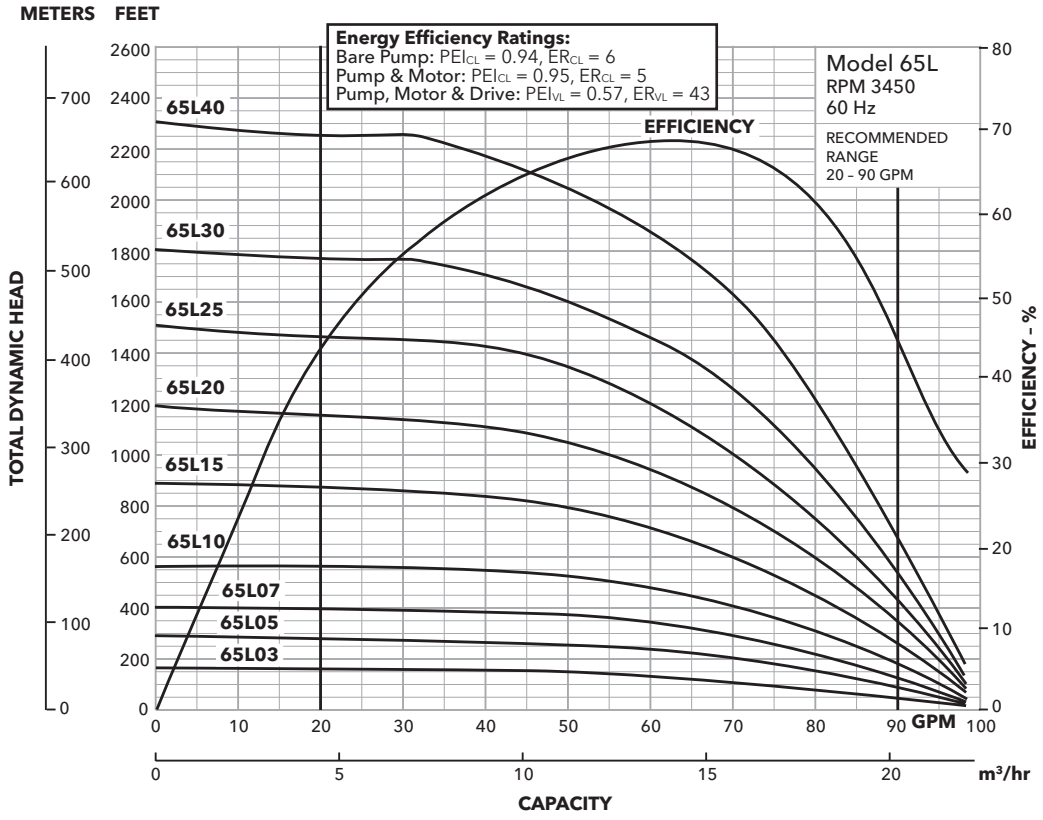
Single Phase Motors Dimensions and Weights					
Motor Order No.	**HP**	**Motor Dia.**	**Volts**	**Length (inches)**	**Weight (lbs)**
6F051	5	6"	230	25.6	143
6F071	7.5			28.1	161
6F101	10			30.3	161
6F151	15			32.8	181
Three Phase Motors Dimensions and Weights					
Motor Order No.	**HP**	**Motor Dia.**	**Volts**	**Length (inches)**	**Weight (lbs)**
6F058	5	6"	200-208	23.0	107.0
6F052			230		
6F054			460		
6F078	7.5		200-208	24.3	117.0
6F072			230		
6F074			460		
6F108	10		200-208	25.6	124.0
6F102			230		
6F104			460		
6F158	15		200-208	28.1	127.0
6F152			230		
6F154			460		
6F208	20		200-208	30.3	152.0
6F202			230		
6F204			460		
6F258	25		200-208	32.8	164.0
6F252			230		
6F254			460		
6F308	30		200-208	35.6	185.0
6F302			230		
6F304			460		
6F404	40		460	39.3	207.0
6F504	50		460	54.1	285.0



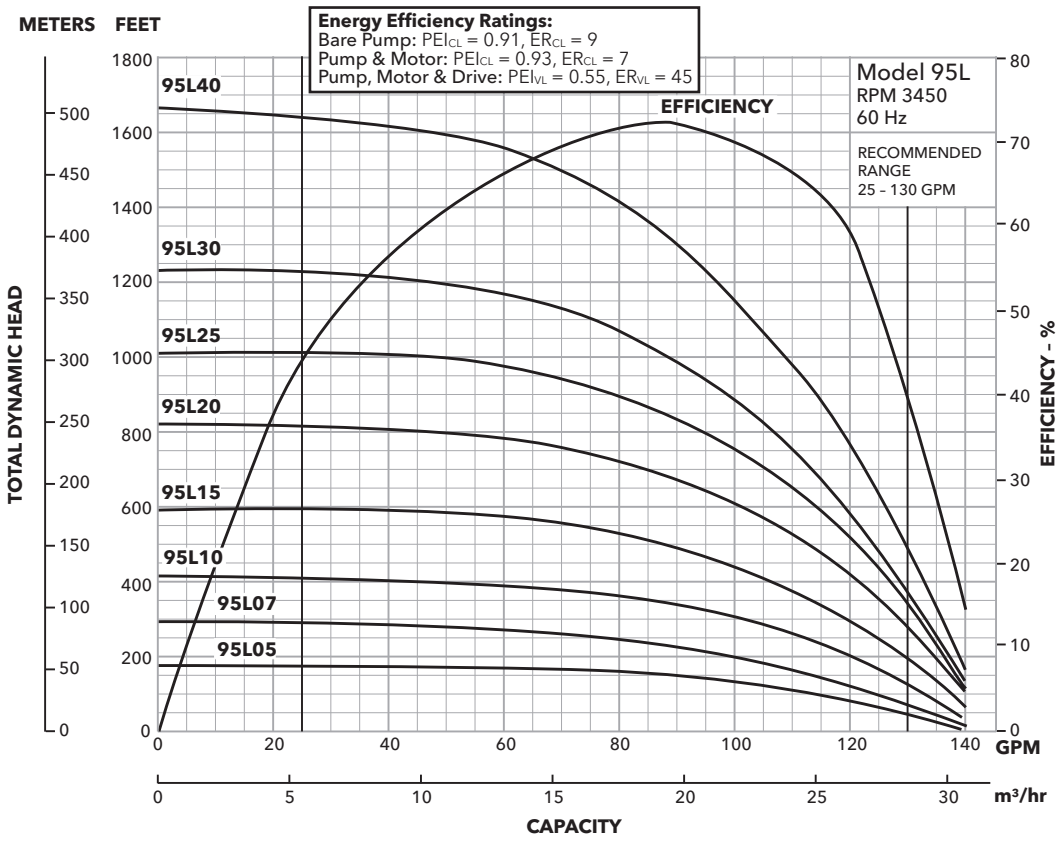
MODEL 50L



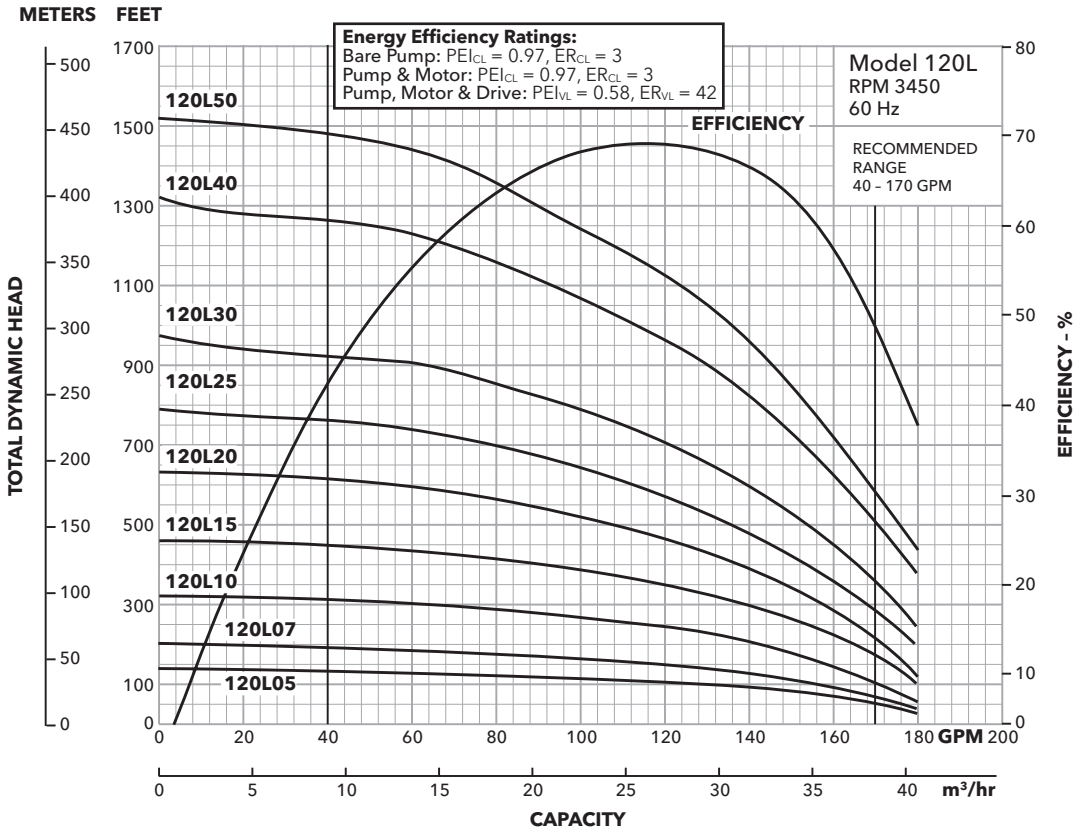
MODEL 65L



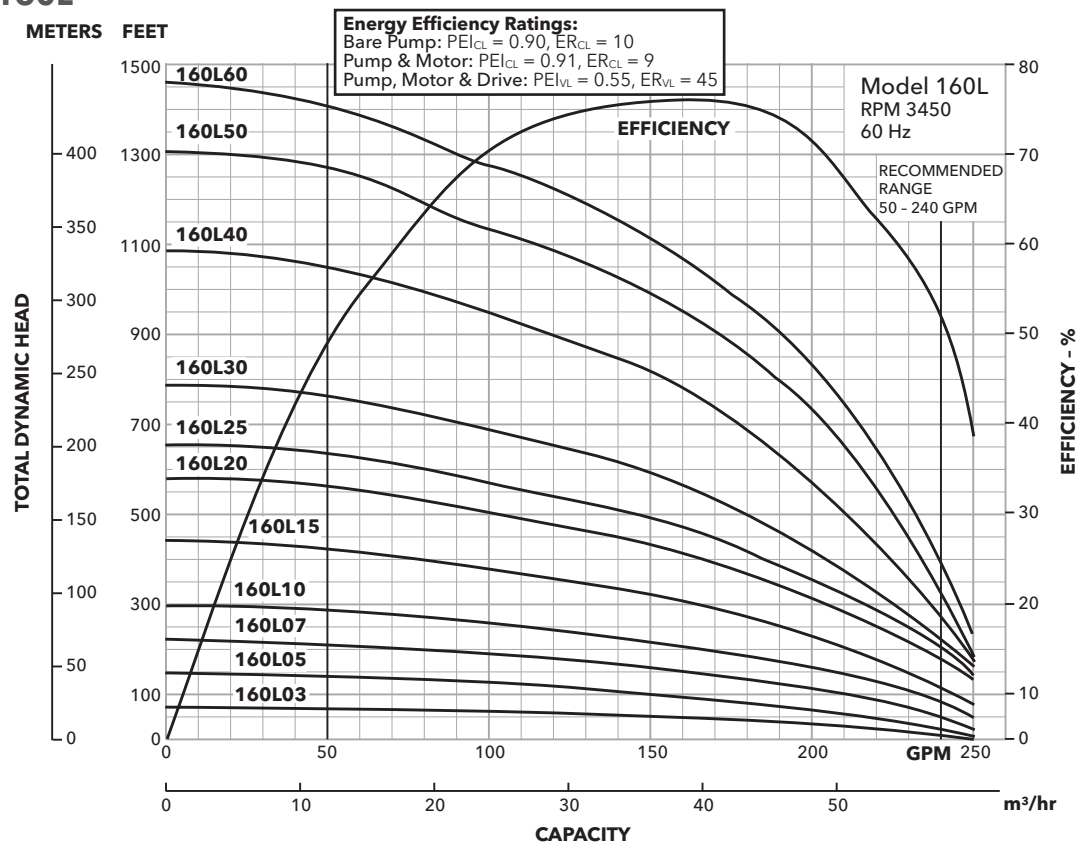
MODEL 95L



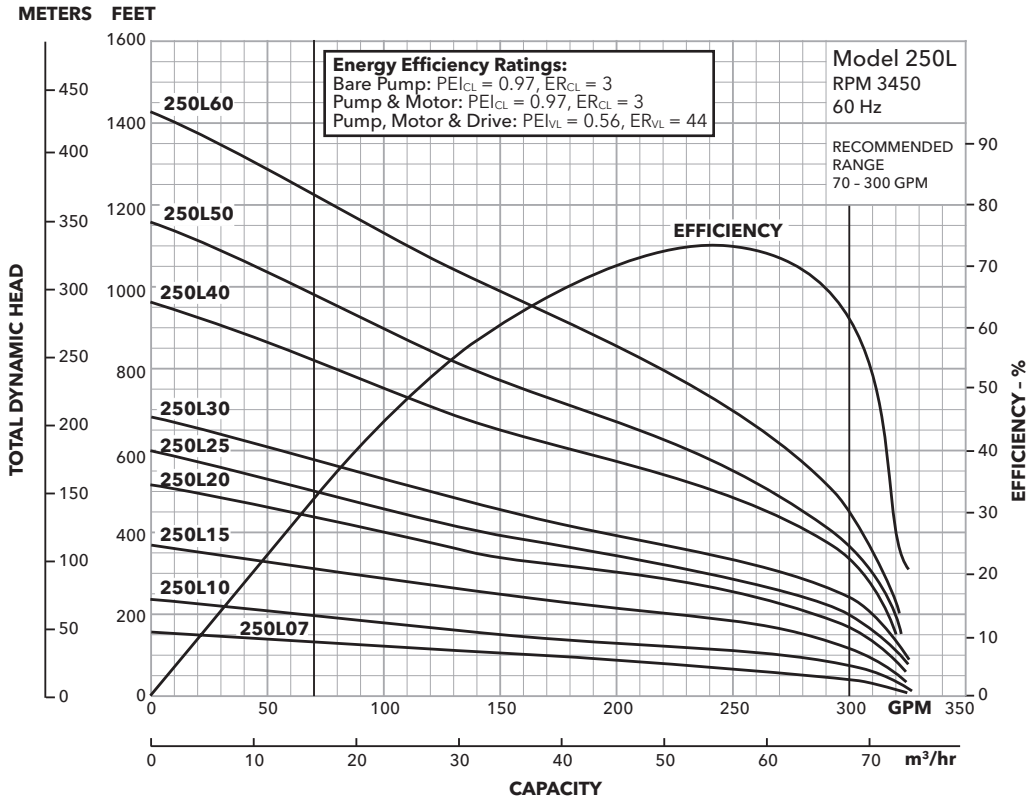
MODEL 120L



MODEL 160L

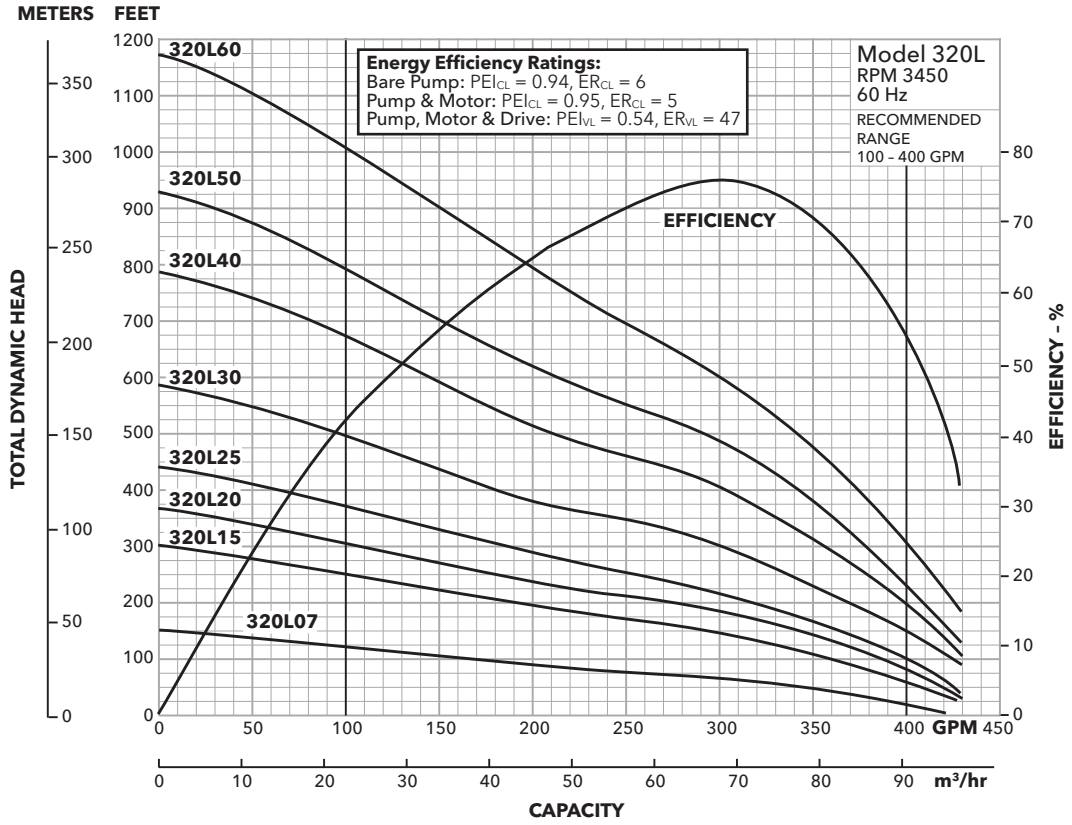


MODEL 250L



NOTE: On 250L, operation below minimum recommended flow will increase motor amp. draw and trip overloads.

MODEL 320L



NOTE: On 320L, operation below minimum recommended flow will increase motor amp. draw and trip overloads.

MODEL 50L

SELECTION CHART

Horsepower Range 3 – 20, Recommended Range 17 – 70 GPM, 60 Hz, 3450 RPM

Pump Model	Depth to Water in Feet/Ratings in GPM (Gallons per Minute)																																
	HP	PSI	25	50	75	100	125	150	175	200	225	250	275	300	325	350	375	400	425	450	475	500	525	550	575	600	625	650	675	700	725	750
50L03 4 Stages	3	0		74	68	62	58	50	42	21																						
		20	69	63	59	52	43	27																								
		30	63	59	52	44	29																									
		40	59	53	45	31																										
		50	53	45	33																											
		60	46	35																												
50L05R 7 Stages	5	0				56	72	67	62	59	58	54	48	44	40	27																
		20		49	72	68	62	60	58	55	49	44	41	31																		
		30	45	71	69	63	60	58	55	50	45	41	32																			
		40	71	69	63	60	58	55	50	45	41	33																				
		50	70	63	60	58	56	51	45	42	34																					
		60	64	60	59	56	51	46	42	35																						
50L05 8 Stages	5	0			65	74	72	68	64	62	60	58	54	50	46	42	36	21														
		20	62	73	72	68	65	62	61	58	55	51	47	43	37	24																
		30	73	73	69	65	63	61	58	55	51	47	43	37	26																	
		40	73	69	65	63	61	59	56	52	47	43	38	27																		
		50	69	65	63	61	59	56	52	48	44	39	28																			
		60	66	63	61	59	56	52	48	44	39	29																				
50L07 11 Stages	7.5	0				63	72	74	72	68	66	64	62	61	59	57	55	52	49	46	43	39	33	21								
		20		60	72	74	72	69	66	64	62	61	60	58	55	52	49	46	43	40	34	23										
		30	59	71	74	72	69	66	64	63	61	60	58	55	52	49	46	43	40	35	25											
		40	71	74	72	69	66	64	63	61	60	58	56	53	50	47	44	40	35	26												
		50	74	73	70	67	64	63	61	60	58	56	53	50	47	44	41	36	27													
		60	73	70	67	65	63	61	60	58	56	53	50	47	44	41	36	27														
50L10 15 Stages	10	0					57	68	73	74	73	71	68	66	65	63	62	61	60	59	57	56	54	51	49	47	45	43	40	36	30	21
		20			54	67	72	74	73	71	69	67	65	63	62	61	60	59	58	56	54	52	49	47	45	43	40	37	32	23		
		30		53	66	72	74	73	71	69	67	65	64	62	61	60	59	58	56	54	52	50	47	45	43	41	37	32	24			
		40	52	65	72	74	73	71	69	67	65	64	63	62	61	59	58	56	54	52	50	48	45	43	41	38	33	24				
		50	65	72	74	73	71	69	67	65	64	63	62	61	59	58	56	54	52	50	48	46	43	41	38	33	25					
		60	71	74	73	72	69	67	65	64	63	62	61	60	58	56	55	52	50	48	46	44	41	38	33	26						

Pump Model	Depth to Water in Feet/Ratings in GPM (Gallons per Minute)																																
	HP	PSI	50	100	150	200	250	300	350	400	450	500	550	600	650	700	750	800	850	900	950	1000	1050	1100	1150	1200	1250	1300	1350	1400	1450	1500
50L15 23 Stages	15	0				63	72	74	72	68	66	64	62	61	59	57	55	52	49	46	43	39	33	21								
		20			62	72	74	72	69	66	64	62	61	59	57	55	52	49	46	43	39	34	22									
		30		50	68	74	73	70	67	65	63	62	60	59	56	54	51	48	45	41	37	29										
		40	33	60	72	74	72	69	66	64	62	61	60	58	55	52	49	46	43	40	34	23										
		50	48	67	73	73	71	68	65	63	62	60	59	57	54	51	48	45	42	38	30											
		60	59	71	74	72	69	66	64	63	61	60	58	55	52	49	46	43	40	35	25											
50L20 27 Stages	20	0					57	68	73	74	73	71	68	66	65	63	62	61	60	59	57	56	54	51	49	47	45	43	40	36	30	21
		20				56	67	73	74	73	71	68	66	65	63	62	61	60	59	58	56	54	52	49	47	45	43	40	37	31	22	
		30			46	62	71	74	74	72	70	67	66	64	63	62	61	60	58	57	55	53	50	48	46	44	42	39	34	27		
		40			54	67	72	74	73	71	69	67	65	63	62	61	60	59	58	56	54	52	49	47	45	43	40	37	32	23		
		50		44	61	70	73	74	72	70	68	66	64	63	62	61	60	59	57	55	53	51	48	46	44	42	39	35	28			
		60	30	53	66	72	74	73	71	69	67	65	64	62	61	60	59	58	56	54	52	50	47	45	43	41	37	32	24			

MODEL 65L

SELECTION CHART

Horsepower Range 3 – 40, Recommended Range 20 – 90 GPM, 60 Hz, 3450 RPM

Pump Model	HP	PSI	Depth to Water in Feet/Ratings in GPM (Gallons per Minute)																																		
			25	50	75	100	125	150	175	200	225	250	275	300	325	350	375	400	425	450	475	500	525	550	575	600	625	650	675	700	725	750	775	800	825	850	875	900
65L03 3 Stages	3	0		89	83	73	64	49																														
		20	84	75	65	53																																
		30	75	66	59																																	
		40	66	56																																		
		50	58																																			
		60																																				
65L05 5 Stages	5	0				89	85	81	75	68	60	47																										
		20		89	85	81	76	69	61	50	21																											
		30	90	86	82	76	69	62	51	25																												
		40	86	82	77	70	63	52	28																													
		50	82	77	71	63	53	31																														
		60	78	71	64	54	34																															
65L07 7 Stages	7.5	0				88	87	86	83	79	74	69	66	63	57	38																						
		20		91	89	88	86	84	80	75	70	66	64	59	43																							
		30		89	88	86	84	80	75	70	67	64	59	45																								
		40	89	88	87	84	81	76	71	67	64	60	46																									
		50	88	87	85	81	76	71	67	64	60	48																										
		60	87	85	81	77	71	67	65	61	50																											
65L10 10 Stages	10	0					91	89	88	88	88	87	85	82	79	75	71	68	66	65	62	57	44															
		20			91	89	88	88	88	87	85	83	79	76	72	69	67	65	63	58	47	23																
		30			89	88	88	88	87	86	83	80	76	72	69	67	65	63	58	48	25																	
		40		89	88	88	88	87	86	83	80	76	72	69	67	65	63	59	49	28																		
		50	89	88	88	88	87	86	84	80	77	73	69	67	65	63	59	50	30																			
		60	88	88	88	87	86	84	81	77	73	70	67	65	63	60	51	32																				
65L15 16 Stages	15	0							91	90	89	88	88	87	87	86	85	84	83	81	79	77	75	72	70	68	67	65	64	63	62	60	57	52	44	31		
		20						90	89	88	88	87	87	86	85	84	83	81	79	77	75	73	71	69	67	66	64	63	62	60	57	53	45	33				
		30					90	89	88	88	87	87	86	86	84	83	81	80	77	75	73	71	69	67	66	64	63	62	60	58	53	46	34					
		40				90	89	88	88	87	87	86	86	85	83	82	80	78	75	73	71	69	67	66	65	63	62	61	58	54	47	35						
		50			90	89	88	88	87	87	86	86	85	83	82	80	78	75	73	71	69	67	66	65	64	62	61	58	54	47	36	20						
		60		90	89	88	88	88	87	87	86	85	83	82	80	78	77	73	71	69	67	66	65	64	62	61	58	54	48	37	22							

Pump Model	HP	PSI	Depth to Water in Feet/Ratings in GPM (Gallons per Minute)																										
			150	200	250	300	350	400	450	500	550	600	650	700	750	800	850	900	950	1000	1050	1100	1150	1200	1250	1300	1350	1400	1450	1500
65L20 21 Stages	20	0						88	87	85	83	81	78	75	72	69	66	63	60	56	50	39								
		20					88	87	85	84	81	79	76	72	69	66	63	61	57	51	40	20								
		30					87	86	85	83	80	77	74	71	68	65	62	59	54	46	32									
		40				88	87	85	84	82	79	76	73	69	66	64	61	57	51	41	22									
		50				87	86	85	83	80	77	74	71	68	65	62	59	55	47	33										
		60			88	87	86	84	82	79	76	73	70	67	64	61	57	52	42	24										
65L25 27 Stages	25	0				91	89	88	88	87	86	86	84	83	81	79	77	74	72	69	67	66	64	62	60	57	51	41	26	
		20			91	89	88	88	87	86	86	85	83	81	79	77	74	72	70	68	66	64	62	60	57	51	42	27		
		30			90	89	88	87	87	86	85	84	82	80	78	76	73	71	69	67	65	63	62	59	55	47	36			
		40		91	89	88	88	87	87	86	85	83	81	79	77	75	72	70	68	66	64	63	60	57	52	43	29			
		50		90	89	88	87	87	86	85	84	82	81	78	76	73	71	69	67	65	64	62	59	55	48	37				
		60	91	90	89	88	87	87	86	85	83	82	80	77	75	72	70	68	66	64	63	61	57	52	44	30				

Pump Model	HP	PSI	Depth to Water in Feet/Ratings in GPM (Gallons per Minute)																								
			500	550	600	650	700	750	800	850	900	950	1000	1050	1100	1150	1200	1250	1300	1350	1400	1450	1500	1550	1600	1650	1700
65L30 32 Stages	30	0					89	87	85	83	80	78	76	74	73	71	70	69	68	67	66	65	62	59	54	47	37
		20				90	88	85	83	81	78	76	74	73	71	70	69	68	67	66	65	62	59	54	47	38	
		30				89	87	84	82	80	77	75	74	72	71	70	69	68	67	66	64	61	57	51	43	33	
		40			90	88	85	83	81	78	76	74	73	71	70	69	68	67	66	65	63	59	55	48	39		
		50			89	87	84	82	80	77	75	74	72	71	70	69	68	67	66	64	61	57	52	44	34		
		60		90	88	86	83	81	79	77	75	73	71	70	69	68	68	66	65	63	60	55	49	40			

Pump Model	HP	PSI	Depth to Water in Feet/Ratings in GPM (Gallons per Minute)																											
			700	750	800	850	900	950	1000	1050	1100	1150	1200	1250	1300	1350	1400	1450	1500	1550	1600	1650	1700	1750	1800	1850	1900	1950	2000	2050	2100
65L40 41 Stages	40	0					89	87	85	83	81	79	78	76	74	72	71	69	68	66	65	64	62	60	58	56	53	49	45	39	32
		20				89	87	85	83	81	80	78	76	74	72	71	69	68	66	65	64	62	61	59	56	53	50	45	39	32	
		30			90	88	86	84	82	81	79	77	75	73	72	70	69	67	66	65	63	62	60	58	55	52	48	43	36	28	
		40			89	87	85	84	82	80	78	76	74	72	71	69	68	67	65	64	62	61	59	56	54	50	45	40	33		
		50		90	88	86	85	83	81	79	77	75	73	72	70	69	67	66	65	63	62	60	58	55	52	48	43	37	29		
		60		89	87	86	84	82	80	78	76	74	73	71	70	68	67	65	64	63	61	59	57	54	50	46	40	33			

MODEL 95L

SELECTION CHART

Horsepower Range 5 – 40, Recommended Range 25 – 130 GPM, 60 Hz, 3450 RPM

Pump Model	HP	PSI	Depth to Water in Feet/Ratings in GPM (Gallons per Minute)																																						
			25	50	75	100	125	150	175	200	225	250	275	300	325	350	375	400	425	450	475	500	525	550	575	600	625	650	675	700	725	750	775	800	825						
95L05 3 Stages	5	0		128	128	117	99	88	38																																
		20	128	120	101	90	55																																		
		30	121	102	90	62																																			
		40	104	91	67																																				
		50	91	72																																				
		60	76																																					
95L07 5 Stages	7.5	0			128	124	122	117	108	97	89	81	58																												
		20		125	123	118	109	99	90	82	64																														
		30	125	123	118	110	99	90	83	66																															
		40	123	119	111	100	91	84	68																																
		50	119	111	101	91	84	70																																	
		60	112	102	92	85	72	26																																	
95L10 7 Stages	10	0					128	126	125	124	120	113	104	96	91	87	77	48																						
		20			128	126	125	124	120	114	106	98	92	87	79	54																								
		30		128	126	125	124	121	114	106	98	92	88	80	57																								
		40	129	126	125	124	121	115	107	99	92	88	81	60																									
		50	126	125	124	121	116	107	99	93	88	82	63																										
		60	125	125	122	116	108	100	93	89	83	65																											
95L15 10 Stages	15	0							129	126	125	125	125	123	120	116	110	104	99	94	91	88	82	71	45														
		20					129	127	125	125	125	123	121	117	111	105	100	95	91	88	83	73	50																	
		30				130	127	125	125	125	124	121	117	112	106	100	95	91	88	84	74	52																	
		40			130	127	126	125	125	124	121	117	112	106	100	95	92	89	84	75	55																	
		50		130	127	126	125	125	124	121	118	112	107	101	96	92	89	85	76	57																	
		60	130	127	126	125	125	124	122	118	113	107	101	96	92	89	85	77	59																	
95L20 14 Stages	20	0										130	128	127	126	125	125	124	122	120	117	114	110	106	102	98	94	91	89	86	82	75	63	43			
		20								130	128	127	126	125	125	124	123	121	118	114	110	106	102	98	95	92	89	86	82	76	65	47					
		30							130	128	127	126	125	125	124	123	121	118	115	111	107	102	99	95	92	89	87	83	77	66	48						
		40							128	127	126	125	125	124	123	121	118	115	111	107	103	99	95	92	90	87	83	77	67	50							
		50						129	127	126	125	125	124	123	121	118	115	111	107	103	99	96	92	90	87	83	78	68	52								
		60					129	127	126	126	125	124	123	121	119	115	112	108	103	99	96	93	90	87	84	78	69	53									

Pump Model	HP	PSI	Depth to Water in Feet/Ratings in GPM (Gallons per Minute)																																						
			200	250	300	350	400	450	500	550	600	650	700	750	800	850	900	950	1000	1050	1100	1150	1200	1250	1300	1350	1400	1450	1500	1550	1600											
95L25 17 Stages	25	0			128	126	126	126	125	122	116	109	102	96	91	88	83	67																							
		20		127	126	126	126	124	120	114	106	99	94	90	86	78	56																							
		30		129	126	126	126	125	122	117	110	103	96	92	88	84	71																							
		40	129	127	123	120	117	114	110	106	101	95	89	81	70	49																							
		50	128	126	126	126	124	120	114	107	100	94	90	87	79	59																							
		60	127	126	126	125	122	118	111	104	97	92	89	84	72																							
95L30 21 Stages	30	0			130	127	126	125	125	124	122	119	115	111	106	101	96	92	89	85	78	66	42																
		20		130	127	126	125	125	124	122	120	116	111	106	101	96	93	89	85	79	67	45																	
		30		129	127	126	125	125	123	121	118	114	109	104	99	95	91	88	83	74	58	29																	
		40	130	127	126	125	125	124	123	120	116	112	106	101	97	93	89	86	80	68	47																		
		50	129	127	126	125	125	124	122	118	114	109	104	99	95	91	88	83	75	60	32																		
		60	128	126	125	125	124	123	120	116	112	107	102	97	93	90	86	80	69	49																			
95L40 28 Stages	40	0				130	128	127	126	126	125	125	124	123	121	119	116	113	109	106	102	99	95	92	89	86	83	78	70	59	41										
		20			130	128	127	126	126	125	125	124	123	121	119	116	113	110	106	102	99	96	92	90	87	83	78	71	60	43										
		30			129	128	127	126	125	125	124	124	122	120	118	115	112	108	104	101	97	94	91	88	85	81	75	66	53	32										
		40		130	129	127	126	126	125	125	124	123	121	119	117	113	110	106	103	99	96	93	90	87	83	79	72	61	44	19										
		50		130	128	127	126	126	125	125	124	122	120	118	115	112	108	105	101	98	94	91	88	85	81	76	67	54											
		60	131	129	127	126	126	125	125	124	123	121	119	117	114	110	107	103	99	96	93	90	87	84	79	72	62	46											

MODEL 120L

SELECTION CHART

Horsepower Range 5 – 50, Recommended Range 40 – 170 GPM, 60 Hz, 3450 RPM

Pump Model	HP	PSI	Depth to Water in Feet/Ratings in GPM (Gallons per Minute)																														
			25	50	75	100	125	150	175	200	225	250	275	300	325	350	375	400	425	450	475	500	525	550	575	600	625	650	675	700	725	750
120L05 2 Stages	5	0		167	147	121	53																									
		20	150	126	68																											
		30	129	75																												
		40	82																													
		50																														
		60																														
120L07 3 Stages	7.5	0			166	153	138	116	74																							
		20	168	155	141	120	82																									
		30	156	142	122	86																										
		40	143	124	90																											
		50	126	93																												
		60	96																													
120L10 5 Stages	10	0				170	164	157	150	141	131	115	91	56																		
		20			165	158	151	143	132	118	95	62																				
		30		165	158	151	143	133	119	97	65																					
		40	166	159	152	144	134	120	99	68																						
		50	159	152	145	135	122	101	71																							
		60	153	145	136	123	103	74																								
120L15 7 Stages	15	0							170	163	155	148	142	136	130	121	109	90	63													
		20					171	164	156	149	143	137	131	123	111	94	68																
		30					164	157	150	143	137	131	123	112	95	70																	
		40				165	157	150	144	138	132	124	113	97	72																		
		50			165	158	151	144	138	132	125	114	98	74	40																	
		60		166	158	151	145	139	133	125	115	100	77	43																		
120L20 10 Stages	20	0									168	164	159	155	151	146	142	137	132	126	119	110	99	85	69	48						
		20					168	164	160	156	151	147	143	138	133	127	120	111	101	88	71	51										
		30					169	165	160	156	152	147	143	138	133	127	120	112	101	89	73	53										
		40				169	165	161	156	152	148	143	139	134	128	121	113	102	90	74	55											
		50			169	165	161	157	152	148	144	139	134	128	121	113	103	91	75	56												
		60		170	166	161	157	153	148	144	139	134	129	122	114	104	92	77	58													
120L25 12 Stages	25	0									169	165	160	156	151	147	143	139	135	130	126	121	116	109	101	91	78	63	44			
		20							170	165	161	156	152	147	143	139	135	131	127	122	117	110	102	92	80	65	47					
		30						170	166	161	157	152	148	143	139	135	131	127	122	117	111	103	93	81	67	49						
		40					170	166	162	157	152	148	144	140	136	132	127	123	117	111	103	94	82	68	50							
		50				171	166	162	157	153	148	144	140	136	132	128	123	118	112	104	95	83	69	52								
		60			171	167	162	158	153	149	144	140	136	132	128	124	118	112	105	95	84	70	53									

Pump Model	HP	PSI	Depth to Water in Feet/Ratings in GPM (Gallons per Minute)																													
			200	250	300	350	400	450	500	550	600	650	700	750	800	850	900	950	1000	1050	1100	1150	1200	1250	1300	1350	1400	1450
120L30 15 Stages	30	0					165	158	151	144	138	131	123	113	99	80	54											
		20				165	158	152	145	138	131	123	114	100	82	56												
		30			169	162	155	148	142	135	128	119	108	92	71	41												
		40			166	159	152	145	139	132	124	114	101	83	58													
		50		169	163	156	149	142	136	128	120	109	94	73	44													
		60		166	160	153	146	139	132	125	115	102	85	60														
120L40 20 Stages	40	0							170	166	161	156	150	145	140	134	129	123	115	107	96	82	65	42				
		20							166	161	156	151	145	140	135	129	123	116	108	97	83	66	44					
		30						169	164	159	154	148	143	138	132	126	120	112	103	91	76	57						
		40						167	162	156	151	146	140	135	130	124	117	108	98	85	68	46						
		50					169	164	159	154	149	143	138	133	127	120	113	104	92	77	58							
		60					167	162	157	151	146	141	135	130	124	117	109	99	86	69	48							
120L50 24 Stages	50	0									168	164	161	158	156	153	149	144	137	130	122	114	107	100	94	87	76	56
		20								168	164	161	159	156	153	149	144	138	130	123	115	108	101	95	87	77	58	
		30								166	163	160	157	155	151	147	141	134	127	119	111	104	98	92	83	69		
		40							169	165	161	159	156	153	150	145	138	131	123	115	108	101	95	88	78	60		
		50							167	163	160	158	155	152	147	142	135	127	120	112	105	99	92	84	71			
		60							165	162	159	156	154	150	145	139	132	124	116	109	102	96	89	79	62			

MODEL 160L

SELECTION CHART

Horsepower Range 3 – 60, Recommended Range 50 – 240 GPM, 60 Hz, 3450 RPM

Pump Model	Depth to Water in Feet/Ratings in GPM (Gallons per Minute)																													
	HP	PSI	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180	190	200	210	220	230	240	250
160L03	3	0	243	237	208	177	147	102																			
		10	198	167	136	86																					
		20	124	62																							

Pump Model	Depth to Water in Feet/Ratings in GPM (Gallons per Minute)																														
	HP	PSI	25	50	75	100	125	150	175	200	225	250	275	300	325	350	375	400	425	450	475	500	525	550	575	600	625	650	675	700	725	750
160L05 2 Stages	5	0	236	214	185	149	87																								
		20	190	155	100																										
		30	158	105																											
		40	111																												
160L07 3 Stages	7.5	0	231	239	227	207	184	158	123	68																					
		20	229	210	188	162	129	78																							
		30	212	189	164	132	83																								
		40	191	166	135	88																									
		50	168	138	92																										
		60	140	97																											
160L10 4 Stages	10	0				233	218	203	185	164	137	103	57																		
		20		234	221	205	188	167	142	109	65																				
		30	235	222	206	189	169	144	111	69																					
		40	223	208	191	171	146	114	73																						
		50	209	192	172	148	117	76																							
		60	193	174	150	120	80																								
160L15 6 Stages	15	0					239	231	222	212	201	190	178	164	148	129	104	74													
		20				232	223	213	203	192	180	166	151	132	108	79																
		30			233	224	214	204	193	181	167	152	134	110	81																	
		40		234	225	215	204	193	182	169	153	135	112	84																		
		50	234	225	216	205	194	183	170	155	137	114	86	50																	
		60	226	216	206	195	183	171	156	138	116	89	53																		
160L20 8 Stages	20	0								234	225	217	209	200	192	183	173	163	151	137	121	102	79	51							
		20						235	227	218	210	202	193	184	175	165	153	140	124	105	83	56									
		30						236	227	219	211	202	194	185	176	165	154	141	125	107	85	58									
		40				236	228	220	211	203	195	186	176	166	155	142	126	108	86	60											
		50			237	229	220	212	204	195	186	177	167	156	143	128	110	88	62												
		60		237	229	221	213	204	196	187	178	168	157	144	129	111	90	65													
160L25 9 Stages	25	0								238	232	225	218	212	205	199	192	185	177	168	158	147	133	117	98	76	50				
		20						239	233	226	219	213	206	200	193	186	178	170	160	149	136	120	102	80	54						
		30					240	233	227	220	213	207	200	194	187	179	170	161	150	137	121	103	82	56							
		40				240	234	227	220	214	207	201	194	187	179	171	162	151	138	123	105	83	58								
		50				234	228	221	214	208	201	195	188	180	172	162	151	139	124	106	85	60									
		60			235	228	221	215	208	202	195	188	181	172	163	152	140	125	108	87	62										
160L30 11 Stages	30	0									237	233	228	223	218	213	208	203	198	192	186	180	173	166	157	148	137	124	109	92	73	50
		20							238	233	229	224	219	214	209	204	199	193	187	181	175	167	159	149	139	126	112	95	76	54		
		30						238	234	229	224	219	214	209	204	199	194	188	182	175	168	159	150	139	127	113	96	77	56			
		40					239	234	229	224	220	215	210	205	199	194	188	182	176	168	160	151	140	128	114	98	79	57				
		50				239	234	230	225	220	215	210	205	200	194	189	183	176	169	161	152	141	129	115	99	80	59					
		60			239	235	230	225	220	215	210	205	200	195	189	183	177	169	161	152	142	130	116	100	82	61						

Pump Model	Depth to Water in Feet/Ratings in GPM (Gallons per Minute)																														
	HP	PSI	150	175	200	225	250	275	300	350	400	450	500	550	600	650	700	750	800	850	900	950	1000	1050	1100	1150	1200	1250	1300	1350
160L40 15 Stages	40	0						238	230	222	214	207	199	192	184	175	166	154	139	122	99	72								
		20					239	235	231	223	215	207	200	192	185	176	166	155	141	123	101	74								
		30				239	235	231	227	219	211	204	196	189	181	172	161	149	133	114	89	59								
		40			239	235	231	227	223	215	208	200	193	185	177	167	156	142	125	103	76									
		50		240	236	232	228	224	220	212	204	197	189	181	172	162	150	134	115	91	62									
		60	240	236	232	228	224	220	216	208	201	194	186	177	168	157	143	126	105	78										
160L50 18 Stages	50	0								239	233	228	223	218	213	208	202	196	189	181	171	160	148	133	116	97	74			
		20							239	234	229	224	219	214	208	203	196	189	181	172	161	149	134	118	98	76	51			
		30						239	237	231	226	221	216	211	206	200	193	186	177	167	156	142	127	109	88	65				
		40					239	237	234	229	224	219	214	209	203	197	190	182	173	162	150	135	119	100	78	53				
		50				240	237	234	232	227	222	217	212	206	200	194	186	178	168	157	143	128	110	90	67					
		60			240	237	234	232	229	224	219	214	209	204	197	190	182	173	163	151	137	120	101	80	55					
160L60 20 Stages	60	0											237	230	224	219	213	207	201	195	189	182	174	165	155	144	130	114	96	74
		20										237	231	225	219	213	207	202	196	189	182	175	166	156	145	131	115	97	76	50
		30										234	228	222	216	211	205	199	193	186	179	171	162	151	139	124	107	88	64	
		40									238	231	225	219	214	208	202	196	190	183	175	167	157	146	132	117	99	77	52	
		50									235	229	223	217	211	205	199	193	187	179	171	162	152	140	125	109	89	66		
		60								238	232	226	220	214	208	202	196	190	183	176	167	158	146	133	118	100	79	54		

MODEL 250L

SELECTION CHART

Horsepower Range 7.5 – 60, Recommended Range 70 – 300 GPM, 60 Hz, 3450 RPM

Pump Model	Depth to Water in Feet/Ratings in GPM (Gallons per Minute)																																				
	HP	PSI	25	50	75	100	125	150	175	200	225	250	275	300	325	350	375	400	425	450	475	500	525	550	575	600	625	650	675	700	725	750	775	800
250L072 Stages	7.5	0		286	224	149	74																											
		20	235	161	85																													
		30	167	91																														
		40	96																															
		50																																
		60																																
250L103 Stages	10	0			294	259	213	160	105	68																								
		20	298	265	221	168	113	78																										
		30	268	224	173	117	83																											
		40	228	177	122	69																												
		50	181	126	72																													
		60	130	76																														
250L155 Stages	15	0					291	271	246	217	183	148	112	77																				
		20			294	275	250	221	189	153	117	82																						
		30		295	276	252	224	191	156	120	84																							
		40	296	278	254	226	194	159	123	87																								
		50	280	256	228	196	162	125	90																									
		60	258	231	199	164	128	92																										
250L207 Stages	20	0							301	291	277	257	233	205	175	145	117	94	75															
		20						293	280	261	237	209	179	149	121	97	78																		
		30					294	281	262	239	211	181	151	123	99	79																			
		40				295	282	264	241	214	184	154	125	101	80																				
		50			295	283	266	243	216	186	156	127	102	82																				
		60		296	284	267	245	218	188	158	129	104	83																					
250L258 Stages	25	0								298	289	275	258	238	216	192	167	143	121	101	83													
		20						299	290	277	261	241	219	195	171	147	124	104	86	70														
		30					300	291	279	262	243	221	197	173	149	126	105	87	71															
		40				300	292	280	264	244	223	199	175	150	128	107	88	72																
		50			301	293	281	265	246	224	201	176	152	129	108	90	74																
		60			293	282	266	248	226	203	178	154	131	110	91	75																	
250L309 Stages	30	0									299	289	277	264	249	233	216	198	180	160	141	121	102	83									
		20							300	290	279	266	251	236	219	201	182	163	144	124	105	86											
		30							291	280	267	253	237	220	202	184	165	145	126	106	87												
		40						292	281	268	254	238	221	204	185	166	147	127	108	89	70												
		50					293	282	269	255	240	223	205	187	168	148	129	109	90	72													
		60				294	283	270	256	241	224	206	188	169	150	130	111	92	73														
250L4013 Stages	40	0														300	295	287	278	266	253	239	224	209	194	179	165	151	138	125	113	101	90	79
		20													296	289	279	268	255	241	226	211	197	182	167	153	140	127	114	103	91	80	69	
		30												297	289	280	269	256	242	227	213	198	183	168	154	141	128	115	104	92	81	70		
		40											297	290	281	270	257	243	229	214	199	184	169	155	142	129	116	104	93	82	71			
		50										297	291	282	270	258	244	230	215	200	185	170	156	143	130	117	105	94	83	72				
		60									298	291	282	271	259	245	231	216	201	186	172	157	144	131	118	106	95	84	73					

Pump Model	Depth to Water in Feet/Ratings in GPM (Gallons per Minute)																																				
	HP	PSI	200	225	250	275	300	325	350	375	400	425	450	475	500	525	550	575	600	625	650	675	700	725	750	775	800	825	850	875	900	925	950
250L5016 Stages	50	0							300	295	289	283	276	269	261	253	245	236	227	218	208	198	188	177	166	156	145	134	123	111	100	89	79
		20						296	290	284	277	270	262	255	246	238	228	219	209	199	189	179	168	157	146	135	124	113	102	91	80	70	
		30					296	291	284	278	271	263	255	247	238	230	220	210	200	190	180	169	158	147	136	125	114	103	92	81	71		
		40				297	291	285	278	271	264	256	248	239	230	221	211	201	191	180	170	159	148	137	126	115	104	93	82	71			
		50			297	291	285	279	272	264	256	248	240	231	221	212	202	192	181	171	160	149	138	127	116	105	94	83	72				
		60		298	292	286	279	272	265	257	249	240	231	222	212	203	192	182	171	161	150	139	128	116	105	94	84	73					

Pump Model	Depth to Water in Feet/Ratings in GPM (Gallons per Minute)																																				
	HP	PSI	400	425	450	475	500	525	550	575	600	625	650	675	700	725	750	775	800	825	850	875	900	925	950	975	1000	1025	1050	1075	1100	1125	1150	1175	1200
250L6019 Stages	60	0						298	294	289	284	278	271	263	255	246	236	227	217	206	196	185	174	164	154	144	134	124	115	107	99	91	84	77	70
		20				299	295	290	285	279	272	264	256	247	238	228	218	208	197	187	176	165	155	145	135	126	117	108	100	92	85	78	71		
		30			299	295	291	285	279	272	265	257	248	239	229	219	209	198	187	177	166	156	146	136	127	117	109	101	93	85	78	72			
		40		299	295	291	286	280	273	265	257	249	239	230	220	209	199	188	178	167	157	147	137	127	118	109	101	93	86	79	72				
		50	299	296	291	286	280	273	266	258	249	240	230	220	210	200	189	178	168	157	147	137	128	119	110	102	94	86	79	73					
		60	296	292	287	281	274	267	259	250	241	231	221	211	200	190	179	169	158	148	138	129	119	111	102	94	87	80	73						

MODEL 320L

SELECTION CHART

Horsepower Range 7.5 – 60, Recommended Range 100 – 400 GPM, 60 Hz, 3450 RPM

Pump Model	Depth to Water in Feet/Ratings in GPM (Gallons per Minute)																												
	HP	PSI	25	50	75	100	125	150	175	200	225	250	275	300	325	350	375	400	425	450	475	500	525	550	575	600	625	650	
320L07 2 Stages	7.5	0		343	262	172																							
		20	275	186																									
		30	193	100																									
		40	107																										
		50																											
		60																											
320L15 4 Stages	15	0		392	393	370	332	286	237	189	143																		
		20	394	374	338	293	245	196	150	105																			
		30	376	341	297	248	200	153	108																				
		40	344	300	252	204	157	112																					
		50	304	256	207	160	115																						
		60	260	211	164	119																							
320L20 5 Stages	20	0				391	365	336	303	267	228	188	147	105															
		20		394	370	341	308	273	234	194	153	112																	
		30	396	372	343	311	275	237	197	156	115																		
		40	374	345	313	278	240	200	159	118																			
		50	348	316	281	243	203	162	121																				
		60	319	284	246	207	166	124																					
320L25 6 Stages	25	0					387	366	343	316	288	257	225	191	157	123													
		20			390	370	346	320	292	262	230	196	162	128															
		30		392	371	348	322	294	264	232	199	165	130																
		40	393	373	350	324	296	266	235	201	167	133																	
		50	375	352	326	299	269	237	204	170	136	101																	
		60	354	328	301	271	239	206	173	138	104																		
320L30 8 Stages	30	0							391	375	357	336	314	291	267	242	217	192	166	141	116								
		20					393	378	360	340	318	295	271	246	221	196	170	145	120										
		30				395	379	361	341	319	296	273	248	223	197	172	147	122											
		40			396	380	363	343	321	298	274	250	225	199	174	149	124												
		50		397	382	364	344	323	300	276	252	227	201	176	151	125	100												
		60	398	383	365	346	324	302	278	254	229	203	178	153	127	102													
320L40 11 Stages	40	0									399	388	375	361	346	331	314	297	280	262	244	225	207	188	169	150	131	113	
		20								390	377	363	349	333	317	300	282	265	246	228	209	191	172	153	134	115			
		30							390	378	365	350	334	318	301	284	266	248	229	211	192	173	155	136	117				
		40						391	379	366	351	336	319	302	285	267	249	231	212	194	175	156	137	118					
		50					392	380	367	352	337	321	304	286	269	251	232	214	195	176	158	139	120	101					
		60				393	381	368	353	338	322	305	288	270	252	234	215	196	178	159	140	121	102						

Pump Model	Depth to Water in Feet/Ratings in GPM (Gallons per Minute)																												
	HP	PSI	200	225	250	275	300	325	350	375	400	425	450	475	500	525	550	575	600	625	650	675	700	725	750	775			
320L50 13 Stages	50	0				395	387	378	367	355	343	330	316	301	286	270	254	238	222	205	188	172	155	138	122	106			
		20		396	388	379	369	357	345	332	318	303	288	273	257	241	224	208	191	174	158	141	124	108	146	135			
		30	397	389	380	369	358	346	333	319	304	289	274	258	242	225	209	192	176	159	142	126	109	147	136	125			
		40	390	381	370	359	347	334	320	306	291	275	259	243	227	210	193	177	160	143	127	111							
		50	381	371	360	348	335	321	307	292	276	260	244	228	211	195	178	161	145	128	112								
		60	372	361	349	336	322	308	293	277	262	246	229	213	196	179	163	146	129	113									

Pump Model	Depth to Water in Feet/Ratings in GPM (Gallons per Minute)																																
	HP	PSI	200	225	250	275	300	325	350	375	400	425	450	475	500	525	550	575	600	625	650	675	700	725	750	775	800	825	850	875	900	925	950	975	1000
320L60 16 Stages	60	0							395	389	383	376	368	360	351	341	331	320	308	295	281	268	253	239	224	209	195	181	167	154	142	130	120	109	100
		20					396	390	384	377	369	361	352	343	332	321	309	297	284	270	255	241	226	212	197	183	169	156	144	132	121	111	101		
		30				397	391	384	377	370	362	353	344	333	322	310	298	285	271	257	242	227	213	198	184	170	157	145	133	122	112	102			
		40			397	391	385	378	370	362	354	344	334	323	311	299	286	272	258	243	228	214	199	185	171	158	146	134	123	112	103				
		50		398	391	385	378	371	363	354	345	335	324	312	300	287	273	259	244	230	215	200	186	172	159	146	135	124	113	103					
		60	398	392	386	379	372	364	355	346	336	325	313	301	288	274	260	245	231	216	201	187	173	160	147	136	124	114	104						

xylem
Let's Solve Water

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2881 East Bayard Street Ext., Suite A
Seneca Falls, NY 13148
Phone: (866) 325-4210
Fax: (888) 322-5877
www.xylem.com/goulds

Exhibit 4
Kupferle TF200
Blow-Off Hydrant

Truflo #TF200

Specify Kupferle's Truflo #TF200 Blow-Off for Above Grade or Truflo #TF250 for Below Grade

Truflo #TF200

- Unique Valve Delivers Full-Flow (400 gpm)
- Heavy Wall Cast-Iron Construction
- Easy to Maintain Without Digging
- 9/16" Operating Nut and Nozzle Cap
- 2½" NST Outlet (other sizes available)
- 2" FIP Vertical (Straight) Inlet
- Optional 2" Horizontal (Side) Inlet
- Optional Handle & Pent Cap (as pictured)
- Optional Hand Wheel Available

TRUFLO™

Truflo #TF250

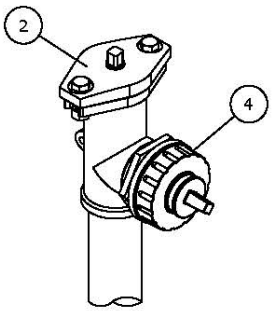
Truflo #TF200

KUPFERLE
Since 1857

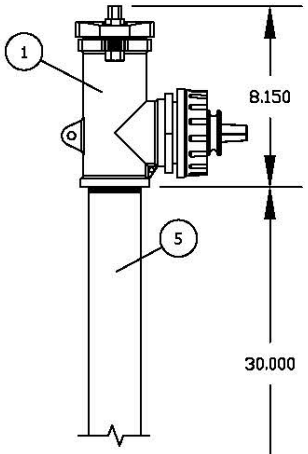
Kupferle
2511 North 9th Street
St. Louis, MO 63102
800-231-3990 / www.hydrants.com
Contact us at info@hydrants.com

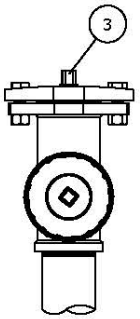
MEMBER

TF-200 TRUFLO POST HYDRANT
SPEC SHEET

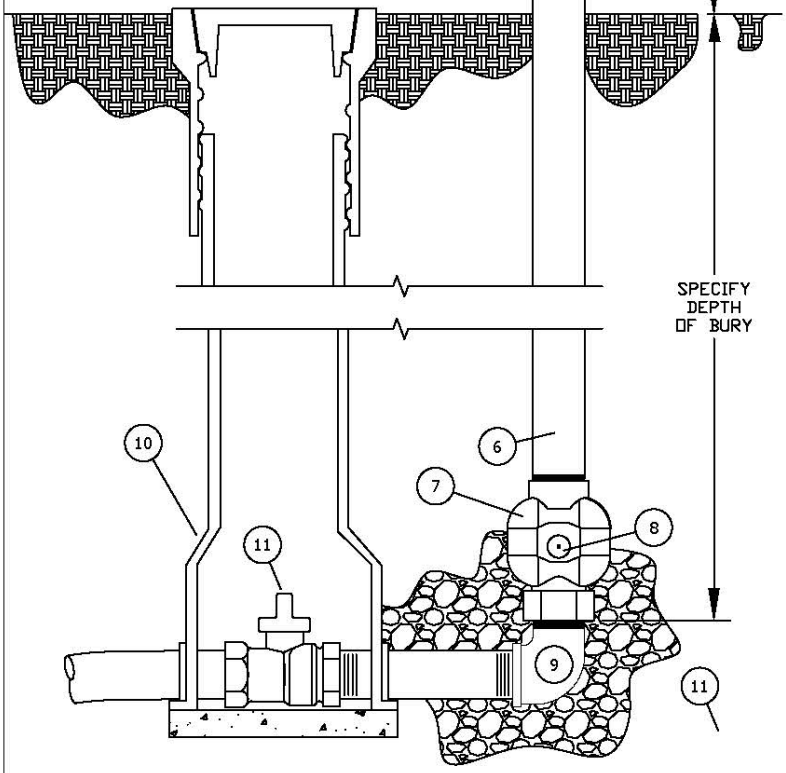


1 ISO VIEW
Scale: 1-1/2"=1'-0"





2 FRONT VIEW
Scale: 3/4"=1'-0"



HYDRANT SHALL BE _____' BURY, WITH (2" MJ SIDE, 2" FIP SIDE, OR 2" FIP VERTICAL) INLET AND (ANY SIZE UP TO 2-1/2" NST) NOZZLE OUTLET.

HYDRANT SHALL BE NON-FREEZING AND SELF DRAINING. HYDRANT SHALL BE OPERATED BY TURNING A TOP-MOUNTED $\frac{9}{16}$" SQUARE OPERATING NUT COUNTERCLOCKWISE TO OPEN AND CLOCKWISE TO CLOSE. HYDRANT MUST SEAL THE DRAIN OUTLET IN ALL POSITIONS FROM 1/4-OPEN TO FULLY OPEN. ALL INTERNAL WORKING PARTS, THE INLET, AND THE OUTLET SHALL BE BRASS WITH THE VALVE BEING PVC. ALL WORKING PARTS SHALL BE SERVICEABLE FROM ABOVE GROUND WITH NO DIGGING REQUIRED. ALL WEAR PARTS (O-RINGS AND VALVE SEAT) SHALL BE OF COMMONLY AVAILABLE DIMENSIONS AND MATERIALS, NONE MAY BE VENDOR UNIQUE DESIGN.

(***ANTI-VANDAL CAP OPTION:*** AN ANTI-VANDAL LOCKING MECHANISM SHALL BE PROVIDED, WHICH SHALL ALSO SERVE AS AN OPERATING WRENCH.)

(***"TRAFFIC" OPTION:*** HYDRANT SHALL BE DESIGNED TO BREAK AWAY AT GRADE LEVEL IN EVENT OF A SIGNIFICANT IMPACT. OUTLET NOZZLE SHALL BE ABLE TO POINT IN ANY OF 8 RADIAL DIRECTIONS. HYDRANT SHALL BE DESIGNED TO ACCEPT FIELD-INSTALLED GRADE-CHANGE MODIFICATIONS.)

HYDRANT SHALL BE MODEL TF-200 AS MANUFACTURED BY THE KUPFERLE FOUNDRY, ST. LOUIS MO. 63102 OR APPROVED EQUAL.

ITEM	ITEM / DESCRIPTION	NOTES
1	HEADSTOCK	
2	TOP CAP	
3	9/16" OPERATING NUT	
4	OUTLET	2-1/2" NST w/ SIDE CAP SHOWN
5	2" BARREL PIPE	STEEL, OTHER OPTIONS AVAILABLE
6	1/2" STEEL OPERATING ROD	NOT SHOWN, OTHER OPTIONS AVAILABLE
7	INLET VALVE BODY	2" FIP VERTICAL INLET SHOWN
8	DRAIN HOLE	
9	STREET ELBOW	BY OTHERS
10	VALVE BOX	BY OTHERS
11	HYDRANT SHUT-OFF VALVE	BY OTHERS
11	CRUSHED ROCK	BY OTHERS

TF-200 HYDRANT TO BE INSTALLED AT THE FOLLOWING LOCATIONS:

_____

		INITIALS	DATE
		DRAWN	DCL 2/12/18
		APPROVED	DCL 2/12/18
		MODIFIED	
DD/MM/YY	ISSUED FOR REFERENCE	TF-200 TRUFLO POST HYDRANT	SCALE 1-1/2"=1'
DATE	STATUS / REVISION		

KUPFERLE
Since 1857

2511 NORTH 9TH STREET
ST. LOUIS, MO 63102
1-800-231-3990
FAX 314-231-2820
www.hydrants.com

Exhibit 5
Woodford Model S-3
Yard Hydrant

WOODFORD

Backflow Protected Automatic Draining Freezeless

Sanitary Yard Hydrant

Model S3

The Model S3 hydrant is designed for use anywhere potable water is required.

Unlike conventional hydrants which drain the water into the ground, the Model S3 employs a reservoir below frost line to contain the water. The hydrant is completely sealed to prevent surface and ground water from entering reservoir or service line. The valve, with it's unique venturi design, removes the stored water along with the water being used.

The Model S3 is equipped with a diverter spout, which allows the hydrant to be operated independently from the backflow preventer. When the hydrant is to be used with a hose, the diverter sleeve is pulled down during flow and water is automatically diverted to the backflow preventer hose connection. The diverter will work with or without a hose attached to the backflow preventer and will automatically release any time the hydrant is shut off.

An important feature of the S3 is easy maintenance. The entire working portion of the hydrant can be removed from the reservoir without any excavation.

SPECIFICATIONS:

HOSE CONNECTION BACKFLOW PREVENTER (BFP)

- NIDEL® Model 37HF
- ASSE 1052
- Field Testable (see instruction sheet)
- Two Check Valves

OPTIONAL: ASSE 1057 listed - Consists of NIDEL® Model 34HF Single Check Vacuum Breaker

Order example: S3-Bury Depth-SC

FEMALE INLET - 1" N.P.T.

MIN PRESSURE - 20 psi

MAX PRESSURE - 100 psi

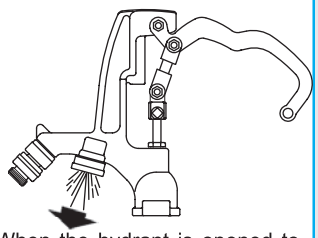
MAX TEMPERATURE - 120° F

Patent Information:
http://www.woodfordmfg.com/Woodford/patents/

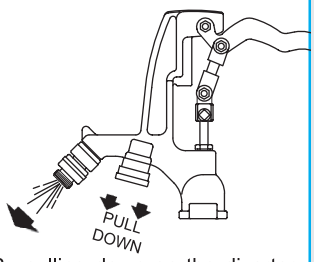
Installation and Troubleshooting Instructions see woodfordmfg.com or call 1-800-621-6032

NOTICE

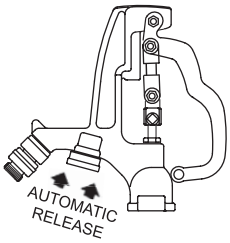
FOR WINTER USE: The hydrant must be operated at full flow, through the diverter, for a minimum of 30 seconds before and after each use to drain the hydrant and prevent freezing.



When the hydrant is opened to an ON position, water will flow through the diverter spout.



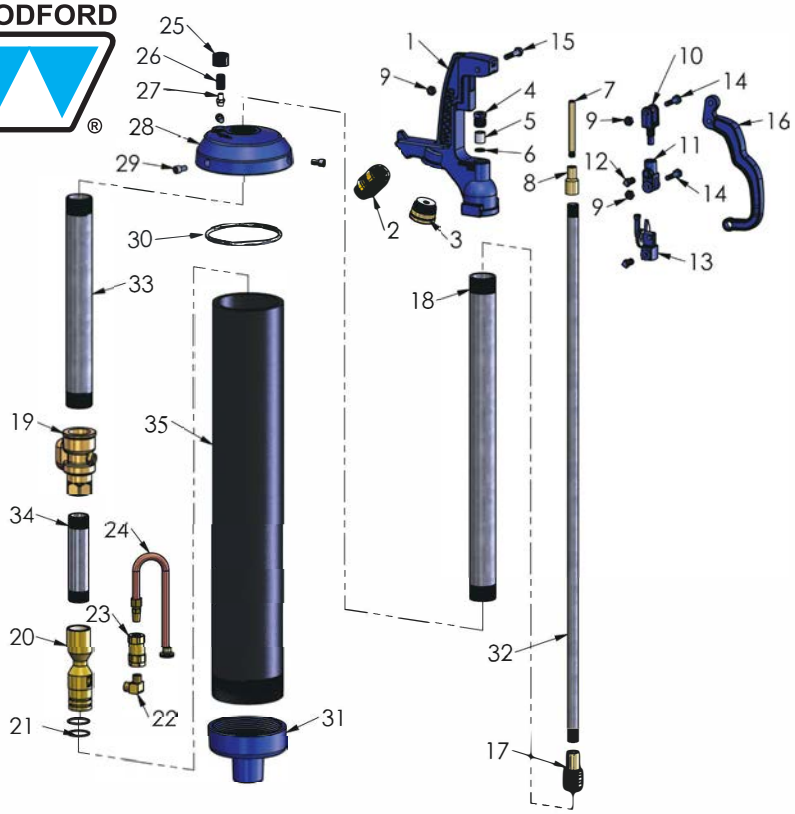
By pulling down on the diverter sleeve during flow, water will be diverted through the backflow preventer (BFP), and allow use with a hose.



When the hydrant is closed to an OFF position, the diverter will automatically release, allowing the hydrant to drain into the reservoir. The hydrant will drain even if a pressurized or non pressurized hose is attached.

When ordering, specify bury depth.

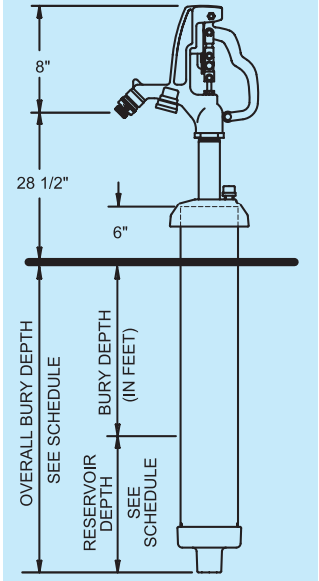
WOODFORD®



Bury Depth	1’	2’	3’	4’ *	5’ *	6’ *	7’ *
Reservoir Depth	10 1/2”	11 7/8”	13 1/4”	14 5/8”	16”	17 3/8”	18 3/4”
Overall Bury Depth	22 1/2”	35 7/8”	49 1/4”	62 5/8”	76”	89 3/8”	102 3/4”
Weight (lbs)	36	42	48	54	59	65	71

* Must ship by truck line due to length.

Rough-In Dimensions



MODEL S3 PARTS LIST

ITEM	PART #	DESCRIPTION
	15219	S3 Head Assembly (Includes Items 1-16)
1	10449	Head
2	37HF-BR	37HF Backflow Preventer
3	15220	Diverter Assembly
4	10100	Packing Nut
5	10101	Packing
6	10102	Packing Support Washer
7	10104	Brass Rod Stem
8	10011	Reducing Coupling
9	10206	Hex Nut
10	10444	Upper Link
11	15211	Lower Link (with set screw 10019)
12	10019	Set Screw
13	15241	Cam and Clevis Assembly (blue)
14	10020	Link Bolt
15	10021	Lever Bolt
16	10443	Lever
17	10106	Plunger
18	10285	Upper Pipe (21 5/16” Long)
19	10017	Valve Body (1” NPT Inlet)
20	15189	Venturi Assembly
21	10321	Valve Body O-Ring (2 Required)
22	10432	Brass Elbow
23	10408	Check Valve
24	15216	Siphon Tube Assembly
25	10446	Vent Cap
26	10445	3/8” Pipe Nipple
27	15136	Snifter Valve
28	15218	Casing Cover w/Warning Label
	15218N	Un-Threaded Casing Cover w/Warning Label (Pre-Sept 2013)
29	10409	Reservoir Clamp Screw (3)
30	10410	Reservoir O-Ring
31	10401	Inlet Casting
32	**OPERATING PIPE (Bury Depth & Length)**	
	10023	1’ Bury (35 ½” Long)
	10024	2’ Bury (47 ½” Long)
	10025	3’ Bury (59 ½” Long)
	10026	4’ Bury (71 ½” Long)
	10027	5’ Bury (83 ½” Long)
	10028	6’ Bury (95 ½” Long)
	10029	7’ Bury (107 ½” Long)
33	**1 ¼” LOWER PIPE (Bury Depth & Length)**	
	10270	1’ Bury (13 ¾” Long)
	10271	2’ Bury (25 ¾” Long)
	10272	3’ Bury (37 ¾” Long)
	10273	4’ Bury (49 ¾” Long)
	10274	5’ Bury (61 ¾” Long)
	10275	6’ Bury (73 ¾” Long)
	10276	7’ Bury (85 ¾” Long)
34	**1” EXTENSION PIPE (Bury Depth & Length)**	
	10411	1’ Bury (5 5/8” Long)
	10412	2’ Bury (7” Long)
	10413	3’ Bury (8 3/8” Long)
	10414	4’ Bury (9 ¾” Long)
	10415	5’ Bury (11 1/8” Long)
	10416	6’ Bury (12 ½” Long)
	10417	7’ Bury (13 7/8” Long)
35	**RESERVOIR PVC CASING (Bury Depth & Length)**	
	10421	1’ Bury (26” Long)
	10422	2’ Bury (39 ¼” Long)
	10423	3’ Bury (52 ¾” Long)
	10424	4’ Bury (66” Long)
	10425	5’ Bury (79 ½” Long)
	10426	6’ Bury (92 ¾ “ Long)
	10427	7’ Bury (106 ¼ “ Long)
	15201	Warning Label Kit

RK-Y1 Repair Kit (Includes Items 4-7 & 17)
RK-SHL Repair Kit (Includes Items 9-15)

For more information contact...

WOODFORD MANUFACTURING COMPANY, LLC.

2121 Waynoka Road, Colorado Springs, Colorado 80915 • **Phone:** (800) 621-6032 • **Fax:** (800) 765-4115

To view our complete product line visit: ***www.woodfordmfg.com*** *or email:* ***sales@woodfordmfg.com***

Exhibit 6
Test Well Log

Water Well And Pump Record

Import ID:

Tax No: 15-007-111-020-00	Permit No:	County: Charlevoix	Township: Hayes

Town/Range:	Section:	Well Status:	WSSN:	Source ID/Well No:
33N 07W	11	Active		

Well ID:

Elevation: 780'
Latitude: 45.3546858
Longitude: 85.1217709
Method of Collection: GPS Std Positioning Svc SA Off

Distance and Direction from Road Intersection:
.5 MILE S OF US 31 ON MURRAY RD

Well Owner: LTBB

Well Address:	Owner Address:
10577 MURRAY RD CHARLEVOIX, MI 49720	2500 GOVERMENT COMPLEX HARBOR SPRINGS, MI 49740

Drilling Method: Rotary
Well Depth: 152'
Well Use: Test well
Well Type: New
Date Completed:

Casing Type: SDR 17
Height:
Casing Joint: SOLVENT PVC WELDED
Casing Fitting: NONE

Diameter: 6.00 in. to 132'

Borehole: 10.88 in. to 152'

Pump Installed: No
Pressure Tank Installed: No
Pressure Relief Valve Installed: No

Static Water Level: 87 . Below Grade
Well Yield Test:
Pumping level
Yield Test Method: Test pump
see pump test

Screen Installed: Yes
Filter Packed: Yes
Screen Diameter: 6.00 in.
Blank: none
Screen Material Type: Stainless steel-wire wrapped
Screen Installation Type:
Slot 12 **Length** 20' **Set Between** 132 to 152'

Fittings: none

Formation Description	Thickness	Depth to Bottom
sand	2	2
med coarse gravel	3	5
sand	4	9
med coarse gravel&clay	4	13
hard pan	14	27
med sand& gravel	5	32
hard pan w/ sand stks	7	39
med sand &gravel	6	45
hard pan	35	80
med coarse sand	59	139
med coarse sand&fine gravel	13	152

Well Grouted: Yes
Grouting Method: triemie pipe

Grouting Material	Bags	Additives	Depth
bentonite slurry	9	None	0.00 ft. to 132'

Geology Remarks:
152' is hard red clay

Wellhead Completion: pvc glue cap

Drilling Machine Operator Name: STEVE P.
Employment: Employee

Nearest Source of Possible Contamination:

Type	Distance	Direction
None WITHIN 250'		

General Remarks:

Other Remarks:

Exhibit 7
Davis Bacon
Wage Rates

"General Decision Number: MI20230111 04/14/2023

Superseded General Decision Number: MI20220111

State: Michigan

Construction Type: Building

County: Charlevoix 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

2 02/24/2023
3 04/14/2023

ASBE0047-005 07/01/2022

	Rates	Fringes
ASBESTOS WORKER/HEAT & FROST INSULATOR	$ 34.62	18.58

BOIL0169-002 01/01/2021

	Rates	Fringes
BOILERMAKER	$ 35.95	34.52

BRMI0009-024 08/01/2020

	Rates	Fringes
BRICKLAYER	$ 30.24	19.67
TILE SETTER	$ 30.24	19.67

CARP0202-002 06/01/2021

	Rates	Fringes
CARPENTER (Drywall Hanger and Form Work)	$ 23.46	20.31

CARP0202-005 06/01/2021

	Rates	Fringes
CARPENTER (Exclude Drywall Hanger and Form Work)	$ 23.46	20.31

CARP1102-005 06/01/2018

	Rates	Fringes
MILLWRIGHT	$ 28.59	24.79

ELEC0498-013 06/01/2022

	Rates	Fringes
ELECTRICIAN	$ 33.44	21.05

ENGI0324-021 06/01/2022

	Rates	Fringes
POWER EQUIPMENT OPERATOR:		
GROUP 1	$ 44.13	24.85
GROUP 2	$ 40.83	24.85
GROUP 3	$ 38.18	24.85
GROUP 4	$ 36.47	24.85
GROUP 5	$ 30.61	24.85
GROUP 6	$ 28.13	24.85

Crane operator with main boom and jib 300' or longer: $1.50 per hour above the group 1 rate.
Crane operator with main boom and jib 400' or longer: $3.00 per hour above the group 1 rate.

PAID HOLIDAYS: New Year's Day, Memorial Day, Fourth of July, Labor Day, Thanksgiving Day and Christmas Day.

POWER EQUIPMENT OPERATOR CLASSIFICATIONS
GROUP 1: Crane operator with main boom and jib 400', 300', or 220' or longer.
GROUP 2: Crane operator with main boom and jib 140' or longer; tower crane, gantry crane and whirley derrick
GROUP 3: Crane; Paver; and Scraper; Stiff Leg Derrick
GROUP 4: Fork Truck (over 20' lift)
GROUP 5: Fork Truck (20' lift and under for masonry work)
GROUP 6: Oiler

IRON0025-005 06/01/2022

	Rates	Fringes
IRONWORKER (REINFORCING)	$ 31.43	34.77
IRONWORKER (STRUCTURAL)	$ 34.50	38.44

LABO1098-028 07/01/2021

	Rates	Fringes
LABORER		
Comon or General; Mason Tender - Brick; Mason Tender - Cement/Concrete; and Pipelayer	$ 17.85	12.95
Sandblaster	$ 18.61	12.90

PLAS0016-036 04/01/2014

	Rates	Fringes
CEMENT MASON/CONCRETE FINISHER	$ 23.10	12.38

PLUM0085-001 05/04/2022

	Rates	Fringes
PIPEFITTER (Excluding HVAC Pipe & System Installation)	$ 41.00	22.39
PIPEFITTER (HVAC Pipe Installation Only)	$ 38.25	21.07
PLUMBER (Excluding HVAC Pipe & System Installation)	$ 38.25	21.07
PLUMBER (HVAC System Installation Only)	$ 34.40	21.07

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* SFMI0669-003 04/02/2023

	Rates	Fringes
SPRINKLER FITTER (Fire Sprinklers)	$ 40.48	25.22

SHEE0007-003 05/01/2018

	Rates	Fringes
SHEET METAL WORKER (Excluding HVAC Duct & System		

Installation).....$ 26.83 23.78
SHEET METAL WORKER (HVAC Duct
Installation Only).....$ 26.83 23.78

---

* SUMI2011-036 02/14/2011

	Rates	Fringes
GLAZIER	$ 17.19	3.83
LABORER: Landscape & Irrigation	$ 11.04 **	4.39
OPERATOR: Backhoe/Excavator	$ 24.04	6.03
OPERATOR: Bulldozer	$ 22.46	7.29
OPERATOR: Grader/Blade	$ 24.04	6.03
OPERATOR: Roller	$ 27.47	8.86
OPERATOR: Tractor	$ 19.60	7.31
OPERATOR: Loader	$ 24.04	6.03
PAINTER: Brush, Prep Work, and Spray Only	$ 16.09 **	2.12
PAINTER: Roller	$ 16.61	2.09
ROOFER	$ 13.64 **	4.58
TRUCK DRIVER, Includes Dump and Tandem Truck	$ 16.56	3.50
TRUCK DRIVER: Flatbed Truck	$ 17.44	4.51

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)).

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.

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"

"General Decision Number: MI20230043 02/17/2023

Superseded General Decision Number: MI20220043

State: Michigan

Construction Type: Heavy

Counties: Antrim, Charlevoix, Leelanau, Manistee, Missaukee and Wexford Counties in Michigan.

Heavy, Includes Water, Sewer Lines and Excavation (Excludes Hazardous Waste Removal; Coal, Oil, Gas, Duct and other similar Pipeline Construction)

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
2	02/17/2023

CARP0202-003 06/01/2021

	Rates	Fringes
CARPENTER, Includes Form Work	$ 23.46	20.31

ELEC0498-001 06/01/2022

	Rates	Fringes
ELECTRICIAN	$ 33.44	21.05

ENGI0325-026 09/01/2022

POWER EQUIPMENT OPERATORS: Underground Construction (Including Sewer)

	Rates	Fringes
POWER EQUIPMENT OPERATOR		
GROUP 1	$ 37.67	24.85
GROUP 2	$ 32.78	24.85
GROUP 3	$ 32.28	24.85
GROUP 4	$ 32.00	24.85

POWER EQUIPMENT OPERATOR CLASSIFICATIONS

GROUP 1: Boring Machine, Crane, Scraper, Trencher (over 8 ft. digging capacity)

GROUP 2: Trencher (8-ft digging capacity and smaller)

GROUP 3: Boom Truck (non-swinging, non- powered type boom)

GROUP 4: Broom/ Sweeper, Fork Truck, Tractor

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* ENGI0326-016 06/01/2022

EXCLUDES UNDERGROUND CONSTRUCTION

AREA 1: MANISTEE COUNTY

AREA 2: ANTRIM, CHARLEVOIX, LEELANAU, MISSAUKEE & WEXFORD COUNTIES

	Rates	Fringes
Operating Engineer:		
AREA 1		
Group 1	$ 44.13	24.85
Group 2	$ 40.83	24.85
Group 3	$ 38.18	24.85
Group 4	$ 36.47	24.85
Group 5	$ 28.13	24.85
Operating Engineers:		
AREA 2		
Group 1	$ 44.13	24.85

Group 2	$ 40.83	24.85
Group 3	$ 38.18	24.85
Group 4	$ 36.47	24.85
Group 5	$ 28.13	24.85

FOOTNOTES:

Crane operator with main boom and jib 300' or longer: $1.50 per hour above the group 1 rate.
Crane operator with main boom and jib 400' or longer: $3.00 per hour above the group 1 rate.

PAID HOLIDAYS: New Year's Day, Memorial Day, Fourth of July, Labor Day, Thanksgiving Day and Christmas Day.

POWER EQUIPMENT OPERATOR CLASSIFICATIONS

GROUP 1: Crane operator with main boom and jib 400', 300', or 220' or longer.

GROUP 2: Crane operator with main boom and jib 140' or longer, tower crane, gantry crane, whirley derrick

GROUP 3: Compactor; Crane; Scraper

GROUP 4: Boom truck (non-swinging)

GROUP 5: Oiler

IRON0025-011 06/01/2022

	Rates	Fringes
IRONWORKER (REINFORCING)	$ 31.43	34.77
IRONWORKER (STRUCTURAL)	$ 34.50	38.44

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* LABO0334-025 09/01/2022

SCOPE OF WORK:
OPEN CUT CONSTRUCTION: Excavation of earth and sewer, utilities, and improvements, including underground piping/conduit (including inspection, cleaning, restoration, and relining)

	Rates	Fringes
LABORER		
(1) Common or General	$ 22.42	12.95
(4) Grade Checker	$ 22.73	12.95

LABO0355-014 06/01/2022

EXCLUDES OPEN CUT CONSTRUCTION

MANISTEE COUNTY

	Rates	Fringes
LABORER		
Common or General	$ 26.70	12.95

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* LABO1098-021 07/01/2022

EXCLUDES OPEN CUT CONSTRUCTION

ANTRIM, CHARLEVOIX, LEELANAU, MISSAUKEE & WXFORD COUNTIES

	Rates	Fringes
LABORER		
Common or General	$ 22.42	12.95

PLAS0016-033 04/01/2014

	Rates	Fringes
CEMENT MASON/CONCRETE FINISHER	$ 23.10	12.38

PLUM0085-010 05/04/2020

ANTRIM, CHARLEVOIX, LEELANAU, MISSAUKEE & WEXFORD COUNTIES

	Rates	Fringes
PLUMBER	$ 38.25	21.07

PLUM0174-014 07/01/2022

MANISTEE COUNTY

	Rates	Fringes
PLUMBER	$ 39.89	23.82

TEAM0007-010 06/01/2020

	Rates	Fringes
TRUCK DRIVER		
Lowboy/Semi-Trailer Truck	$ 28.15	.50 + a+b

FOOTNOTE:
a. $470.70 per week.
b. $68.70 daily.

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* SUMI2010-041 11/09/2010

	Rates	Fringes
LABORER: Landscape	$ 10.89 **	1.74
LABORER: Mason Tender - Cement/Concrete	$ 15.97 **	3.51
LABORER: Pipelayer	$ 15.28 **	3.99
OPERATOR: Backhoe/Excavator	$ 16.05 **	9.55
OPERATOR: Bobcat/Skid Steer/Skid Loader	$ 12.98 **	6.12
OPERATOR: Bulldozer	$ 16.17 **	9.51
OPERATOR: Grader/Blade	$ 15.50 **	3.62
OPERATOR: Roller	$ 13.74 **	7.93
OPERATOR: Loader	$ 13.68 **	8.41

TRUCK DRIVER: Dump Truck.....$ 12.63 ** 1.25

WELDERS - Receive rate prescribed for craft performing operation to which welding is incidental.

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